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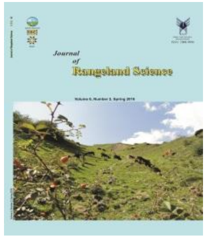

Research and Full Length Article:

Effect of Micro-Catchment on Indices of Rangeland Health Using Landscape Function Analysis Method

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Abstract. Water harvesting is the collection of runoff for productivity purposes, instead of runoff being left to cause erosion. In arid and semi-arid drought-prone areas, micro-catchments are widely used as a water harvesting method to improve rangeland condition. The aim of present study was to investigate the effects of micro-catchment on ecological indices of rangeland health in Ghick-Sheikhha, Jiroft, Iran using LFA (Landscape Function Analysis) method. A free micro-catchment area (as control) was selected to compare the effects of micro-catchment on the soil and vegetation cover. In this method 11 soil parameters were assessed (transects of 100 m length) to recognize three functional properties, including stability, infiltration and nutrient cycling. Statistical data analyses were done using analysis of landscape function and paird t test to compare the performance indicators in the control and micro-catchment. To determine the best factors affecting the health of the range, multivariate regression model was used. The results showed that in the micro-catchment treatment, the length of patches was more than that in the control area. Significant differences were observed between the areas in terms of three indices ($p \leq 0.05$). Regression models suggested that the parameters of soil sedimentation, soil resistance to humidity, soil surface roughness and canopy cover in the micro-catchment area, and soil surface roughness, litter cover and surface resistance to disturb in the control area had respectively, the higher impact on rangeland health indices. Generally, the present study suggested the effectiveness of micro-catchment compared to the control area.

Keywords: Micro-catchment, Soil surface properties, Ecological indices, Jiroft rangeland

Introduction

Natural ecosystems such as rangelands provide benefits to human society, which are of great ecological, socio-cultural and economic value (de Groot *et al*., 2002). In Iran, rangelands are of the highest extent regarding the other natural ecosystems (Mogaddam, 2006) and most of the rangelands have encountered the changes in vegetation trend and conditions as well as soil erosion, resulting in the reduction of plant and livestock production due to incorrect management and exploitation (Azarnivand and Zare Chahoki, 2012). Rangelands having native vegetation and natural potential are managed as a natural ecosystem. Considering ecology, the recognition of fundamental ecologic concepts and the evaluation of ecosystem play significant roles in recognizing the ecosystems' structure and function (Abedi and Arzani, 2004). Changing the ecologic concepts and assumptions is more likely to alter the range evaluation (Abedi and Arzani, 2004). Dynamic ecosystem changes because of environmental disturbances so that the sustainable exploitation will be possible when these changes are identified (Sabeti, 1975). Some changes are regarded as ecosystem natural ones; however, if these changes go over the habitat's protective threshold, they are to destroy the rangeland (Sabeti, 1975).

The increase in intensity of management practices over recent decades has had a strong impact on the rural landscape, affecting the quality of natural or semi-natural habitats, such as field boundaries (José-María *et al*., 2010). The direct effect of management on vegetation cover can vary depending on practices. High-intensity disturbance can dramatically reduce vegetation patchiness of boundaries, while intermediate disturbance can affect successional vegetation dynamics (Bassa *et al*., 2011). Evaluation of rangeland health in response to management is important for land managers, ranging from individuals to governments, especially when the output has direct relevance for management decision-making (Ata Rezaei *et al*., 2006).

It may be seeking to look for evidence of landscape degradation or of rehabilitation and the procedure needs to have equal facility in dealing with these scenarios. One of the most important resources of the rangeland ecosystems is the soil.

The history of the soil shows that some soil surface functions and soil properties are strongly related to soil productivity and stability (Ata Rezaei *et al*., 2006). They reported that soil indices can be regarded as suitable elements for determining the habitat potentials and plant composition. However, measuring soil surface functions and properties is highly time-consuming and costly, especially at large spatial extent (Ángeles *et al*., 2012).

Therefore, instead of using direct measures of the processes of interest, methods based on functional indicators are often used. The Landscape Functional Analysis (LFA) assesses the functional status of an ecosystem or landscape by means of easily measured indicators of landscape structure and soil surface condition (Tongway and Hindley, 2004).

The LFA indices are further integrated into three indices that represent basic soil functions: infiltration (capacity for rain and run-on water to infiltrate), surface stability (resistance to erosion) and nutrient cycling (organic matter decomposition and cycling) (Pyke *et al.*, 2002; Tongway and Hindley, 2004). The LFA approach has been extensively applied in semiarid ecosystems worldwide, such as in Australia (e.g., Tongway and Hindley, 2004; McR. Holm *et al*., 2002; Bartley *et al*., 2006), Iran (Ata Rezaei *et al*., 2006; Heshmati *et al.*, 2007, 2008a), South Africa (Parker *et al.*, 2009), Tunisia (Derbel *et al*., 2009), and Spain (Maestre and Cortina, 2004;

Ángeles *et al*., 2012). It has been reported that these indices can be regarded as suitable elements for determining the habitat potentials and plant composition (Maestre and Cortina, 2004; McR. Holm *et al*., 2002).

Ebrahimi *et al*. (2014) in assessing the effects of enclosure on ecological indices of rangeland health using LFA showed that three indices of infiltration, soil stability and nutrient cycling were of higher values in the enclosure, and the length of ecological components (vegetation patches) was more than that in the control treatment. Sharafatmandrad and Forouzeh (2012) in assessing the effect of water spreading system on the functionality of rangeland ecosystems, reported that the improvement of ecological patches and rangeland ecosystem was achieved where water spreading systems were practiced.

Yari *et al.* (2012) in investigation of soil surface indicators and rangeland functional attributes by LFA in Birjand, Iran reported that the corrective actions including micro-catchment and enclosure could improve rangeland functional attributes.

Muscha and Hild (2006) in assessing biological soil crusts in grazed and ungrazed Wyoming sagebrush steppe reported that 32–45 years of grazing removal had not increased soil lichen cover but did increase moss cover inside enclosures. Delavari *et al.* (2014) in assessing the effects of micro-catchment on soil surface functionality using LFA indicated that micro-catchment could improve the structural and functional status of rangelands, biological restoration with endemic shrub and woody species were also effective to improve rangeland condition.

This paper aims to evaluate the effects of micro-catchment on three functional properties such as stability, permeability and nutrient cycle in Ghick-Sheikhha rangelands in Anbarabad region, Jiroft city, Iran using LFA method; in other words, has micro-catchment improved the mentioned functional indices in the studied rangeland?

Materials and Methods

The study area

The Ghick-Sheikhha area is located in Kerman province in Iran, between latitudes 28°24′48′′–29°24′57′′ N and between longitudes 58°3′32′′–58°16′35′′E (Fig. 1).

The experimental area is characterized by dry summers, a rainy season, and warm autumn and the cool winter weather. The mean annual rainfall levels in the region is 137 mm. The mean annual evaporation is approximately 56.40 mm, denoting a high water deficit in the region. The average annual temperatures is 25°C in May and June, and in winter, occasional periods of subfreezing surface temperature occur. The growing season is from March to May. The area represents a common arid landscape, characterized by steep slopes covered by a mosaic of shrub-grass.

The vegetation cover, is around of 59.5%. The shrub-grass and tree types covered 16% on 24.5% vegetation, respectively.

The vegetation types are dominated by desert vegetation (e.g. *Salsola* spp, *Calligonum* spp; *Astragalus* spp, *Amygdalus lycioides*, *Ziziphus* spp). Vegetation in the area has changed considerably over the past several decades, primarily due to overgrazing by sheep. The soils, derived mainly from limestone, and silt loam to sandy loam in texture (Report of Range Improvement-Water Harvesting, Jiroft, 2005).

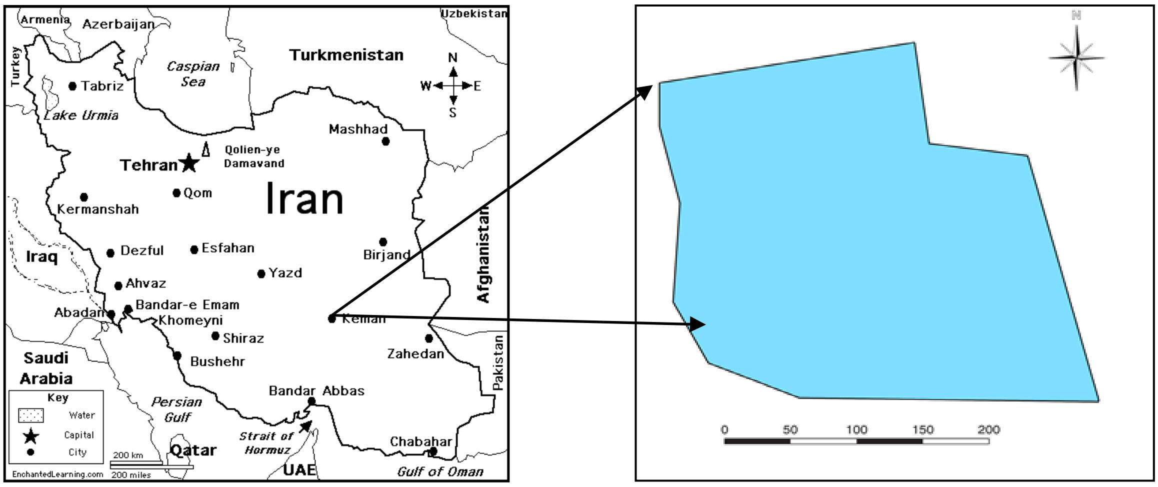

Fig. 1. Location of the study area in Kerman province, southwestern Iran

Field sampling and data analysis

Surveys of the plant associations in the micro-catchment area is primarily dependent on the prevailing ground slope and the selected size of the micro-catchment. It is recommended to construct micro-catchment with a height of at least 25 cm in order to avoid the risk of over-topping and subsequent damage. Where the ground slope exceeds 2.0%, the micro-catchment height near the infiltration pit must be increased (Shanan and Tadmor, 1979; Armas and Pugnaire, 2005) and the control treatment (the area without improvement operations) was along transects (100 m) with systematically-randomized method during the blossoming period of dominant plant species.

At each site, we conducted a comprehensive investigation of the vegetation types. There were no differences between topography, soil type, and spatial heterogeneity for each site (Spatial heterogeneity refers to the uneven distribution of a trait, event, or relationship across a region. It refers to the uneven distribution of various concentrations of each species within an area. A landscape with spatial heterogeneity has a mix of concentrations of multiple species of plants, geological formations, environmental characteristics such as rainfall, temperature, wind (Leyequien *et al*., 2007).

In the micro-catchment area, the plantation has not been after construction of the treatments. At least three transects were located in each area. Each transect was oriented parallel to the general slope of the area. The LFA method was employed to derive values for three soil surface indices, namely: soil stability index, infiltration index, and nutrient cycling index. We estimated the LFA indices by combining field measurements of eleven soil surface features (Tongway and Hindley, 2004): soil conservation (Assess the projected percentage cover of perennial vegetation to a height of 0.5 m. plus rocks > 2 cm and woody material > 1 cm in diameter or other long-lived, immoveable objects. These objects intercept and break up raindrops, making them less erosive and less liable to form soil physical crusts. This indicator relates to the stability index), litter cover (Litter refers to annual grasses and ephemeral herbage both standing and detached as well as detached leaves, stems, twigs, fruit, dung, etc. The position of litter in the overall landscape also assists in defining fertile patches. There are three properties of litter that need to be assessed: the cover (in 10 classes), the origin of the litter and the degree of decomposition), cryptogam cover (The objective is to assess the cover of cryptogams visible on the soil surface. Cryptogam is a generic term that includes algae, fungi, lichens, mosses and liverworts), crust crunching (A crust is defined as a physical surface layer that overlies sub-crust material.

The objective is to assess to what extent the surface crust is broken, leaving loosely attached soil material available for erosion), erosion type and intensity (Erosion in this context refers to accelerated erosion caused by the interaction of management and climatic events, rather than the background levels of geologic erosion. The objective is to assess the type and severity of recent/current soil erosion i.e. soil loss from the query zone), sedimentations (The presence of soil and litter materials on the query zone indicates the availability for transport of resources from upslope sources in the landscape and implies some instability. Silts, sands and gravels usually comprise the alluvium. The objective is to assess the nature and amount of alluvium transported to and deposited on the query zone), soil surface nature (The objective is to assess the ease with which the soil can be mechanically disturbed to yield material suitable for erosion by wind or water. This assessment should only be done on dry soil, as all moist soils are soft. All the criteria below assume dry soil), slake test (The objective of this test is to assess the stability of natural soil fragments to rapid wetting.

The fragment was obtained with a chisel or knife blade, breaking the fragment with the fingers to the appropriate size), vegetation indices of perennial species (This indicator assesses the contribution of the below-ground biomass of perennial vegetation in contributing to nutrient cycling and infiltration processes. Plant cover was assessed by summing the butt lengths of perennial grass plants in the query zone. Tree and shrub cover was defined from the cover and density of the canopy overhanging the query zone.), soil surface roughness (Surface roughness may be due to soil surface micro-topography which retain flowing resources or to high grass plant density such that water flows are highly convoluted at the 5 cm horizontal scale), soil texture (Hydrometer method, Day, 1982). These soil features were measured for bare soil inter-patches and the main types of plant patches in the area. A patch of a given cover type is defined as a cluster of cells of the same cover type, which are contiguous using a 4-neighbor rule (*i.e.*, touching in any of the 4 cardinal directions, but not counting the diagonals) (Tongway and Hindley, 2004). Five, randomly selected bare soil inter-patches and five plant patches (three per patch type) were sampled per micro-catchment area and the control treatment.

Data analysis was performed using Excel software of LFA. Micro-catchments and the control treatments were compared by paird t test. Multiple linear regression method was applied using SPPSS ver.18 in order to specify the best indices affecting the rangeland health.

In multiple linear regression method, in order to calculate stability index, the parameters of soil cover, cryptogams, crust crunching, erosion intensity, sedimentations were tested as independent parameters. For infiltration, independent factors were the parameters of vegetation indices of perennial species, soil texture, litter cover, soil surface roughness, surface resistance to disturbance and surface resistance to humidity.

For nutrient cycling, independent parameters were vegetation indices of perennial species, cryptogam cover, soil surface roughness and litter decomposition. Correlation coefficients between the LFA indices and soil surface attributes were also calculated through the Spearman correlation coefficient.

Results

Ecologic patches characterization

Ecologic indices of micro-catchment and the control treatments indicated that in the studied region, the mean length of ecological patches was 3.03 m, whereas it was given as 0.52 m for the control treatment. Number of patches were 22 and 14 for the control and micro catchment treatments, respectively. Patch area index (mean area divided by the total number of patches) was computed as 0.3 and 0.016 for micro-catchment and the control treatments, respectively. Organization index was given as 1 for both treatments (Table 1).

Table 1. Characteristics of ecologic patches in the micro-catchment and the control treatment

Area Ecologic Patches	Patch Area Index	Number	Width (cm)	Length (%)	Length (m)
Micro-catchment					
Amygdalus lycioides	0.39	3	360.00	77.95	3.79
Ziziphus spp	0.38	3	293.30	44.10	2.87
Calligonum spp	0.12	8	211.90	100.00	2.44
Average	0.30	-	288.40	74.01	3.03
Control					
Salsola spp	0.03	8	76.60	81.77	0.78
Astragalus spp	0.02	14	28.90	54.70	0.26
Average	0.016	-	52.75	68.24	0.52

Comparison of LFA indices

In micro-catchment treatment (Table 2), functional indices of patches had higher values with respect to the number and area of the patches in the ecosystem as compared to the control. Results indicated that there was a significant difference between the functional indices of two treatments ($p \leq 0.05$). Therefore, studying the indices in micro-catchment treatment showed that three indices of stability, permeability and nutrient cycle were higher than those for control treatment on the basis of number of area of patches (Table 2).

Table 2. Means of the LFA indices in patches in micro-catchment area and control treatment (T test)

Area	Nutrient Cycling Index	Infiltration Index	Stability Index
Micro-catchment	22.83±6.36 a	30.73±5.50 a	43.70±4.70 a
Control	10.73±1.53 b	19.65±1.40 b	32.05±2.00 b

Means± Standard Errors of each column followed by different letters indicate significant differences

Rangeland health indices

In the micro-catchment area, in the stability regression model, just soil sedimentation and soil resistance to humidity were entered in the final model. There was a positive relationship between stability and other two traits (Table 3). Infiltration index was influenced by two factors, soil surface roughness and surface resistance to humidity. There was an inverse relation between infiltration and surface roughness in the model. The nutrient cycle index involves canopy cover, and soil surface roughness. Based on the regression model, the increase of two elements of canopy cover and soil surface roughness increased the nutrient cycle index (Table 3). In the control treatment, among 11 studied indices, litter cover, soil resistance to disturbance and soil resistance to roughness were entered in the regression models. The litter cove had a positive relationship with three indices. However, soil resistance to disturbance had a positive relationship with infiltration; it had a negative effect on stability (Table 3).

Table 3. Most important effective rangeland health indices

Function Indices	Micro-Catchments	Control
Stability	Y_S=35.2 + 2.379 SS + 1.414 SRH	Y_S=37.29 + 0.30 LC - 1.80 SRD
Infiltration	Y_I= -7.09 + 14.30 SSR - 0.093 SRH	Y_I=9.65 + 1.80 LC + 2.35S RD
Nutrient cycling	Y_N= -36.36 + 0.15 CC + 22.0 SSR	Y_N=-10.22+2.80 LC + 12.50 SSR

Where: SS= Soil sedimentation, SRH=Surface resistance to humidity, SSR= Soil surface roughness, SRD= Surface resistance to disturbance, CC= Canopy cover, LC= Litter cover

Correlation among functional indices

Results in Table 4 showed that, in the micro-catchment treatment, infiltration index was positively correlated with canopy cover and soil surface roughness, whereas, it showed negative correlation with soil surface resistance to disturbance. Maximum correlation coefficient values of this index were obtained for soil surface roughness. The highest proportions of canopy cover and soil surface roughness in the infiltration index, are probably because the plants grow in large clumps and increased soil water content (Ninot *et al.*, 2007). The reason might explain the greater infiltration measured in the micro-catchment treatment. Similar results have been achieved for nutrient cycling index in such a manner that this index had positive correlation with canopy cover, litter decomposition and soil surface roughness. Maximum correlation coefficient (r=0.99) was obtained for surface roughness. The stability index had positive correlations with erosion intensity, sedimentation, while having a negative correlation with crust crunching (Table 4). This mechanism occurs in response to two factors. (I): in the micro-catchment treatment improved vegetation cover is likely to reduce soil erosion while trapping wind-blown, nutrient-enriched, fine materials from surrounding open areas (Rathore *et al.*, 2015). (II): nutrient enhancement is largely attributable to the plant litter and root mass additions to the soil (Zhang *et al.*, 2006; Rathore *et al*., 2015). In the control treatment, infiltration index was positively correlated with canopy cover, litter cover, soil surface roughness, surface resistance to humidity and disturbance. Maximum correlation coefficient of this index (r=0.97) was obtained with both soil surface roughness and surface resistance to disturbance. Stability had the maximum correlation with erosion intensity and sedimentation (r=0.63), respectively. Nutrient cycling index had positive correlations with canopy cover, litter decomposition and soil surface roughness. Maximum correlation coefficient of this index was given (r=0.91) for litter decomposition (Table 4).

Rangelands improvment provides suitable micro-habitats for the growth of plant species in arid lands (Ebrahimi *et al.*, 2014). The habitat-modifying capacity of a plant can alter its environment both above and below-ground. Understory microclimate is characterized by lower irradiance and air temperature, and consequently lower evapotranspiration demands, as compared with the areas with lower vegetation (Maestre *et al.*, 2003). In addition, reduced soil erosion and improved soil properties associated with shrub development create a nutrient-rich, water-retaining substrate, thus providing a better environment for plants, and productivity in water and nutrient poor environments (Su *et al.*, 2002).

Table 4. Correlation coefficients among three function indices and effective factors

Micro-catchment		Infiltration	Basal area/ canopy cover	Litter cover	Soil surface roughness	Surface resistance to humidity	Soil texture	Surface resistance to disturbance
	Infiltration	1	0.55*	0.49$^{n.s}$	0.99**	0.17$^{n.s}$	0$^{n.s}$	-0.27$^{n.s}$
		Stability	Cryptogams	Litter cover	Sedimentation	Erosion intensity	Soil cover	Crust crunching
	Stability	1	0$^{n.s}$	0.21$^{n.s}$	0.66*	0.79*	0$^{n.s}$	-0.93**
		Nutrient cycling	Basal area/ canopy cover	Litter decomposition	Cryptogams	Soil surface roughness		
	Nutrient cycling	1	0.53*	0.51*	0$^{n.s}$	0.99**		
Control		Infiltration	Basal area/ canopy cover	Litter cover	Soil surface roughness	Surface resistance to humidity	Soil texture	Surface resistance to disturbance
	Infiltration	1	0.97**	0.70*	0.97**	0.71*	0$^{n.s}$	0.97**
		Stability	Cryptogams	Litter cover	Sedimentation	Erosion intensity	Soil cover	Crust crunching
	Stability	1	0$^{n.s}$	0.58*	0.63*	0.90**	0$^{n.s}$	0$^{n.s}$
		Nutrient cycling	Basal area/ canopy cover	Litter decomposition	Cryptogams	Soil surface roughness		
	Nutrient cycling	1	0.81**	0.91**	0$^{n.s}$	0.81**		

*significant at the 0.05 probability level, **significant at the 0.01 probability level, n.s means non-significant

Discussion

Landscape assessment constitutes a bridge between scientific knowledge and socio-economic issues that are needed to meet the demands of sustainable landscape management (Bastian *et al.*, 2006). In this way, rangeland function studies make the judgments possible on the impacts of management on primary ecosystem processes such as water cycle, energy movement and materials' cycle using several simple indices (Toranjzar *et al.*, 2009). It has been observed that in the rangeland with less grazing, soil properties are better than rangeland with inappropriate management (i.e., overgrazing and soil plowing) ecosystem conditions are not healthy (Tongway and Hindley, 2004). In regions of arid and semi-arid rangeland, landscapes that entrap and keep resources including soil particles, organic matter and rain water, offer more conducive environments for plants and fauna and are regarded as more operational compared to the landscapes that leak or lose the essential resources ecology (Bastin *et al.*, 2002).

In the present study, micro-catchment treatment resulted in the changes of soil surface properties and range functional features in such a manner that these indices were reduced in the control treatment as compared to micro-catchment treatment. Rangelands involve a variety of natural resources extensively. As a result, it is necessary to evaluate rangelands in order to achieve the sustainable and long-term exploitations and make decisions on the range changes. Soil and vegetation parameters that are considered as representative ecological indicators of ecosystems (Pyke *et al.*, 2002) are quantitatively measurable characteristics that indicate the dynamic condition of a habitat or natural field (Pellanet *et al.*, 2000). Patch and inter-patch structures affect soil moisture in arid and semi-arid zones, and thus determine soil erosion rate. A reduction in the size, number, spacing or effectiveness of fertile patches may increase runoff and erosion in intense rainfall and cause landscape degradation (Saco *et al.*, 2006).

A considerable amount of studies showed that plant species of the ecosystem were affected by management (Bassa *et al.*, 2011; José-María *et al.*, 2010; Petersen *et al.*, 2006). Our study highlighted the fact that there was a strong effect of micro-catchment on vegetation patches of the studied area. The mean length of ecological patches in the micro-catchment treatment was more than that of the control treatment. Therefore, it can be concluded that in the rangelands with corrective management, vegetation cover will become increasing and it significantly improves the soil properties. Additionally, in central Iran with an average annual precipitation of 188 mm, the use of rangeland ecosystems monitoring procedures is employed to calibrate LFA method for an arid rangeland ecosystem and investigate the effects of management activities on soil surface indicators and rangeland functional attributes (Anari and Heshmati, 2009; Yari *et al.*, 2012). According to the results, the indicators and functional characteristics of the rangeland were changed due to the management activities, as significant differences were found among all soil surface indicators except erosion feature and cryptogam cover in the study regions.

Our results indicated that micro-catchment had the highest values of infiltration, nutrient cycling and soil stability; while these values declined in the control treatment. These results are in agreement with the previous works that have proven the ability of improvement practices for improving rangeland functional attributes (Yari *et al.*, 2012; Ebrahimi *et al.*, 2014). It is interesting to note that, the vegetation patches are more likely to act as a source for seed dispersal (Pulliam, 1988), avoiding local plant extinctions (Dunning *et al.*, 1992). Thus, the corrective human activities on the natural ecosystem maintained the source of landscape (Farina, 1995).

In the micro-catchment treatment**,** surface roughness, sedimentation, surface resistance to humidity and canopy cover, litter cover in the regression arrived at the model and the maximum correlation coefficient was found for soil surface roughness. Roughness at the soil surface decelerates the intensity of outputs and accelerate the permeability while creating a safe environment for the aggregation of seeds and litter (Heshmati *et al.*, 2008b). Thus, It can enhance the vegetation cover in the ecosystem (Ebrahimi *et al.*, 2014). On the other hand, soil surface properties affect the range features directly so that such factors as plant species and vegetative type are influenced. Plants including small bushes, grasses and trees create an environment with micro-climate which is more moderate than the external environment in summer and winter and plays crucial roles in stabilizing soil and avoiding the soil erosion (Sabeti, 1975).

Results show that range management affects the ecologic range properties directly which are dependent on vegetation and soil characteristics and alters the ecological indices of Ghick-Sheikhha rangeland. Micro-catchment landscape along with the grazing management is of higher average than the control treatment regarding the studied indices, showing that corrective actions led to the relative improvement of rangeland. In addition, control treatment which was not managed correctly had lower averages as compared to micro-catchment treatment with corrective actions. However, these results do not necessarily mean that the micro-catchment treatment area can store the infiltrated water. Therefore, evaluation requires another index to describe the soil profile characteristic that relates to water storage capacity, depending on the depth of profile, soil texture of whole profile, and gravel content, and is not expressed by indices based on soil surface properties or vegetation characteristics (Tongway and Hindley, 2004).

Conclusion

Results showed that micro-catchment affected the ecological rangeland properties through direct influences involving soil properties and vegetation cover. There was significant difference between the area with the micro-catchment operation and the area without it. In the micro-catchment treatment, the length of patches was more than that in the control area. Significant differences were observed between the areas in terms of three indices. Therefore, range management schemes should be designed to improve the rangeland condition. The LFA methodology has an enormous potential to assist land managers and policy makers in the establishment of cost-effective desertification monitoring and restoration programs in semi-arid environments. However, the information provided by LFA indices could be used when comparatively evaluating the functional status resulting from the various range management actions. In addition, the managers explore the role of a variety of environmental factors as drivers of land degradation or recovery, and finally identifying dry land areas for conservation, sustainable management, or restoration programs.

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تاثیر هلالی آبگیر بر شاخص‌های سلامت مرتع با استفاده از روش تحلیل عملکرد چشم‌انداز

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چکیده. جمع‌آوری آب عبارت است استفاده از رواناب به‌منظور اهداف تولید بیوماس. به‌جای این که رواناب منج به فرسایش خاک گردد. در مناطق خشک و نیمه‌خشک که در مواجه با خشکسالی هستند، هلالی‌های آبگیر به شکل وسیعی به منظور احیای مراتع استفاده شده‌اند. در تحقیق حاضر تأثیر هلالی‌آبگیر در مرتع غیک‌شیخها در شهرستان جیرفت بر شاخص‌های اکولوژیکی سلامت مرتع با روش LFA را بررسی شد. به‌منظور مقایسه عملیات اصلاحی هلالی‌آبگیر بر فاکتورهای خاک و پوشش گیاهی در کنار منطقه مورد مطالعه یک تیمار شاهد در نظر گرفته شد. در این روش برای تعیین سه ویژگی عملکردی مرتع شامل پایداری، نفوذپذیری و چرخه مواد غذایی ۱۱ شاخص سطح خاک (ترانسکت‌های ۱۰۰متری) بررسی گردید. تجزیه و تحلیل آماری داده‌ها با استفاده از نرم‌افزار LFA صورت گرفت و برای مقایسه شاخص‌های عملکردی در دو منطقه هلالی‌آبگیر و شاهد از آزمون غیرپارامتری من وایتنی استفاده شد. همچنین برای تعیین بهترین شاخص‌های تاثیرگذار بر سلامت مرتع از مدل رگرسیونی چندمتغیره استفاده شد. نتایج به‌دست آمده نشان داد که در سایت هلالی‌آبگیر میانگین طول قطعات اکولوژیک بیشتر از منطقه شاهد بود. مقایسه شاخص‌های عملکردی قطعات در هر دو منطقه هلالی‌آبگیر و شاهد نشان داد که تفاوت معنی‌داری در شاخص‌های عملکردی بین دو منطقه وجود دارد (p≤۰/۰۵). مدل رگرسیونی نشان داد که در منطقه هلالی‌آبگیر مواد رسوبی، پایداری در برابر رطوبت، ناهمواری سطحی و پوشش گیاهی و در منطقه شاهد، پوشش لاشبرگ و مقاومت خاک سطحی به‌ترتیب بیشترین سهم را در شاخص‌های سلامت مرتع داشتند. به‌طور کلی نتایج مطالعه حاضر حاکی از اثربخشی عملیات هلالی‌آبگیر در منطقه مذکور در مقایسه با شاهد بود.

کلمات کلیدی: هلالی‌آبگیر، ویژگی‌های سطح خاک، شاخص‌های اکولوژیکی، مراتع جیرفت