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The Effect of Grazing Intensity on the Elements of N, P and K in Gardaneh Zanbouri Rangeland of Arsanjan, Iran

Zeinab Khademolhosseini
Instructor,
Department of Natural Resources and Environment,
Payame Noor University, Iran
Email: zbkhadem@pnu.ac.ir

Negar Yazdani Jahromi
Associate Professor,
Department of Natural Resources and Environment,
Payame Noor University, Iran
Email: negar.yazdani.j@gmail.com

***Abstract* – Livestock as one of the main elements of range ecosystems has different effects on its different parts. An effective factor is the number of livestock when it is beyond the capacity of the range. This has different effects on soil and plants with different intensities in the range. To study the effect of grazing intensity on the N, P and K soil properties in the three critical, reference and key areas of Gardaneh Zanboori rangeland in Arsanjan, systematic random soil sampling was conducted at two horizons of 0 -15 and 15 -30 cm. 5 samples were selected per horizon and factors of total nitrogen, percentage of soil absorbable phosphorus and potassium were measured in each sample. Results of the two-way analysis of variance (ANOVA) and Tukey test showed that there was no significant difference between critical, reference and key areas in terms of N value. However, in the key area, the N value was less than that of critical area. Meanwhile, the increased grazing intensity was associated with a decrease in the P and K values.**

***Keywords* – Arsanjan, Grazing Intensity, Nitrogen, Phosphorus, Potassium.**

I. Introduction

Changes caused by grazing on range ecosystem are generally assessed based on the soil conditions and vegetation. Livestock as one of the main elements of range ecosystem has different effects on its different parts. One of these effects is the effect of the number of surplus livestock on range. This has different effects on soil and plants with different intensities in the range. These effects can be created directly by the sheep hoof, soil stepping or as a result of the impact on soil specific bulk density and its moisture content. The effects can also be created indirectly by vegetation cover decreasing with grazing and as a result increasing the size of the crown of the plants, their number and vegetation litters (Mesdaghi, 1998).

Willms et al. (1990), reported that periodic grazing reduces soil nitrogen compared with the control area, but the amount of phosphorus increases in the control plot. Singh et al. (1991), study suggested that increased animal wastes help the soil potassium recycling. Mohammadi et al. (2001), in one study on Sabzkoh ranges of Chahar Mahal and Bakhtiari reported that phosphorus and potassium available in the enclosure area was more than the grazing areas. Mousavi (2001), studied the effect of enclosure on soil and vegetation in the Semnan steppe vegetation ranges and suggested that the amount of phosphorus inside enclosure areas was more than the outside of the enclosure, but the amount of potassium was higher inside the enclosure.

Sanadogl (2002), investigated the short-term effect of grazing on soil physical and chemical properties in the Hamand Absard station. He studied the changes in nitrogen, phosphorus and potassium elements in four treatments of grazing intensity (light, moderate, heavy and closed grazing) and two continuous and periodic systems of grazing. Obtained results showed decreased amount of organic material and soil nitrogen percentage proportional to increased grazing intensity, but the increased soil phosphorus was observed. Meanwhile increased grazing intensity reduced potassium changes of the soil. Therefore, the amount of potassium in grazing area was less than that of enclosure areas. Mohammadi and Raeesi Gahrouyi (2003), investigated the long-term effects of grazing on the spatial changes of soil chemical properties in two enclosures and grazing areas in the Sabzkuh area of Chahar Mahal and Bakhtiari. They concluded that the value of available total nitrogen, phosphorus and potassium in the enclosure areas was more than overgrazing area.

Javadi et al. (2005), investigated the effects of grazing on the soil parameters in the Lar summer range. They studied phosphorus and potassium value in the three reference, key and critical areas at two horizons of 0 -10 and 10 -30 cm. Results indicated that the amount of phosphorus and potassium in the soil of critical area was more than the other two areas. Moreover, there was a significant difference between two horizons in terms of the mentioned factors. Therefore, the amount of phosphorus and potassium in the first horizon was more than the second horizon. Gebremeskel & Pieteres (2006), studied the effect of grazing on the soil around the river basin in semi-arid ranges of Ethiopia. They found no significant difference between N, P and K values of the soil in long-term grazing at distances up to 1500 meters from the river. Kohandel et al. (2006), studied the effect of grazing intensity on the elements of N , P and K in Savojbolagh ranges and concluded that grazing intensity increases these elements.

Heydariyan Agakhani et al. (2010), investigated the effect of grazing on vegetation and soils in the Sysab ranges of Bojnurd. They found that amount of soil phosphorous and nitrogen would significantly decrease with grazing. They suggested that intense grazing creates negative changes in soil nutrient and endangers the range stability. ZareKia et al. (2012), investigated the effects of grazing intensity on soil physical and chemical properties in the steppe grasslands of Saveh city in Iran. They suggested that elements such as phosphorus and potassium in the intense grazing areas was more than other but in these areas no significant difference was found between nitrogen in the soil.

Arsanjan rangeland in Fars province, located on the nomads' migration path. Moreover, overcapacity livestocks in the rural areas in this region along with overgrazing caused more pressure on the ecosystem of the region. Since the components of an ecosystem have mutual relationships and interactions with each other and management of range ecosystem requires a correct understanding of the relationship between ecosystem components, the range management should have necessary and sufficient information about components of the management units (water, soil, plants, livestock, etc.) and how they interact with each other. This helps to prevent unwanted changes in the path of offering necessary measures for conservation, restoration, modification, development and operation principles of the ranges. Therefore, evaluation of the effects of grazing management and adopting a strategy to find a policy for the grazing in ranges will be necessary. With regard to the vital role of soil in the range ecosystems, this study was conducted aimed to determine the effects of different grazing intensities on the elements of N , P and K in Gardaneh Zanboori Rangeland in Arsanjan in order to determine the best grazing intensities in this region.

II. Materials and Methods

Description of the study area

Gardaneh Zanboori Range with an area of 2412 acres is located in Arsanjan in eastern part, at a distance of 17 km, between lat 29° 51´ to 29° 54´ N, and long 53° 23´ to 53° 26´ E. This is an area of mountains, hills and plains with the maximum height of 2280 meters above sea level and minimum height of 1640 meters above sea level. The range slope varies in different parts but the north – south slope is dominant. According to the weather station of Arsanjan, the average rainfall in the area is 443.5 mm. The average temperature in the warmest and coldest month of the year was 34°C and about -2.9°C, respectively (khademolhosseini, 2004; 2010).

Methodology

First, related areas were separated under three different management methods of enclosure, moderate grazing and heavy grazing. These three areas considered as symbolic areas of grazing intensity including the reference area where no grazing intensity was observed, the key area where medium to heavy grazing was applied and critical area where heavy grazing was used. These areas were similar in all characteristics such as topography, soil type and rainfall and differ only in their grazing intensity factor. Then, the soil samples were collected. Random systematic soil sampling was conducted at two horizons of 0 -15 and 15 -30 cm. Therefore, five profiles in each area (enclosure, moderate grazing and heavy grazing), a total of 15 soil profiles, were excavated and two samples were taken in each profile (one sample from each horizon). Finally, 30 soil samples were transported to the laboratory. Samples were dried in the air laboratory and passed a two millimeter sieve after smashing. In the laboratory, the percentage of available phosphorus in soil was determined by Olsen method (Olsen, 1954) while the percentage of soil potassium determined using flame photometry method. Moreover, total soil nitrogen measured using Kjeldhal method (Brenner, 1960). Data analysis conducted by SPSS software. Mean comparison was performed by the Tukey test after data analysis and obtaining the knowledge of the mean significancy. It should be noted that the mean comparison was not conducted in the case of no significant F test.

III. Results

Obtained result of two-way analysis of variance for investigated factors is shown in Table 1. According to this table, there is a significant difference between two depths of sampling in terms of absorbable phosphorus and potassium at 5% level. On the other hand, there is a significant difference between two factors of grazing intensity depth and grazing intensity levels. It means that there is a correlation between the two factors of grazing depth and intensity.

Table 1: Two-way analysis of variance for investigated factors

Factor	Source of change	Depth	Grazing intensity	Depth *grazing intensity
P	Amount of F	220.005	19.353	4.720
	significant	0.000	0.000	0.019
K	Amount of F	70.523	19.908	8.959
	significant	0.000	0.000	0.001
N	Amount of F	4.064	40.070	32.568
	significant	0.055	0.000	0.000

Results of Tukey's method for homogeneous averages grouping are given in Table 2. As it can be seen in this table, there is a significant difference between the three areas of enclosure, moderate grazing and heavy grazing in terms of the percentage of absorbable phosphorus and potassium at 5% level. However, there is no significant difference between enclosure and heavy grazing areas in terms of the amount of total nitrogen in the soil. Statistically, there is a significant difference between the enclosure and moderate grazing areas. Moreover, there is a significant difference between heavy and moderate grazing areas at 95% level in terms of the total nitrogen content of the soil. In depth of sampling, since there are just two depths and the mean comparison does not occur for less than three characters, the grazing comparison carried out only at different levels of grazing.

Table 2: Results of Tukey's method for homogeneous averages grouping

Factor	Grazing intensity	Sub-classes at 0.05 level		
		1	2	3
P	Heavy	287.000000		
	Moderate		306.600000	
	Enclosure			336.000000
	Significant	1.000	1.000	1.000
K	Heavy	287.000000		
	Moderate		306.600000	
	Enclosure			336.000000
	Significant	1.000	1.000	1.000
N	Moderate	0.031250		
	Heavy		0.065350	
	Enclosure		0.068250	
	Significant	0.000	0.805	

IV. Discussion and Conclusion

According to investigation of the obtained results, it is observed that there is a significant difference at 5% level between two sample depths and different levels of grazing intensity. Therefore, in all three grazing areas, this factor in the first depth is greater than the second depth. Javadi et al. (2005), also came in to a similar conclusion. On the other hand, in both sampling depths, percentage of absorbable phosphorous in the enclosure area has the highest value followed by moderate and heavy grazing areas. Therefore, it can be observed that the amount of absorbable phosphorus decreases with grazing increase. Willms et al. (1991), Mohammadi (2001), Mousavi (2001), Mohammadi and Raeesi Gahrouyi (2003), Heydariyan Aghakhani (2010), also came to this conclusion.

The results of the study on the percentage of absorbable potassium indicate that there is a significant difference between the two sampling depths and different levels of grazing intensity at 5% level. Thus the most and least percentage of absorbable potassium was in the enclosure and high intensity grazing areas in both sampling depths. Moreover, in the three regions of grazing, the value of this factor is greater in the first depth than the second depth. Mohammadi (2001), Sanadgol (2002), Mohammadi & Raeesi Gahrouyi (2003), obtained the similar results. Sharif et al. (1994), suggested that in the different range ecosystems, the first indirect and significant effect of continuous grazing on soil is vegetation removal and its exclusion from the ecosystem followed by considerable effect on the cycle of nutrients elements and their absorbability. Heavy grazing endangers ecosystem sustainability with creating negative changes in the soil nutrients and fertility decline. Researchers such as Bauer (1987), Dormaar (1989) and Greatz (1986), suggested that grazing systems can influence the flow and cycle of nutrients in the grazing ecosystems through the use of elements, returns from livestock waste, redistribution and sending out the soil elements. It seems that in the studied ranges, the phosphorus and potassium elements decrease through the use and leaving of vegetation in the area. These values decrease with the increase of grazing intensity.

The results of the study on the percentage of total nitrogen showed that there is no significant difference between the two studied depths. But the percentage of total nitrogen in the enclosure area and in the first depth is greater than the second depth. Meanwhile, in the moderate and heavy grazing areas, the amount of this factor in the second depth is greater than the first depth. Zhang et al. (2012), in one study on northern China's range found that two factors which reduce the amount of organic carbon in the surface to subsurface horizons of the soil are overgrazing and the light texture. This causes leaching of organic carbon from surface to subsurface horizons. On the other hand, it can be seen that there is no difference between enclosure and heavy grazing areas in terms of the percentage of total nitrogen. Researchers like Frank et al. (1995), Menezes et al. (2001) and Mohammadi & Raeesi Gahrouyi (2001), also found no significant differences between the two areas of enclosure and grazing. The reason of this finding attributed to the changes in the species composition under heavy grazing. Moreover, there is a significant difference between the moderate grazing area and two areas of enclosure and heavy grazing. Therefore, the percentage of total nitrogen is lower than that of other two areas. Leibig et al. (2006), also came to a similar conclusion. Here, there are two problems. First, the percentage of total nitrogen in moderate grazing area is lower than enclosure area. The amount of soil organic carbon is reduced with increased grazing intensity. This it because more amount of vegetation harvesting of the ground level in high grazing intensity which reduces the plant residues and organic materials in the soil which in turn disrupts the activities of degrading microorganisms, reduces decomposition of organic materials followed by reduced soil fertility. Intensive grazing also influences the amount of soil nutrients by changing the vegetative form and the act of stepping. Soil temperatures and litter decomposition rate increases in areas under intensive grazing with reduced litter biomass due to foliage grazing and also plant residues fragment due by animal transportation. These results are consistent with the results of studied conducted by researchers such as Liu et al. (2012), Golluscio et al. (2009), Vermeire et al. (2005), Schuman et al. (2004), Azarnivand et al. (2005) and Javadi et al. (2005). The second problem is that the percentage of total nitrogen under moderate grazing area is lower than that of heavy grazing area. Surveys conducted by Johnston et al. (1971), Dormaar et al. (1994) and Sharif et al. (1994), showed that moderate grazing causes further decomposition of plant residues and organic nitrogen mineralization but there was no difference between two treatments of heavy grazing and enclosure areas. In heavy grazing intensity, the amount of soil organic carbon and nitrogen increases by several mechanisms. First, with soil bulk density and increased soil compaction, the oxygen supply and degradation rate decreases (Dormaar et al., 1994). In second mechanism, intensive grazing changes the vegetation composition and root to shoot ratio. This affects the root biomass share in the pool of soil organic material (Li et al., 2011). Actually, grazing biomass increases the underground biomass contribution (Reeder, 2004). The increased contribution of roots increases the soil carbon entering and nitrogen maintenance in the soil which leads to the accumulation of organic carbon in soil. Nitrogen deposition in tissues of the root and closed rotation in the root zone are considered as mechanisms of increasing the nitrogen supply (Hui & Jackson, 2005). In turn, increased carbon and nitrogen can again lead to increased effects of grazing in the root biomass and plant residue because they are important sources of carbon and nitrogen in grasslands (Stewart & Frank, 2008). In third mechanism, animal urine and feces can speed the nitrogen cycle in grassland ecosystems (Gao et al., 2009). Results obtained by the study of researchers such as Lee et al.(2011), Dormaar et al. (1994) and Aghamohseny Fashamy et al. (2008), also confirm the results from this study. It seems that simultaneous effect of above factors studied in the related range causes no significant difference between heavy grazing and enclosure areas in the percentage of total nitrogen. Therefore, there is a balance on one hand due to suitable vegetation and no harvesting in the enclosure area, and on the other hand due to heavy grazing and effect of above mentioned mechanisms on heavy grazing area. This caused no significant difference to be observed between the two areas.

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