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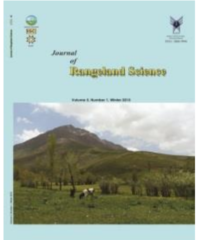

Research and Full Length Article:

Studying Short-Time Dynamics of Vegetation and Soil Organic Carbon in a Semi-arid Rangeland (Case Study: Zharf, Khorasan Province, Iran)

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Abstract. Rangeland vegetation dynamics encompass all processes of changes in vegetation composition and structure over time. Investigating the rangeland ecosystem dynamics makes it possible to determine the effects of climatic and management conditions on qualitative and quantitative changes of the vegetation in a specific period of time. Accordingly, data collection and measurements for evaluating vegetation dynamics in rangeland ecosystems of Zharf region in Khorasan province, Iran were conducted from 2009 to 2013. Vegetation variables were measured by the means of 3 transects with the length of 500m and sampling plots. Meanwhile, at the location of each plot, soil moisture content was measured at two depths of 0-15 and 15-30 cm using a Time-Domain Reflectometer (TDR) instrument. At the same locations, soil samples from topsoil layer (up to 15 cm depth) were collected to measure organic carbon. Results showed that at a four-year period, depending on inter-annual changes in rainfall and other climatic parameters and under local management practices, more or less changes occurred in some major vegetation factors such as species and total canopy cover. Changes were more prominent in canopy cover of annual plants, perennial forbs and to some extent in perennial grasses. Changes in soil organic carbon showed a very slow trend. Based on soil texture and variations of seasonal and annual rainfall, soil moisture caused variations in vegetation factors. In the study site, considering the relative stability of soil cover by stones, gravels and plant litter, total soil cover changes were a function of changes in total canopy cover of plants. The results of this study could be considered for proper adjustment of rangeland management in Zharf region.

Key words: Vegetation dynamics, Rangeland ecosystem, Zharf region, Khorasan Razavi, Iran

Introduction

Monitoring the rangeland ecosystems is the most basic measure needed in rangeland management. Rangeland ecosystems in the arid and semi-arid regions are mainly affected by climatic factors and the type of grazing management due to prevailing environmental conditions. Therefore, understanding the relationships between vegetation and climatic factors is a prerequisite for applying correct management methods in such ecosystems. In this regard, studying the vegetation dynamics provides an opportunity to determine the effects of climatic and management conditions on quantitative and qualitative changes in vegetation (Fernandez and Allen, 1999).

Principally, rangeland management must be based on the changes in range conditions and grazing capacity. For this reason, studying the rangeland vegetation changes and identifying the effective factors are considered as essential items for range management. Vegetation changes in rangelands are affected by various natural and human factors. Climatic factors including drought and wet conditions are inevitable natural factors. Rangelands attain stability over time. However, human factors and especially management play effective roles in maintaining either the stability or destruction of rangelands (Arzani *et al.*, 1999).

Evaluation of rangeland vegetation dynamics as a comprehensive, flexible and proper way is applied for monitoring the qualitative and quantitative changes in vegetation to make appropriate management decisions for rangeland ecosystems. O'Connor and Roux (1995) studied the effects of rainfall variability and livestock grazing on vegetation changes of Karoo shrub lands in South Africa during 1949-1971. They concluded that changes in vegetation community were mainly due to the rainfall fluctuations. However, the effects of livestock grazing were more important in long term periods. The amount and direction of vegetation changes in shrublands of Southwestern Utah during 1933-1989 were investigated by Yorks *et al.* (1992). They concluded that moderate grazing was the most effective factor to improve conditions and trend of these rangelands.

O'Connor (1995) reported that severe drought in combination with a history of severe grazing transformed grassland of predominantly palatable perennial grasses (*Themeda triandra*, *Setaria incrassata*, *Heteropogon contortus*) to grassland dominated by the unpalatable perennial *Aristida bipartita*, annual grasses and forbs. Navarro *et al.* (2002) in a study on the rangelands of New Mexico observed that the canopy cover of *Bouteloua eriopoda* and *Hilaria mutica* were similar and did not change significantly under dry and wet conditions of a 48-year period (1952-1999). In other words, the positive effects of wet period have been offset by the occurrence of drought. Yavari *et al.* (2003) surveying the dynamics of rangeland plants in semi-arid region of North Khorasan, Iran found that vegetation type was not changed under the deferred grazing while production and vegetation cover increased.

Monitoring the rangeland ecosystems in our country has been based on either experimental and estimation methods or sampling methods of production and canopy cover. According to the flaws of old methods including the intervention of personal preferences in the estimation methods and difficulties of the measurement of annual production, the use of quantitative and laboratory methods based on the calibration of effective factors was the main hypothesis of this study. Accordingly, studying the range conditions' changes in the rangeland ecosystems and achieving an appropriate method in order to determine the rangeland conditions and trend in different ecological zones based on determinant factors including rainfall, soil moisture and organic carbon were the objectives of this study.

Materials and Methods

a) Case study

Zharf site is located at 80 km of southeastern Mashhad city, Iran between the latitudes of 35°23′30″ to 35°24′40″ N and longitudes of 59°56′16″ to 59°55′27″ E with an altitude of 2130-2210 m above sea level in a mountainous land unit and semi-steppe vegetative region (Fig. 1). It has a cold semi-arid climate with the mean annual precipitation of 270 mm. The type of rangeland use is rural of which rural farmers of Zharf are the most. The composition of grazing livestock on the rangelands of the study area includes 5% goats and 80% sheep and the other livestock comprises the remaining 15%. The grazing season starts from mid-May with entry of 10 herds of 1000 heads to the Zharf rangeland and continues until mid-June. Cushiony species such as *Astragalus heratensis*, *Acanthophyllum* sp., *Acantholimon* spp. constitute the dominant species in Zharf rangeland site. The other rangeland species include: *Gundelia tournefortii, Agropyron trichophorum, Cousinia* spp., *Scariola orientalis, Eryngium bungei, Stipa barbata, Tragopogon persicum, Eremurus spectabilis, Poa bulbosa, Astragalus persicus, Denderostellera lessertii, Taraxacum iranicum, Iris songarica, Polygonum afghanicum, Noaea mucronata, Rosa persica,* and *Phlomis cancellata* (Kashki *et al.*, 2012).

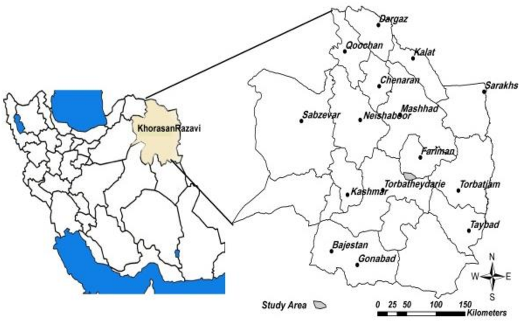

Fig. 1. Location of study area in Khorasan province, Iran

b) Research method and data collection

Data collection was performed through the establishment of 3 transects and 30 plots (quadrates) in the study site. According to the area of the site, the length of transects was determined as 500 m. The size of plots considering canopy diameter and distance between major species was 4 m^2. Ten plots were established on each transect by a randomized systematic method at 50 m intervals. Measurement of relevant factors was conducted when dominant species were at vegetative growth stage and sometimes at early reproductive stage. The measured factors included canopy cover, relative canopy cover, density and frequency of species as well as total canopy cover and soil cover.

Regeneration and vitality (vigor) of the species were also recorded at the study site by a quality method through the observation and comparison. Simultaneously, soil moisture in root zone of species was measured at two different depths of 0-15 and 15-30 cm using a Time-Domain Refletometer (TDR) instrument. In addition, climatic data were provided to draw Ombrothermic diagrams for each vegetative year from the Torbat-e-Hydarieh station having the elevation and aspect similar to the study site. Sampling and analysis of surface soil were performed to measure only organic carbon percent in each year.

c) Statistical analysis

The collected data of vegetation, soil moisture and organic carbon were entered into Excel software. After classifying the data, statistical analysis was performed using SAS software. General linear model and ANOVA were applied. All of data except organic carbon had a normal distribution. Means comparisons of canopy cover for major species and different plant groups such as shrubs, grasses, forbs and also total canopy cover were performed by Duncan's Multiple Range Test at 1and 5% levels of probability. In addition, Means comparisons for soil cover, soil moisture and soil organic carbon were conducted. Interpreting the results of data analysis was done with regard to the distribution of rainfall, accumulated effective precipitation (from early October until the date of field data collection), annual precipitation and temperature using Embrothermic diagrams (Fig. 2).

Results

a) Climatic conditions of site

Essentially, the existence of vegetative regions is influenced by climatic factors, especially precipitation. Embrothermic curves of Zharf region (Fig. 2) during the study period indicated that drought period was begun from May, Jun, March and May in 2009, 2010, 2011 and 2012, respectively. As, we need to consider the changes of wet and drought periods as an important factor on vegetation dynamic, Embrothermic curves were drawn yearly. Although composition and diversity of vegetation was effected by the other environmental factors such as soil, land formation, surface hydrology and hydrogeology, the effectiveness of these factors is nearly fixed. So, dynamic vegetation mainly depends on climatic factors' changes, especially precipitation and temperature. Annual precipitation and accumulated effective precipitation during the studied years in Zharf rangeland area as well as the dates of data collection are shown in Table 1.

Table 1. Rainfall (precipitation) changes at Zharf site during the study years (mm)

Date of Data Collection	May 20, 2009	Apr. 28, 2010	May 10, 2011	May 20, 2012
Accumulated effective precipitation	272.33	168.7	117.46	209.3
Annual precipitation	279.48	236.03	126.48	229.7

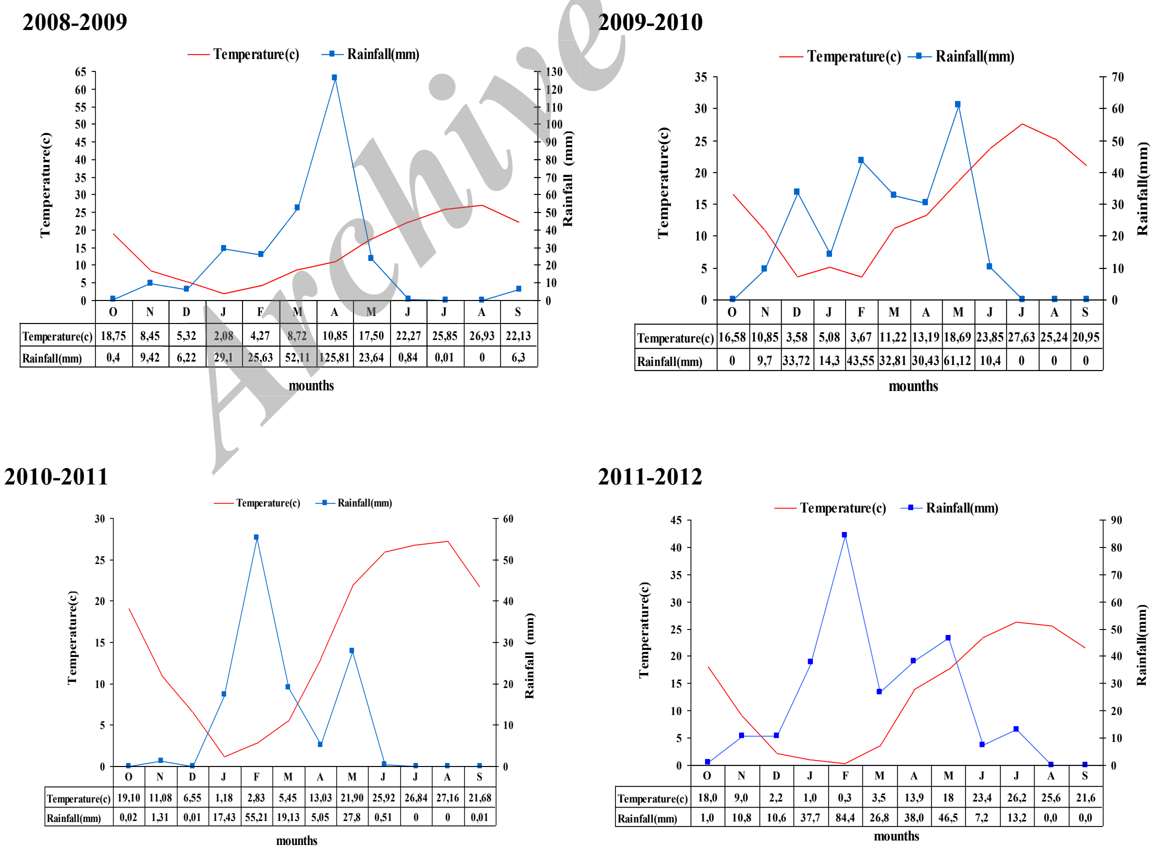

Fig. 2. Embrothermic curves of Zharf site, Torbat-e-Hydarieh station, over 4 years (2009 to 2012)

b) Plants frequency, regeneration and vitality

Frequency of main species indicates that the shrub species with the highest frequency were dominant species in this site while some species of forbs and grasses were also of great abundance. During the studied years, frequency of shrub species such as *Astragalus heratensis* and *Acanthophyllum* sp. was 90-100% and 86.6-90%, respectively. Frequencies of *Gundelia tournefortii* and *Scariola orientalis* as forbs were 53.3-93.3% and 40-76.6%, respectively. Frequency for *Stipa barbata* as a perennial grass was 10-56.6% (Table 2). During the studied years, regenerations for *Astragalus heratensis, Acanthophyllum* sp., *Eremurus spectabilis*, *Scariola orientalis* and *Stipa arabica* were Low (L) to High (H) while regeneration of *Gundelia tournefortii* as a forb was Medium (M) to High (H) (Table 2). Also, vitality (vigor) and freshness of major species were affected by the changes in rainfall and soil moisture. In 2009, 2010 and 2012, due to more proper rainfall, vitality and vigor of most species were recorded as High (H) or Medium (M). However, because of low annual precipitation (117.46 mm) and low accumulated effective rainfall (126.48 mm) in 2011 as compared to the other years of study, vitality of most species was low (Tables 1 and 2, Fig. 2).

Table 2. Frequency (Freq.), regeneration (Reg.) and vitality of some major species in Zharf study site (2009-2012)

Species	Years											
	2009			2010			2011			2012		
	Freq. (%)	Reg.	Vitality (Vigor)	Freq. (%)	Reg.	Vitality (Vigor)	Freq. (%)	Reg.	Vitality (Vigor)	Freq. (%)	Reg.	Vitality (Vigor)
Astragalus heratensis	100	* H	H	90	H	H	93.3	H	L	100	H	H
Acanthophyllum sp.	90	L	H	93.3	H	H	86.6	H	L	86.6	M	H
Scariola orientalis	40	L	M	56.6	M	H	63.3	H	L	76.6	M	H
Gundelia tournefortii	73.3	M	M	60	M	H	53.3	H	M	93.3	M	H
Stipa barbata	56.6	M	H	30	H	M	13.3	L	M	10	L	H
Eremurus spectabilis	33.3	L	H	10	H	M	10	L	L	20	H	H
Annuals	3.33	L	H	20	H	H	46.6	L	L	96.6	H	H

*H: High, M: Medium, L: Low

c) Changes of canopy cover, soil cover, soil moisture and soil organic carbon during 2009-2012

The results of the analysis of variance between the years showed that changes in canopy cover of perennial grasses, forbs, grass-like species and annual species group were significant (P<0.01). In addition, year-to-year variations in total canopy cover, soil cover, soil moisture at the depths of 0-15 and 15-30 cm and the average moisture content in two depths were also significant (P<0.01). Changes in the amounts of soil organic carbon was significant (P<0.01). Year-to-year differences related to canopy cover of shrubs were not significant.

(Table 3), shows the means comparisons of canopy cover in the years of experiment. Maximum canopy cover was recorded for shrubs, perennial forbs, perennial grasses, grass-like species and total canopy cover with the values of 24.57%, 9.92%, 4.49%, 1.67% and 43.59% in 2012, 2012, 2010, 2010 and 2012, respectively. The canopy cover of dominant species (*Acanthphyllum* sp. and *Astragalus heratensis*) did not show significant differences in the years of experiment.

Table 3. Means comparisons between years for various plants canopy covers (%)

Years	*Astragalus heratensis*	*Acanthophyllum* sp.	*Gundelia tournefortii*	*Cousinia* spp.	Shrubs	Perennial Forbs	Perennial Grasses	Grass-Like Species	Annuals	All Species
2009	12.79^{a}	10.69^{a}	3.44^{a}	1.83^{a}	24.61^{a}	8.85^{a}	0.32^{b}	0.03^{c}	3.93^{a}	37.21^{ab}
2010	9.22^{a}	7.17^{a}	2.09^{ab}	1.35^{ab}	18.29^{a}	5.58^{b}	4.49^{a}	1.67^{b}	0.18^{c}	30.21^{bc}
2011	8.42^{a}	8.22^{a}	1.57^{b}	1.20^{b}	17.69^{a}	4.91^{b}	0.59^{b}	1.44^{b}	0.42^{c}	25.06^{c}
2012	8.17^{a}	6.59^{a}	3.33^{a}	0.98^{b}	24.57^{a}	9.92^{a}	3.98^{a}	3.65^{a}	1.48^{b}	43.59^{a}

Means followed by the same letters in each column are not significantly different (P<0.05)

Means comparisons of soil cover, soil moisture and soil organic carbon in the years of experiment are presented in Table 4. Soil cover showed a significant difference as a consequence of canopy cover changes so that the highest and lowest soil cover values (27.12% and 46.09%) were obtained in 2012 and 2011. The average soil moisture at 30-cm depth was recorded as 21.80% in 2010 and the lowest soil moisture (13.52%) was obtained in 2011. Maximum and minimum soil organic carbon percent was recorded as 2.09% and 1.68% in 2009 and 2011, respectively.

Table 4. Means comparisons between years for soil cover (%), soil moisture (%) and soil organic carbon (%)

Years	Soil Cover (%)	Soil Moisture(%)			Soil Organic Carbon (%)
		Depth 1 (0-15 cm)	Depth 2 (15-30 cm)	Average (0-30 cm)	
2009	39.37^{ab}	13.53^{b}	21.81^{a}	17.67^{b}	2.09^{a}
2010	32.59^{bc}	21.19^{a}	22.40^{a}	21.80^{a}	1.77^{b}
2011	27.12^{c}	13.89^{b}	13.16^{c}	13.52^{c}	1.68^{b}
2012	46.09^{a}	19.94^{a}	16.09^{b}	18.01^{b}	1.96^{ab}

Means followed by the same letters in each column are not significantly different (P<0.05)

d) Effects of soil moisture on canopy cover

Table 5 shows the relationships between soil moisture and vegetation variables. According to the obtained results, the canopy cover of perennial grasses and grass-like species was positively correlated with soil surface moisture showing significant correlation coefficients at 1% and 5% probability levels, respectively so that their canopy cover was increased by increasing the soil moisture at 0-15 cm depth. However, *Acanthophyllum* sp. did not respond to the increased soil moisture and its canopy cover was reduced. Dominant species including *Astragalus heratensis* and *Cousinia* spp. showed a positive correlation to the increased soil moisture at 15-30 cm depth and their canopy cover was increased.

Table 5. Correlation analysis between soil moisture and monitored variables at Zharf site over 4 years (2009-2012)

Variables	Soil Depth 1 (0-15 cm)	Soil Depth 2 (15-30 cm)	Soil Total Depth (0-30 cm)
Astragalus heratensis	-0.52	**0.65***	0.13
Acanthophyllum sp.	**-0.82****	0.32	-0.26
Gundelia tournefortii	0.03	0.36	0.25
Cousinia spp.	-0.53	**0.68***	0.13
Canopy cover of shrubs	-0.07	0.21	0.09
Canopy cover of perennial forbs	0.09	0.15	0.14
Canopy cover of perennial grasses	**0.92****	0.24	**0.75****
Canopy cover of grass-like species	**0.68***	-0.44	0.11
Canopy cover of annuals	-0.51	0.37	-0.06
Canopy cover of all species	0.29	0.18	0.31
Soil cover (%)	0.31	0.19	0.31
Soil organic carbon (%)	-0.14	0.45	0.21

* and **= significant at the 0.05 and 0.01 probability level, respectively

Discussion and Conclusion

Study of temporal changes process in plant parameters including canopy cover, frequency, regeneration and vitality (vigor) as well as variations in the amount and distribution of precipitation was performed in Zharf rangeland site as a semi-steppe region for four years (2009-2012). Both climatic and management factors were considered simultaneously.

Results of the study indicated that frequency, regeneration and vitality (vigor) of perennial species were less affected by year-to-year changes of climatic variables.

In this rangeland site, due to the higher palatability of grasses, their distribution in terms of current management is confined to the sub floor of spiny shrub species. In other words, shrubs play a role of nurse for grasses. While the frequency of forbs and annual species are strictly a function of rainfall in the same year, the frequency of shrub species does not show much significant dependence on annual changes of precipitation.

Regeneration of main species was affected by the changes in both annual precipitation and effective rainfall. So, in the years with adequate precipitation and appropriate distribution of rainfall, seed germination and natural regeneration were occurred for most species.

Changes of soil moisture storage in root zone of the rangeland species were proportional to the changes in volume of precipitations in Zharf site during the studied years. The dominant shrub species of *Astragalus heratensis* and *Acanthophyllum* sp. with cushiony vegetative forms were not significantly affected by year-to-year changes of climatic variables. The response of these species to the changes in annual rainfall is sluggish because they use soil moisture stored in previous seasons, employing their deep root systems to compensate drought or lack of precipitation. Britta *et al.* (2010) found that the changes of climate factors including the altered precipitation patterns, increased temperature and elevated atmospheric Co_2 led to different responses of grass and shrub cover so that a shift from a grass dominated system to a shrub encroached state is visible. The soil of this rangeland site is comprised of sandy loam and loamy textures while possessing adequate capacity to store moisture in deep layers. Despite significant differences in soil moisture during the studied years, the presence of wetness in root zone at levels of 13.6% to 22.4% was enough to enable shrub species for their normal vegetative growth. The obtained results are in accordance with the research reported by Sharifi and Akbarzadeh (2009) showing that changes in canopy cover of woody shrub species were slow and mild while perennial grasses were affected by annual rainfall. They stated that shrub species were less affected by year-to-year changes of climatic variables.

The group responses of perennial forbs and most individuals in this group such as *Gundelia tournefortii* and *Cousinia* spp. were significant to the amount and distribution of rainfall and the level of soil moisture. The reaction of perennial forbs species to seasonal precipitation was faster and more considerable than that of shrub species. Reduction of precipitation resulted in a significant decrease in canopy cover of perennial forb group in 2010 and 2011 as compared to canopy cover of this group in 2009 and 2012. Actually, there are two main reasons for considerable increases in canopy cover of perennial forbs in 2012. First reason could be proportional to the increase in effective spring rainfalls. The second reason might be the delay that occurred in the starting date of grazing in this year.

More appropriate distribution of rainfall in growing season of 2010 and 2012, particularly proper amount of rainfall in May as well as significantly higher moisture of soil surface layer (depth 1) in these two years led to a significant increase in canopy cover of perennial grasses as compared to those in 2009 and 2011. The shallow root systems of perennial grasses mostly absorb soil moisture in surface layer while soil texture of this site is sandy loam and loamy. So, these species are not able to use moisture which is stored in deeper layers of soil resulting from the rainfalls that occur out of growing season. For this reason, high rainfall events of late March to mid April in 2009 cannot be considered as effective rainfall events for grass species. Considerable reduction of spring rainfall in 2011 prevented the necessary conditions for the appropriate growth of perennial grasses. Moreover, in 2009 and 2011, measurements and data collection were performed when a local herd of goats and sheep entered the desired rangeland and started grazing the range plant species.

The group of annual plants at Zharf site responded to the seasonal effective rainfall (spring rain) and soil moisture storage in surface layer of soil followed its changes. Year-to-year variations in canopy cover of annual species group depend on the changes and distribution of spring rainfall. Rainfalls in late March to mid April in 2009 (125 mm) provided appropriate moisture conditions for annual species group. These conditions resulted in a significantly higher canopy cover of annuals in 2009 as compared to their canopy covers in 2010, 2011 and 2012.

Slow changes in soil organic carbon as a criterion of carbon sequestration in the study site indicated that the current range management conditions and especially early grazing and overgrazing impacts affected the quantity of plant residues negatively. The level of soil organic carbon relies on the amount of soil organic matter content. Because of relatively low temperature from November to April, litter decomposition in the study area has a slow process. Therefore, in such conditions, soil organic carbon changes could be applied as one of the criteria in the assessment of range conditions or range trend only in long-term while requiring data collection for 10 to 15 years or more.

Considerable and significant changes in total canopy cover or in its subsets (canopy cover of shrubs, perennial grasses, perennial forbs, annuals) observed in the study site were mainly due to the changes in rainfall (amount and distribution) or because of changes in date of livestock entry into the rangeland (early grazing or late grazing) or early data recording. Distinct responses of various community attributes to climate variability support the conclusion of Fernandez & Allen (1999) that the evaluation of a broader set of vegetation variables including individual species attributes or specific functional groups may be affected by both grazing and climatic variability rather than climatic variability. Since the capacity of soil for moisture retention depends on soil texture which is almost constant, annual assessment and monitoring of the moisture content of soil layers (regarding the accurate date for data collection) could be considered as one of the criteria for understanding vegetation dynamics in this rangeland. Finally, proportional to the changes of total canopy cover and its subsets resulting from annual and multi-year variations in climatic factors or due to management approach, range management and grazing scheme can be corrected.

The overall conclusion is that the study of vegetation dynamics in Zharf semi-steppe rangeland showed that under the same management system, the changes in canopy cover of species groups, particularly groups of perennial grasses and forbs were mainly influenced by climatic fluctuations, especially rainfall. The effects of rainfall on canopy cover were also through its effects on soil moisture fluctuations. With increasing rainfall, particularly effective precipitation, a significant increase occurred in soil moisture storage. The moisture of surface soil provides the water required for annual species, perennial grasses and most perennial forbs. For this reason, species such as *Phlomis cancellata*, *Gundelia tournefortii* and *Eremurus spectabilis* as forbs showed a positive response to the increase in annual precipitation and their canopy cover increased. However, the response of shrubs to the changes in annual precipitation was slow. In fact, moisture storage of soil with sandy loam to loamy textures and water absorption by deep roots in lower layers compensated the lack of rainfall and drought for shrub species.

Literature Cited

Arzani, H., Fatahi, M. & Ektesasi, M. R., 1999. Survey on trend of quantity and quality changes of vegetation in Poshtkouh - Yazd rangelands during decade 1990-1999. *Pajouhesh & Sazndeghi*, 44(3):31-35. (In Persian).

Britta, T., Florian, J., Erwin, Z., Nikolaus, C., Alexander, G., Katja, S. and Jens, O., 2010. Effects of climate change on the coupled dynamics of water and vegetation in drylands. *Ecohydrol*. 3: 226-237.

Fernandez-Gimenz, M. E. and Allen- Diaz, B., 1999. Testing a non-equilibrium model of rangeland vegetation dynamics in Mongolia. *Jour. App. Ecol*. 36: 871-885.

Kashki, M. T., Sahmoradi, A., Mohamadi, M. and Namdost, T., 2012. The Final report of the research project "Vegetation dynamics in Khorasan rangeland ecosystems", pages 79. (In Persian).

Navarro, J. M., Galt, D., Holechek, J., McCormick, J. and Molinar, F., 2002. Long-term impacts of livestock grazing on Chihuahuan Desert rangelands. *Jour. Range Manage*. 55(4): 400-405.

O'Connor, T. G. and Roux, P. W., 1995. Vegetation changes (1949-1971) in semi-arid grassy dwarf shrublands in the Karoo, South Africa: Influence of rainfall variability and grazing by sheep. *Jour. Applied Ecology*. 32: 612-626.

O'Connor, T. G., 1995. Transformation of a Savana grassland by drought and grazing. African *Jour. Range and Forage Science*, 12: 53-60.

Sharifi, J. and Akbarzadeh, M., 2009. Survey on vegetation changes under rainfall effect on the Semi-steppe rangelands (Case study: Saeen, Ardabil province), The 4th National Congress on Range and Range management, P: 85. (In Persian).

Yavari, A., Tavakoli, H., Grivani, G., 2003. The final report of the project "of rangeland vegetation Dynamics in semi-arid North Khorasan. Office research agriculture and nature resources in Khorasan.48p. (In Persian).

Yorks, T. P., West, N. E. and Capels, K. M., 1992. Vegetation differences in desert shrub lands of western Utah, Pine Valley between 1993 and 1989. *Jour. Range Manage*. 45(6): 569-577.

بررسی کوتاه مدت پویایی پوشش گیاهی و کربن آلی خاک در مراتع نیمه استپی (مطاله موردی: ژرف- خراسان رضوی، ایران)

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چکیده. پویایی پو شش گیاهی مرتع در برگیرنده کلیه فرآیندهای تغییر در ترکیب و ساختار پو شش گیاهی در طول زمان ا ست. برر سی پویایی اکو سیـ ستم‌های مرتعی امکان تعیین اثر شرایط اقلیمی و مدیریتی حاکم بر یک مرتع در روند تغییرات کمی و کیفی پو شش گیاهی آن را در یک بازه زمانی فراهم می سازد. بر این ا ساس پویایی پو شش گیاهی در اکو سیستم مرتعی منطقه ژرف شهر ستان تربت حیدریه از سال ۱۳۸۸ مورد توجه قرار گرفته و به مدت ۴ سال دنبال گردید. روش برر سی متغیرهای پو شش گیاهی مبتنی بر بکارگیری سه ترانسکت ۵۰۰ متری و نمونه برداری در ســطح پلات‌ها بوده اســت. همزمان، در محل هر پلات میزان رطوبت خاک در ناحیه تو سعه ری شه در دو عمق ۱۵-۰ و ۳۰-۱۵ سانتیمتری به روش حجمی و با کمک د ستگاه TDR اندازه‌گیری شد. نتایج نشان داد که در یک دوره چهار ساله، متناسب با تغییرات سالیانه بارندگی و پارامترهای اقلیمی دیگر و تحت شرایط مدیریت بومی و محلی اعمال شده، کم و بیش تغییراتی در و ضعیت پو شش گیاهی رخ داده ا ست. این تغییرات در سایت ژرف به طور عمده، بصورت تغییرات در میزان پوشش یکساله‌ها، فورب‌های چند ساله، و بعضی گندمیان چند ساله بوده ا ست. تغییرات کربن آلی خاک روندی کند دا شته ا ست. لیکن رطوبت خاک متنا سب با نوع بافت خاک و تغییرات بارندگی بـ صورت فاکتوری تغییرپذیر ظاهر شده ا ست. تغییرات پوشش خاک با توجه به ثبات نسبی پوشش سنگ و سنگریزه و لاشبرگ، تابع تغییرات پوشش تاجی کل بوده است.

کلمات کلیدی: پویایی پوشش‌گیاهی، اکوسیستم مرتعی، منطقه ژرف، خراسان رضوی، ایران