http://www.pjbs.org

PJBS

ISSN 1028-8880

Pakistan Journal of Biological Sciences

ANSInet
Asian Network for Scientific Information
308 Lasani Town, Sargodha Road, Faisalabad - Pakistan

Pakistan Journal of Biological Sciences 10 (24): 4391-4398, 2007
ISSN 1028-8880

Effects of Grazing on Chemical Soil Properties and Vegetation Cover (Case Study: Kojour Rangelands, Noushahr, Islamic Republic of Iran)

[1]R. Tamartash, [2]H. Jalilvand and [3]M.R. Tatian
[1]Department of Range and Watershed Management,
Sari Agricultural Sciences and Natural Resources University, Iran
[2]Department of Forestry, Faculty of Natural Resources,
Sari Agricultural Sciences and Natural Resources University, Iran
[3]Post Graduate Student of Range Management,
Science and Research Unit of Tehran, Azad University, Iran

Abstract: This research is conducted to study the effects of grazing on chemical soil properties and vegetation cover in three areas separated as the key, reference and critical areas. The study area is located at the river basin of Kojour in the Southwestern of Noushahr (in the North of IR-Iran). Sampling and collecting the soil and vegetation cover data from the site areas are accomplished in the first step of the research. The vegetation cover data was collected in 20 sample plots of 1 m^2 in each area. The data was collected through a random- systematic method in the early grazing season. The soil data was collected out of two layers (0-10, 10-30 cm), in two time intervals before and after grazing. Five samples were selected per layer. Some edaphical factors such as organic carbon, percentage of soil organic matters, total nitrogen, absorbable phosphorus and potassium, pH and EC were measured. The results revealed that there is an inverse relationship between the grazing intensity and amount of carbon, nitrogen, soil organic matter and EC. However, a direct relation exists between the grazing intensity and amount of soil potassium, phosphorus, pH and the ratio of carbon to nitrogen. Vegetation in class 1 and 2 which were cereals and forbs had greatest percentage in the reference area. Furthermore, the percentage forage cover increases with the grazing intensity. The more unpalatable vegetation of class 3 forms the prevailing coverage in the critical area. The conclusion of this study shows that overgrazing is considered as a threat for the nutritional elements of soil and vegetation cover.

Key words: Chemical soil properties, vegetation cover, reference, key and critical areas

INTRODUCTION

There has been a permanent interaction between the livestock and ranges; however, when the number of livestock in each ecosystem is proportional to the range capacity, no damages will threat its worthy resources such as water, soil and vegetation cover (Muscha and Hild, 2006). An adequate understanding and knowledge about the range ecosystem is a prerequisite for proper managing and selecting appropriate methods (Amiri *et al.*, 2005) of range renovation. The imbalance between the range capacity and the number of livestock leads to developing many changes in the vegetation cover and various soil properties.

Thurow *et al.* (1986) studied the effects of four treatments of light, moderate, heavy and closed grazing on the organic matter production. Their results showed a lower amount of organic material in the areas under the heavy grazing treatment comparing the other treatments.

Liebig *et al.* (2006) assessed the soil reaction in a pasture under a long term moderate grazing, heavy grazing pasture and the high fertilized grass ranges under a 70-year grazing period in the North of America. The result of this study revealed that organic carbon in the surface depth of soil in high fertilized grass ranges and heavy grazing pasture is higher than moderate grazing pasture. Higher amounts of organic carbon exist in the depth of 30-40 and 35-56 cm of high fertilized grass ranges rather than moderate and heavy grazing pasture. Due to acidifying the nitrogen fertilizer, pH level decreases in the soil of high fertilized grass ranges.

Gebremeskel and Pieterese (2006) studied the effect of grazing on soil condition around the river basin in semi-dried ranges of Ethiopia. They found that no statistical

Corresponding Author: H. Jalilvand, Department of Forestry, Faculty of Natural Resources,
Sari Agricultural Sciences and Natural Resources University, Sari, Mazandaran Province,
P.O. Box 737, Islamic Republic of Iran Tel: +98-1512445411 Fax: +98-1524222982

difference exists in the amount of soil K, P, N, OC in the long-term mobile grazing up to the 1500 m distant from the river basin.

Thompson *et al*. (2006) conducted a research on the effect of grazing on forage harvesting and the effect of the soil compaction and nutrient erosion in an agricultural land under an 8-week grazing period They found from 50% of the available forage that Nitrogen ($p = 0.10$) decreases with the periodic grazing and phosphorus ($p = 4$) increases with grazing period. Furthermore, nitrogen capacity increased in the dry parts of the area. There is a low amount of potassium ($p<0.10$) in cereals and a low pH level ($p = 0.10$) in oats. No changes observed in EC and carbon organic matter during the time and under fertilization treatment ($p>0.91$). David *et al*. (2006) studied the relations between the soil organic carbon, the total reserved nitrogen in 0-50 cm depth of reclaimed soil and the physical and chemical properties of soil to reclaim the grassland in 4 separated parts of meadow, dry grassland, pasture, disturbed pasture as well as a reference area. The results showed that EC and pH of soil in the grasslands is higher than the reference area. pH and EC in the meadows are generally lower than pastures and disseminated ranges, however, these factors are higher in the dry grasslands rather than the meadow pasture and the reference area.

Dormaar *et al*. (1989) examined the effect of grazing on the soil chemical and physical properties as well as its effect on rangelands condition. According to the results of their study, a mount of soil carbon and Nitrogen will significantly decrease with grazing. Also, there is a significant difference in the amount of carbon in the grazing season, however, no seasonal change is observed in the amount of nitrogen.

Frank *et al*. (1995) and Willms *et al*. (2002) conducted a research on the long-term effects of the heavy, moderate and closed grazing treatments on the soil nitrogen and carbon in the grassland. Based on their results, enclosure is more effective than the other two treatments. The result of this study showed that the amount of soil nitrogen decreases with grazing. In closed grazing treatment, the amount of soil organic carbon is higher than in moderate grazing, however, there is no difference between the heavy and closed grazing treatment. In this study, no difference is observed between the treatments regarding the C/N ratio.

Akbarzade (2005) studied the vegetation cover enclosure changes in and out of Rood Shour. He found that the range enclosure causes in improving the vegetation cover class 1 and 2, although in the short term, this improvement is not remarkable in the overgrazing ranges. The enclosure is not functional as a corrective method for plant cover reclamation. Enclosure results in increasing the exterminating species entry into the ranges. This matter is important in preserving the bio- diversity in the ranges.

Qelichnia (1996) performed a comparison among the reference, key and critical area in Golestan national park and the neighboring ranges regarding their vegetation cover. As he reported, the highest percent of plant composition in the closed area (reference area) belongs to the forbs. Grasses in the key area and brushes in the critical area formed the dominant percent of plant composition. Javadi (2003) examined the grazing effect on the soil chemical properties in the river basin of Lar dam. The results showed a reverse relationship between the soil nitrogen and organic matter and the grazing intensity. Comparing the key and the reference area, he found that a direct relation exists between the grazing intensity and the amount of soil phosphorus and potassium, causing a reduction in the soil fertility. Ali *et al*. (2006) studied the influence of enclosure on the vegetation cover and surface soil of salt ranges in Golestan province. the results showed that the most extensive canopy cover inside the enclosure belongs to the growth form of perennial cereals and one- year forbs, as compared with the outside of enclosure. Enclosure had a negative effect on the amount of nitrogen and EC, however, it had no statistical influence on the soil pH and organic matter. They also expressed the reclamation of the vegetation cover takes place very slowly, due to the long time precedent of that range, but the comparison between the vegetation cover parameters inside and outside of the enclosure was indicative of a good plant cover condition inside the enclosure and effectiveness of enclosure on the range claiming. Savadogo *et al*. (2007) studied the effects of grazing intensity in West Africa policies for prescribed livestock grazing in the Savanna. The inherently different management characteristics and their effects on the vegetation dynamics make comparison of non-grazed areas, lightly grazed areas, moderately grazed areas, heavily grazed areas and very heavily grazed areas. The parameters assessed reflected changes in herbaceous plant cover, biomass as well as soil physical properties. Hosseinzadeh (2006) studied the effect of grazing on soil characteristic and vegetation cover rangelands in Eskelimrood basin of Mazandaran province. She concluded that grasses and forbs in reference area had the most percentage cover, whereas intensity grazing causes to increase of shrub. Also, species palatability classes of one and two had the most percentage in reference area, but in critical area species of class three and un-palatability plant had increased.

Different results are obtained from the soil chemical properties; this matter is arising from the specific and unique conditions of the climates, soil, vegetation cover, range management, examination period and type of livestock using the range, the grazing system and the stocking period. In this study, we tried to find the cases of these differences. Due to the importance and necessity of knowing the soil properties, particularly the chemical ones, in order to properly manage the range ecosystems, this study aimed at evaluating the amount and changes in some of soil properties such as the organic material, nitrogen, carbon potassium, phosphorus, the electric conductivity and pH within the three areas including the reference area, the key area and the critical area. After comparing the results, we measured the amount of vegetation cover and the plant combination in terms of their growth form and palatability in the three mentioned areas.

MATERIALS AND METHODS

Kojour watershed with an area of over 30956 ha^{-1} located between the 44° 51'-45° 51' of east longitude and 19° 36'-20° 36' of north latitude. Kojour rangelands are considered as the rural ranges of the country regarding to their climate and vegetation cover. The study area, Omej rangeland is connected to the agricultural lands from its northern part and to the Khachak mountain rangeland from its southern border and to the Khachak mountain agricultural land and khachak village from east (Farazmand, 2004). The aspect of the study area and altitude are in the direction of western and 1550-1700 m, respectively.

Kojour rangelands are generally with a slope of over 30%. The hydrophilous cold-resistant vegetation form the predominant coverage of the ranges in the study area. According to the Kopan Table, this area has a dry, cold winter and a short summer. The annual rainfall was 400-500 mm. The minimum annual temperature of the area is below 0°C in the fall and winter seasons. August and September are the dry months of the area. The soil is silt-loam with a pH of approximately 6 to 7 (Farazmand, 2004).

After visiting the region, three areas including key, reference and critical area with different grazing intensity were selected to study the vegetation cover and soil parameters. These areas have homogeneity in physiography (Slope, Height and Aspect), soil type and the amount of rainfall.

There are just different in their grazing intensity. The types of vegetation cover in these three areas are grasses and brushes. To measure the vegetation cover parameters, 20 plots of 1 m^2 were selected via a random-systematic method. Some factors such as the a viable vegetation list, the percentage of the canopy cover of available plants in the area, canopy cover of each growth form, the uncovered soil, rocks, gravel- stones and litters were determined in each plot. A random-systematic sampling method was also used to take soil samples. The soil samples were collected from 5-10 and 10-30 cm depths (regarding the separation border of horizons) during two time intervals in 2004. Five samples were selected from each horizon. Some other parameters such as organic carbon, soil organic matter percentage, nitrogen, phosphorus, potassium, acidity and electric conductivity were also measured. EXCELL and SPSS software were applied to accomplish the statistical test.

RESULTS

Vegetation cover: Based on the results of measuring the vegetation cover, the percentage of vegetation cover was 3.78, 57 and 3.39% in the reference, key and critical area, respectively (Table 1). Also, these results showed that as we progress from the reference area towards to the critical area, vegetation cover percentage reduced and their growth form and palatability will also changed. Among the index species of the reference area were: *Bromus tectorum*, *Hordeum bulbosum*, *Stachys byzantia*, *Festuca ovina*, *Br. tomentellus*, *Medicago polymorpha*, *Trifolioum repens*, *Tr. pratense*. The index species of the key area were: *Hordeum bulbosum*, *Me polymorpha*, *St. laxa*, *St. byzantia*, *Br. tectorum*. In the critical area, the index species were: *Astrogalus* sp., *Ho. bulbosum*, *Cynodon dactylon*, *Stipa barbata*, *Artemisia aucheri*.

Chemical soil properties

Acidity (pH): The analysis of variance of this factor revealed statistical difference at the 1% level at three mentioned areas. In the case of other parameters, however, no difference was observed between the various depths and time periods. Duncan group mean comparison test showed an increase in pH level at the end of

Table 1: Vegetation cover characteristics (%) in the reference, key and critical areas

Area	Vegetation cover	Cereals cover	Brush cover	Forb cover	Litter	Non-vegetation	Rock and gravel	Vegetation class 1	Vegetation class 2	Vegetation class 3	Unpalatable vegetation
Reference	78.2	41.20	5.22	31.87	13.33	3.06	5.41	44.07	9.06	23.27	1.80
Key	57.0	13.13	26.10	17.77	4.94	33.33	4.73	7.60	7.02	25.30	17.08
Critical	39.3	3.54	32.38	3.38	3.57	40.98	16.15	1.85	1.00	28.16	8.29

Table 2: Chemical soil properties analysis of variance (ANOVA)

Soil properties	Source of Variations	Total square	df	Mean square	CV	R^2	F_{value}
pH	Model	1.010	5	0.202	1.4	0.67	18.552*
	Error	0.588	54	0.011			
C	Model	6.586	5	1.317	2	0.70	70.444**
	error	1.010	54	0.019			
N	Model	0.012	5	0.002	8	0.82	370.148**
	error	0.000	54	0.000			
K	Model	28.575	5	5.715	7	0.66	392.060**
	error	0.787	54	0.015			
OM	Model	16.639	5	3.328	5	0.91	69.904**
	error	2.571	54	0.048			
EC	Model	0.001	5	0.0002	0.001	0.88	7.239**
	error	0.002	54	0.000			
P	Model	580.150	5	116.030	3	0.81	28.004**
	error	223.740	54	4.143			
C/N	Model	10726.086	5	2145.216	5	0.78	51.439**
	error	2252.030	54	41.704			

*: p<0.05; **: p<0.01

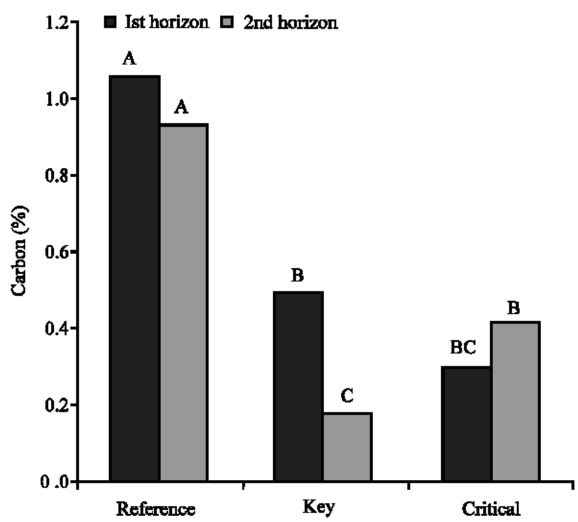

Fig. 1: Carbon percentage in different grazing area

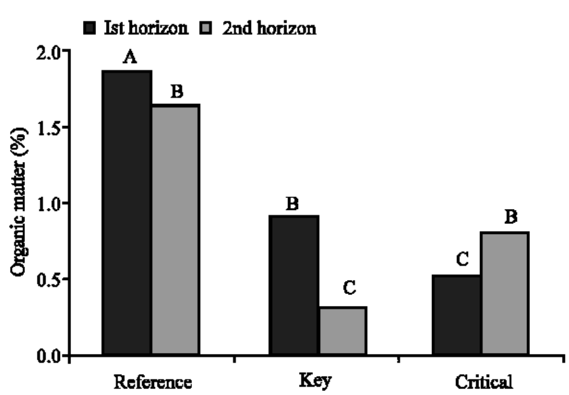

Fig. 2: Organic matter percentage

grazing season. A comparison among the different areas showed that the highest acid level was related to the critical area (after grazing) (7.68) and the lowest one was related to the reference area (before grazing) (7.33). Studying the acid level in different soil depths showed the lowest acid level in the second horizon of the reference area (7.33) and the highest one in the first horizon of critical area (7.67).

Total carbon: In different depths at the key area was statistically significant difference at the 5% level. However, this difference was not statistical in before and after grazing. This element was statistical in 1% level in the various areas (Table 2). Duncan test showed that the second horizon of the key area had the lowest percentage of carbon (<120%) and the first horizon of reference area had the highest percentage of carbon (>1%) (Fig. 1).

Organic matter: The results of this study showed a statistical difference of 1% level in the amount of soil organic matters among different depths and areas, before and after grazing. There was no statistically difference in the reciprocal effect between the grazing and depth of the area (except for the grazing effect on the depth of the key area (in 5% level) and the grazing effect on the depth of the reference area (in 1% level). Duncan test result showed that the amount of organic matter in the early grazing period was higher rather than that of the late grazing period (Fig. 2 and Table 2).

Nitrogen: Nitrogen in the depths in areas and grazing were statistically difference in the 1% level (except for the relation between the grazing and the second depth of the reference area which was statistically significant at the 5% level).

The results showed a reduction in soil nitrogen in the late grazing period. So, the lowest percentage of soil nitrogen was observed in the critical area, after grazing (p<0.0084). Meanwhile, the highest amount of nitrogen was related to the late grazing period at the key area (5%) (Table 2 and Fig. 3).

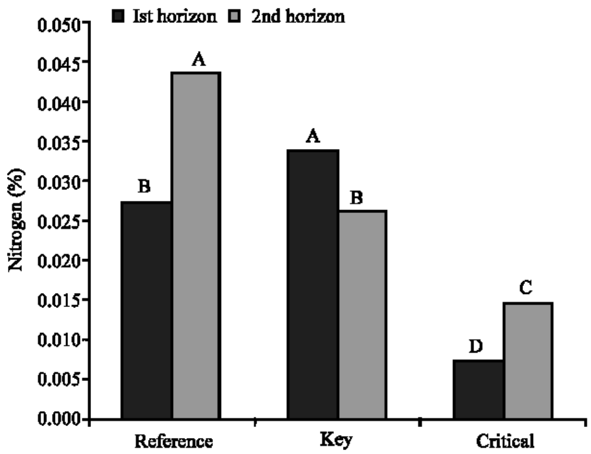

Fig. 3: Nitrogen percentage in different soil horizons of various grazing areas

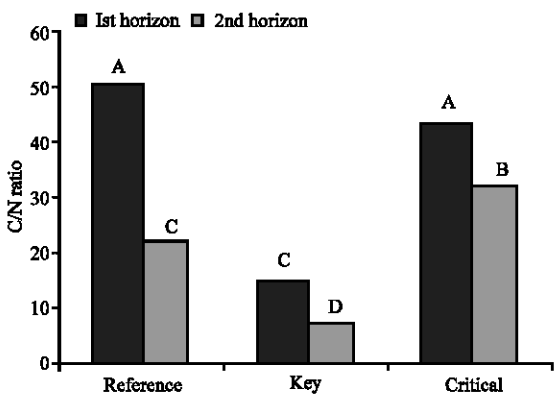

Fig. 4: Carbon nitrogen ratio (C/N) in different soil horizons of various grazing areas

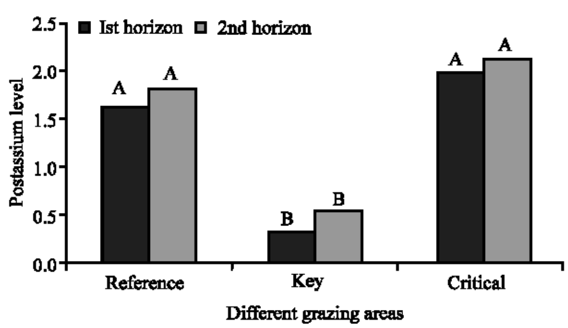

Fig. 5: Potassium level in different soil horizons of various grazing areas

Carbon-nitrogen ratio: According to the results of this study, in the relation between the area before grazing and the depth of an area was statistically significant at the 1% level, but any statistical differences were observed in

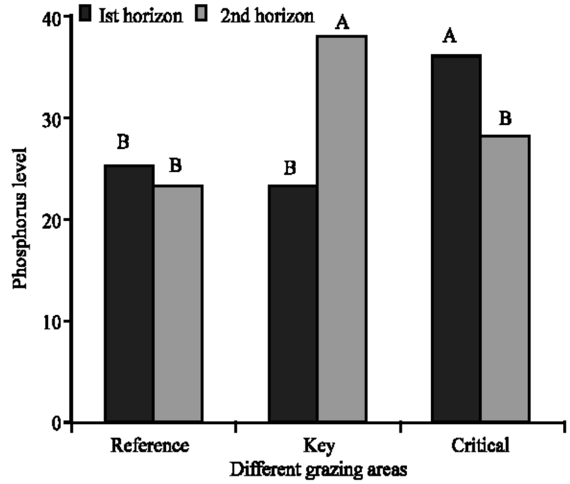

Fig. 6: Phosphorus level in different soil horizons of various grazing areas

other cases (Table 2). The lowest carbon-nitrogen ratio was found in the second horizon of the key area (6.78) and the highest one was related to the first horizon of the reference area ($p<0.056$) (Fig. 4).

Potassium: There was a statistically significant difference in the amount of potassium in at whole areas, in depths and grazing. The effect of grazing on the area was significant at the 1% level, however, it was significant at the 1% level and 5% in different depths respectively (although the effect of depth on grazing was not statistically significant at the reference area) (Table 2 and Fig. 5).

Phosphorus: Based on the data analysis, the phosphorus level at difference areas were significant at 1% level. The effect of grazing on the first depth of key area was differed at the 1% level and its effect on the first and second depth of the critical area and the first depth of the reference area was statistical at the 5% level. In the key and the critical area, the phosphorus was lower at the early grazing season; however, the amount of phosphorus at the early grazing season was higher in the reference area (Table 2 and Fig. 6).

Buffer density: Buffer density of the critical area (1.55 g^{-1} cm^{-3}) was higher comparing to the key (1.28 g^{-1} cm^{-3}) and the reference areas (1.27 g^{-1} cm^{-3}).

Electrical Conductivity (EC): There was statistical difference at the 5% level in different areas before and after grazing, however, no statistical difference was observed between the studying depths and before and

Table 3: Mean group comparison of chemical soil properties before and after grazing

Areas	Grazing	C	BD	C/N	P	EC	OM	K	N	pH
Reference	Before	1.16^{a}	1.27	40.57^{a}	27.5^{c}	0.094^{ab}	1.84^{a}	1.600^{d}	0.0360^{b}	7.33^{c}
	After	0.84^{d}	1.27	25.53^{a}	24.7^{d}	0.088^{bc}	1.45^{b}	1.710^{c}	0.0330^{c}	7.35^{c}
Key	Before	0.38^{d}	1.28	11.71^{c}	30.2^{b}	0.089^{ab}	0.66^{d}	0.480^{e}	0.0330^{c}	7.45^{b}
	After	0.29^{ed}	1.28	5.87^{d}	32.1^{b}	0.095^{a}	0.51^{de}	0.350^{f}	0.0500^{a}	7.50^{b}
Critical	Before	0.52^{c}	1.55	41.92^{a}	31.8^{b}	0.083^{cd}	0.89^{c}	2.159^{a}	0.0130^{d}	7.62^{a}
	After	0.22^{e}	1.55	26.32^{b}	34.0^{a}	0.082^{d}	0.38^{e}	1.860^{b}	0.0084^{e}	7.68^{a}

Probability levels 5%, data with the same letter(s) were not statistically significant at the 5%

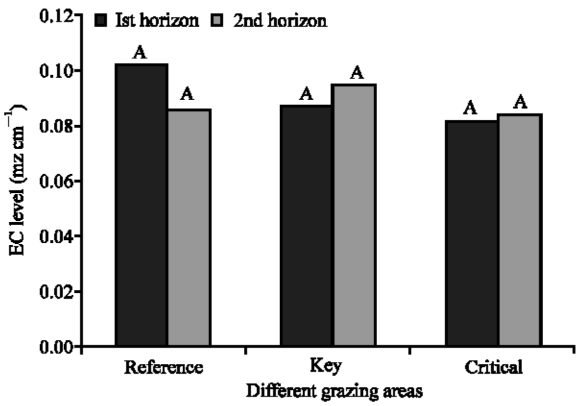

Fig. 7: EC level in different soil horizons of various grazing areas

after grazing. The EC for the reference, key and critical areas were 0.0911, 0925 and 0.0833 mz, respectively (Fig. 7, Table 2, 3).

DISCUSSION

Vegetation cover: Based on the results of this study, the more grazing intensity had the less vegetation cover. The amount of uncovered soil, rocks and gravels increases with the grazing intensity. An inverse relation exists between the grazing intensity and the coverage of forbs and cereals, but there was a direct relation between the grazing intensity and bush coverage. The results of this study are agreement with Bowns and Bagley (1986), Willms *et al.* (1990), Qelichnia (1996), Qaredaghi and Jalili (1999) and Savadogo *et al.* (2007). The grazing intensity has a negative effect on the palatability of plant composition. A comparison among three studying areas showed the effectiveness of enclosure on the range plant cover renovation and reclamation.

Chemical soil properties

Carbon and organic matter: The vegetation cover decreases with grazing. Thus, the amount of total carbon and organic carbon is reduced as the result of decreasing the amount of organic matter turnover to the soil. Due to its vast vegetation cover, the reference area involves the higher amount of organic matter rather than that of the grazing areas. The high levels of carbon and organic matter in the first horizon is due adding the high litter volume in this horizon. These results are in concord with the results obtained in different areas (Johnston *et al*., 1971; Thurow *et al*., 1986; Bauer *et al*., 1987; Dormaar *et al*., 1989; Willms *et al*., 1990, 2002; Frank *et al*., 1995; Frank and Groffman, 1998; Papaioannou, 2003; Mousavi, 2001; Raeisi *et al*., 2001; Dormaar *et al*., 1997b).

Nitrogen: In a same process as the soil organic matter changes, the amount of soil nitrogen decreases with the grazing intensity. The researchers concluded that the soil under the plants with abundant roots involves higher amounts of nitrogen and organic matter (Salardini, 1995). Due to the enormous vegetation cover and the volume intensity of their roots in the soil, the nitrogen level is higher in the reference area as compared with the grazing areas. According to the results of this study, the amount of nitrogen in the key area is more than the reference area, after the grazing period. This can be caused by animal excrements and urine, although this effect is insignificant. Based on the obtained results, legumes have a vast coverage in the reference area as compared with the key and critical areas. High nitrogen levels in the reference area can be related to the presence of legumes. These results have agreement with many finding researches (Dormaar and Willms, 1998; Willms *et al*., 1990; Sheriff *et al*., 1994; Frank *et al*., 1995; Michael *et al*., 2006).

Carbon nitrogen ratio: The grazing intensity has a positive effect on the carbon-nitrogen ratio, i.e., the grazing intensity has conformity with this ratio. There is a direct relationship between this ratio and plant decomposition. The reference area with more carbon levels comparing the key and the critical areas has also a higher carbon-nitrogen ratio. This ratio is significantly decreased after the grazing period. These findings are in agreement with Smoliak *et al.* (1972), Frank and Groffman (1998) and Shariff *et al.* (1994).

Acidity (pH): The soil acidity is increased with the grazing intensity. The soil acidity in the closed or reference area and the critical area were 7.34 and 7.65, respectively. The same results are obtained by Johnston *et al.* (1971), Dormaar and Willms (1998), Papaioannou (2003) and Mousavi (2001).

Potassium: A direct relationship exists between the grazing intensity and soil potassium. Animal wastes and their traffic have a positive effect on soil potassium. Due to the large number of livestock per surface unit and high amounts of animal wastes, soil potassium increases in critical areas. Moreover, due to the low vegetation coverage, less soil potassium is used by plants, thus, this element will be increased in the soil because of the fewer number of livestock in the key area and there was a significant increase in the soil fertilizer potassium. There is a higher chance for plant regret in the key area, therefore, more potassium are used by plants. As the result, the amount of potassium in the key area is lower than this amount in the reference and the critical areas. It doesn't find any reference that show of the results that can compare with the results of this part of study.

Phosphorus: The grazing intensity is associated with an increase in the phosphorus level. Increasing the phosphorus amount in the critical area can be related to the frequent animal traffic which leads to more reduced of litters and micro organisms activity in the soil. This area with more animal wastes comparing the other two areas involves more phosphorus motion on the soil surface caused by animal traffic. Phosphorus is mainly observed in combination with the organic matters, thus, the soil with abundant organic matters included more phosphorus. The soil surface layer involves more phosphorus rather than its lower layer, however, more phosphorus existed in the lower soil layer in the key and the critical areas, because of the sufficient rainfall and the low vegetation cover and phosphorus can be easily washed away and transferred to the lower soil layers. These results are in agreement with Dormaar *et al.* (1997a).

Buffer density: The results of this study indicated a direct relationship between the grazing intensity and the buffer density. This matter originates from a decrease in vegetation cover and soil compaction caused by animals over traffic. These results are in concordance with Dormaar and Willms (1998), Givi *et al.* (2001), Mousavi (2001) and Ataeian (2002).

Electric Conductivity (EC): As the results of this study shows an inverse relations existed between the grazing intensity and the soil electrical conductivity. The soil electrical conductivity in the reference area was lower comparing the key area. These results are similar to the results obtained by Chaneton and Lelavado (1996). Generally, the ranges of study areas are adjacent to the rural areas. Overgrazing and untimely grazing in these areas result in the range instability. Of course, the positive effects of grazing can't be ignored. When a balance exists between the number of livestock and the amount of range forage, our purpose is establishing a balance in Kojour.

REFERENCES

Akbarzade, M., 2005. Vegetation cover changes inside and outside of Roudshoor enclosure. Iran. J. Range Desert Res., 12: 178-188 (In Persian).

Ali, A.M., M. Mesdaghi and M. Erfanzade, 2006. Studying the effect of enclosure on the vegetation cover and the surface soil of Gomishan salt ranges in Golestan Province. J. Agric. Sci. Nat. Resourc. Gorgan, 13: 194-202 (In Persian).

Amiri, F., M. Basiri and M. Erevani, 2005. Comparison of measurement methods on the amount of utilization of *Eurotia ceratoides*. J. Sci. Technol. Agric. Nat. Resourc., 9: 229-242 (In Persian).

Ataeian, B., 2002. Settlement of index range vegetation under a different condition of soil compaction. M.Sc. Thesis, Range Management, Karaj Natural Resources College, Tehran University, pp: 75 (In Persian).

Bauer, A.C., V. Cole and A.L. Black, 1987. Soil property comparisons in virgin grassland between grazed and non-grazed management system. Soil Sci. Soc. Am., 51: 176-182.

Bowns, E.J. and F.C. Bagley, 1986. Vegetation responses to long-term sheep grazing on mountain ranges. J. Range Manage., 39: 431-434.

Chaneton, E.J. and S. Lavado, 1996. Soil nutrients and salinity after long term grazing exclusion in a flooding Pampa grassland. J. Range Manage., 49: 181-182.

David A.N.U., L. Rattan and P.A. Jacinthe, 2006. Post-reclamation land use effects on properties and carbon sequestration in mine soils of Southeastern Ohio. Soil Sci., 171: 261-271.

Dormaar, J.F.S., Smoliak and W.D. Willms, 1989. Vegetation and soil responses to short-duration grazing on fescue grasslands. J. Range Manage., 42: 252-256.

Dormaar, J.F., S. Smoliak and A. Johnston, 1997a. Seasonal variations in chemical characteristics of soil organic matter of grazed and un-grazed mixed prairie and fescue grassland. J. Range Manage., 30: 195-198.

Dormaar, J.F., W.D. Willms and B.W. Adams, 1997b. Impacts of rotational grazing on mixed prairie soils and vegetation. J. Range Manage., 50: 647-651.

Dormaar, J.F. and W.D. Willms, 1998. Effect of forty-four years of grazing on fescue grassland soils. J. Range Manage., 51: 122-126.

Farazmand, S., 2004. Determining of animal unit and their daily needs in ranges of Western Mazandaran, M.Sc. Thesis, Natural Resources and Sea Sciences, Nour College, Tarbiat Modarres University, pp: 67 (In Persian).

Frank, A.B., D.L. Tanka, L. Hofmann and R.F. Follett, 1995. Soil carbon and nitrogen of Northern Great Plains grasslands as influenced by long-term grazing. J. Range Manage., 48: 410-474.

Frank, D.A. and P.M. Groffman, 1998. Ungulate vs. landscape control of soil C and N processes in grasslands of Yellowstone National park. Ecology, 79: 2229-2241.

Gebremeskel, K. and P.J. Pieterse, 2006. Soil status of a semi-arid rangeland in Ethiopia. Afr. J. Ecol., 45: 72-79.

Givi, J., J. Mohammadi, H. Fathllahi and M. Talebi, 2001. the effect of closed management on the soil renovation in forest reservoir of Ardal chartagh. Proceedings of the Conference on Watershed Management Difficulties Identification and of Presenting Proper Solutions in the Domain of Karoun and Zayanderood, pp: 126 (In Persian).

Hosseinzadeh, G., 2006. Investigation and comparison of vegetation cover changes and some characteristic of soil in grazed and un-grazed rangeland in Eskelimrood District, M.Sc. Thesis, Mazandaran University, pp: 117 (In Persian).

Javadi, A., 2003. The grazing effects on soil and vegetation cover properties. Thesis of Natural Resources, Tehran University, pp: 70 (In Persian).

Johnston, A., J.F. Dormaar and S. Smoliak, 1971. Long-term grazing effects on fescue grassland soils. J. Range Manage., 24: 185-188.

Liebig, A.A., J.R. Gross, S.L. Kronberg, J.D. Hanson, N.B. Frank and R.L. Phillips, 2006. Soil response to long-term grazing in the Northern Great Plains of North America. Agric. Ecosyst. Environ., 115: 270- 276.

Michael, H., J. Parsons, B. Koch, S. Lamont and M. Fairbanks, 2006. Planting density effects and selective herbivory by Kangaroos on species used in restoring forest communities. Forest Ecol. Manage., 229: 39-49.

Mousavi, M., 2001. Studying the effect of enclosure on the process of soil vegetation cover changes in Reza Abad semi-steppe ranges in Semnan. Proceedings of 2nd National Congress of Range and Range Management in Iran. Iran Range Manage., pp: 106 (In Persian).

Muscha, J.M. and A.L. Hild, 2006. Biological soil crusts in grazed and ungrazed Wyoming sagebrush steppe. J. Arid Environ., 67: 195-207.

Papaioannou, A., 2003. Modifications of surface soil characteristics due to grazing, of a Magus ecosystem in Northern Greece. Geotechnical Scientific Issues, Aristitle University of the Ssaloniki, opapaioa@ for.auth.gr.

Qaredaghi, H. and A. Jalili, 1999. A comparison between the plant cover composition of lands under grazing and exclosure of Roodshur steppe ranges. J. For. Pasture, 43: 28-44 (In Persian).

Qelichnia, H., 1996. Comparing the vegetation cover of the reference, key and critical areas in Golestan national park and pasture. Res. Reconstruct., 30: 72-75 (In Persian).

Raeisi, F., V. Asadi and J. Mohammadi, 2001. The quality of range vegetation litters and its relation with carbon dynamics under different management in Sabz kuh ranges. Proceedings of the 2nd Conference of Ranges and Range Management in Iran. Iran Range Manage. Soc., pp: 98 (In Persian).

Salardini, A., 1995. Soil Fertility. Published by Tehran University, pp: 268 (In Persian).

Savadogo, P., L. Savadogo and D. Tiveau, 2007. Effects of grazing intensity and prescribed fire on soil physical and hydrological properties and pasture yield in the savanna woodlands of Burkina Faso. Agric. Ecosyst. Environ., 118: 80-92.

Shariff, A.R., M.E. Biondini and C.E. Grtgiel, 1994. Grazing intensity effects on litter decomposition and soil nitrogen mineralization. J. Range Manage., 47: 444-449.

Smoliak, S., J.F. Dormaar and A. Jahnston, 1972. Long-term grazing effects on Stipa Bouteloua prairie soils. J. Range Manage., 25: 246-250.

Thompson, N.B., Withey and W. Poland, 2006. Effect of livestock grazing of feeding on cropland soil compaction and nutrient deposition. Annual Report.

Thurow, T.L., W.H. Blackburn and C.A. Taylor, 1986. Hydrological characteristics of vegetation types as effected by livestock grazing system, Edwards Plateau Texas. J. Range Manage., 39: 505-509.

Willms, W.D., J.F. Dormaar and S. Smoliak, 1990. Vegetation response to time-controlled grazing on mixed and fescue prairie. J. Range Manage., 43: 513-517.

Willms, W.D., J.F. Dormaar, B.W. Adams and H.E. Douwes, 2002. Response of the mixed prairie to protection from grazing. J. Range Manage., 55: 210-216.