Journal of Applied Sciences

ISSN 1812-5654

Journal of Applied Sciences 10 (18): 2001-2009, 2010
ISSN 1812-5654

Short Time Impact of Enclosure on Vegetation Cover, Productivity and some Physical and Chemical Soil Properties

[1]G. Hosseinzadeh, [2]H. Jalilvand and [3]R. Tamartash
[1]Department of Range and Watershed Management,
Sari Agricultural and Natural Resources University, P.O. Box No. 737, Iran
[2]Department of Forestry, Faculty of Natural Resources,
Sari Agricultural Sciences and Natural Resources University,
P.O. Box No. 737, Codal Post 48441-76111, Iran
[3]Department of Range and Watershed Management, Faculty of Natural Resources,
Sari Agricultural Sciences and Natural Resources University, P.O. Box No. 737, Iran

Abstract: Since the vegetation cover and soil characteristics impose a significant effect on performing a proper integrated management in rangeland ecosystems. We evaluated the changes of vegetation cover and soil characteristics under different grazing treatments in Eskelimroud basin located at west part of Savadkouh (Mazandaran province in Iran). Three adjacent areas under different grazing intensities including critical, key and enclosure (reference) had been selected. Statistical analysis of variance and group mean comparison showed that the enclosure area was mostly covered by vegetations of class I while dominant vegetation covers in the key and critical areas were covered by class II and class III types, respectively. These findings showed that increasing of grazing intensity, palatable species had been gradually replaced by unpalatable species, but in the reference area *Graminea* and palatable forbs was dominantly covered. Crown cover percentage and productivity was significantly differed at the 1% level between the reference and grazing areas. Analysis of variance of soil data showed that soil in reference area was mainly covered by dense herbaceous species containing more amounts of organic matter, nitrogen, electric conductivity, phosphorus and potassium as compared with grazing areas. In fact, it can be concluded that short term enclosure of vegetation cover and soil quality in Eskelimroud basin was due to its adequate rainfall and climate condition.

Key words: Enclosure, vegetation cover, soil, Eskelimroud basin

INTRODUCTION

Rangelands are restorable natural resources with different uses such as providing the main part of livestock's' forage (88%) (Moghaddam, 2000). At present, forage required for 37 million livestock units in 7 month of rangelands productivity in Iran for one year. While from totally of 124 million livestock units, 83 million, are merely grazing in rangelands which leads to destruction of these ecosystems. Various studies in different areas showed the same result indicating heavy grazing pressures on rangelands and inconsistency of livestock densities and rangeland potentials. Based on the estimations of an American company using remote sensing images rangelands covered more than 90 million ha in Iran at 1974. However, those ecosystems are undergoing serious changes in terms of their quality and grading due to the damaging activities occurring during recent years. On the other side, due to the ever-increasing populations associated with developed agricultural equipments, wide rangeland surfaces were transformed into agricultural lands resulting in imposing higher grazing pressure on remained rangeland. So that despite of high productive potential of these ecosystems remained (Moghaddam, 2000).

Some human activities such as entering their domestic livestock into rangelands and their managing operations would damage the vegetation cover and soil quality in these areas. To prevent these consequences, the grazing intensities must be controlled (Andrieu *et al*., 2007; Riginos and Herrick, 2010) in these ecosystems via fencing the area and monitoring the water input in trough several parameters effective on vegetations natural regeneration as follows: availability of desirable plant

Corresponding Author: Hamid Jalilvand, Department of Forestry, Faculty of Natural Resources,
Sari Agricultural Sciences and Natural Resources University, P.O. Box No. 737,
Codal Post 48441-76111, Iran Tel: 0981512442981-5/09112140616 Fax: 0981512442982

species, humidity of soil, proper climatic conditions and abundance of soil nutrient materials. These parameters are obtainable through monitoring on trapping operations and grazing seasons, developing water resources and completely closing the rangelands (Mesdaghi, 1998).

Short term and midterm enclosures aimed at natural range reclamation and palatable vegetation replacement play a significant role in management operations (Ahmadi *et al*., 2009; Verdoodt *et al*., 2009). If the closed sites are properly chosen and managed, all the potential of these areas would be emerged and the vegetation resources would be certainly conserved. Moreover, researchers can study the history of soil and vegetation cover changes and previously applied management processes to introduce new integral management strategies (Hoveizeh *et al*., 2001; Wellstein *et al*., 2007). According to Brand and Goetz (1986) an abandoned undistracted rangeland may be gradually covered by a vegetation community with a relatively permanent structure.

In order to reproduce and increase the desirable vegetation species as original plants for seed production, we should previously prospect the consequences of enclosure operations (Moghaddam, 2000) and some management measures such as preventing short term or long term grazing to improve the vegetation structure and more production, vegetation vigor and nutrition reserves in aerial and earth organs (Tavakoli, 2001).

Studied on complicated ecologic relation in mountainous of Sichuan in China the lowest and the highest soil qualities were related to the agricultural land and shrubbery (containing the highest percents of organic carbon total nitrogen and available nitrogen), respectively; assessed the density of shrubs in closed areas. They found that shrub densities in these areas were significantly higher than key and critical areas (Liu *et al*., 2002; Bastin *et al*., 2003). Rangeland condition is a main determinant of different livestock grazing treatments and it is considered as a substantial tool to improve grazing condition and rangeland management. a longer grazing period and higher grazing intensity after degradation of rangeland quality. A reverse relationship existed between range land degradation and grass species type, abundance and numbers. To increase the production of desirable forage species and reduce the Euphorbia multi leafy biomass, a proper time period must be selected for livestock grazing. Effects of normal livestock grazing on rangeland conditions and domestic animal production in Goladam station, Salmas were studied. According to their results, rangeland under normal grazing conditions enhanced from mean to good grand. The vegetation cover increased in these areas from 24 to 33% ($p<0.05$) (Ahmadi *et al*., 2007; Hileman, 2008; Kassahun *et al*., 2008).

The results of some researches that were done in enclosure and grazing areas show: bare soil surfaces were increased in the grazed areas by domestic animals, while the vegetation cover was increased in non-grazed areas. Litter production varied between 30-425 g m^{-2} per year, in upper rangeland at north Etyopia while it had been increasing during long term enclosure. Vegetation cover changes in grazing and non-grazing areas of Chat rangeland at Gonbad, for a 5 year period in Iran were reported. Thus the more logging intensity, the less forage production would be in areas surrounding the closed area. Moreover, there existed higher percents of available nitrogen, phosphorus and potassium in closed area of Sabzkouh rangeland at Charmahal and Bakhtiari by comparing the grazing area. Results showed rangeland conditions improved during enclosure and desirable species were increased. For example in Karo rangelands at South Africa where had been closed, despite of increasing percents of multi- year grasses, one year aged grass coverage were reduced in reference area and crown cover changes in closed areas were quicker than other areas. (Mohammadi., 2001; Kirkpatric and Bridle, 2005; Descheemaker *et al*., 2006; Kraaij *et al*., 2006; Khatir Sameni, 2007). The guide of this study was investigation of positive impact of enclosure on vegetation cover, productivity, soil surface litter fall and some physical and chemical soil properties.

MATERIALS AND METHODS

The studying area located at Eskelimroud basin in sub region of Pashakola dam, called Najarkola and Gardanesar rangelands. This mountainous area placed in Mazandaran province within 6271 ha at the north of Iran from longitude of 36° 13' 36'' to 36°5' 32'' and east latitude from 52° 42' 44'' to 52° 48' 20''. Two- third of the area is covered by forests and the remained parts are dominated by rangelands in upper lands. This area lies between the height ranges of 230-2890 m (Table 1).

Due to the lack of a reliable meteorology station inside the study area, we used the nearest neighbor stations (Sheikhmousa and Alasht) to estimate rainfall and temperature. Average annual precipitation which mostly

Table 1: Measured the areas related to rangelands in Mazandaran

Rangeland type	Rangeland area (ha)	Rangeland area (%)
Good	220462.2	21
Medium	587899.2	56
Poor	241458.6	23
Total	1049820	100

snowfall is 415 mm. The average maximum and minimum annual temperatures are 10.8°C and -3.9°C, respectively. Based on Amberget classification, the study area had a mountainous climate (Q2 = 50).

Vegetation cover type in the studying rangeland, based on its dominant coverage is *Onobrychis cornuta* L. including *Calamagrostis pseudophragmites* H., *Bromus tectorum* L., *Festuca ovina* L., *Buplerum rotundiflorum* L. and *Asteragalus vereskensis* L.

The dominant formation of the area is Asmari containing lime rock types; uncompleted low depth soil with lime origin that is classified as Lythosol and Caloyal soils. Moreover the soil type had an average loam texture with pH≥7. This research is performed in three phases including preliminary and field surveys, laboratory and statistical data analysis.

Preliminary and field surveys: Homogeneous units were identified from topographical map to do primary surveys and preparing floristic list. Three areas under different grazing intensities including reference, key and critical areas were selected. These adjacent areas formed a uniform area regarding their physiographic (slop, height and aspect), soil and precipitation. Some parameters such as vegetation cover and soil properties and other measurements were down within three above mansion areas.

A random systematic method was used to prepare some samples to study vegetation cover. Totally we had taken 45 sample plots in three regions. Two meter pixel size was considered for grassland–shrubbery cover type to measure crown cover and production (Mesdaghi, 2001). In the next phase, crown closure, production for each species, soil surface cover including rock and gravel and vegetation percentage leftover were measured in each plot. Crown closure of species in class I, II and III was measured by grille quadrates in each plot.

A cut and balance methods used to produce measurements. Production amounts (kg ha^{-1}) of 6 species among index, dominant and co-dominant vegetations classified as good palatability (class 1) and moderate grazing (class II) in reference, key and critical regions.

Grass vegetations had been cut from one cm above soil surface, as for shrubs, the parts grown in that year were separated from the plant to find out the effects of grazing on several soil parameters. Four samples from soil depth of 0-5 and 5-10 cm were provided in each treatment areas. Sampling was done via a random-systematic method within homogeneity pots.

Laboratory analysis: Soil samples were transferred to a laboratory to determine soil texture, appearance specific gravity, pH, Electrical Conductivity (EC), absorbable potassium, phosphorus, total nitrogen and organic matter.

To measure the absorbable phosphorus, total nitrogen and absorbable phosphorus, we used Walkley Black method, Kejeltak device and Olsen method, respectively. Soil potassium contents were determined using ammonium extractable in a Flame Photometer System. A pH meter system used to measure the acidity of samples in saturated mud. An electric conductor used in extracted samples showed the level of their EC. Finally, we used standard rings for appearance bulk density and soil texture analyzes.

Statistical analysis: The collected data analyzed using SAS software statistical program (SAS Institute, 1997). Factorial experiment in completely randomized design was used to analyze variance. After significance of variance, group mean comparisons were down by Student-Newman-Keules (S.N.K) test.

RESULTS AND DISCUSSION

Crown cover: Based on the Results of measuring three vegetation cover types, the highest crown closure percent for all species (85%) was related to the reference area, while the lowest crown cover percent (61.96%) was attributed to the critical area. Thus critical area showed a significant difference at 1% level with two other treatments of reference and key areas in terms of average crown cover percentage of all species (Fig. 1a). The highest coverage were related to the reference area (31.62%) while 12.14% of key area and 2.47% of critical area were covered by class I species ($p<0.01$ existed among these three areas in terms of class I vegetation cover. The highest percent of class II crown coverage (53.84%) was related to the key area as compared with two other reference (33.80%) and critical (11.24%) ($p<0.01$) existed among the areas. As far class III of vegetations, the critical and key areas showed the highest (47.7%) and lowest (19.7%) cover age, respectively (Fig. 1b-d).

Vegetation production: Results of measuring the production percents of several palatable species in different grazing treatments showed a significant difference ($p<0.01$) between critical and reference areas. No significant difference however existed between reference and key areas. Based on these finding the highest production volume was related to reference area (609.06 kg ha^{-1}) and the lowest one was attributed to critical area (174.16 kg ha^{-1}) (Fig. 2). The selected species to measure their production are as follows:

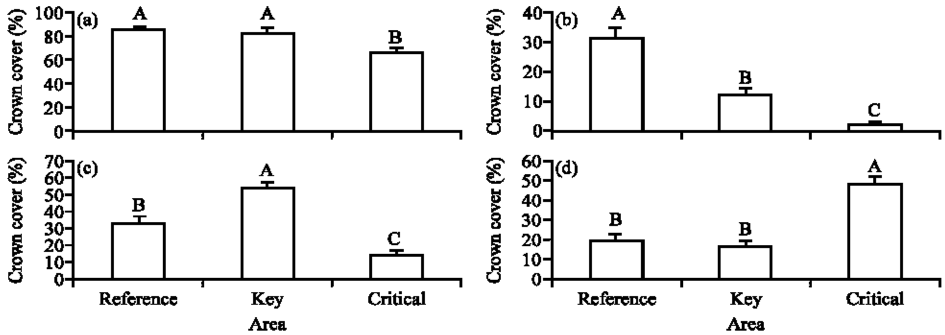

Fig. 1: (a) Crown cover percentage of all, (b) class I, (c) class II and (d) class III species in different grazing areas (p<0.01)

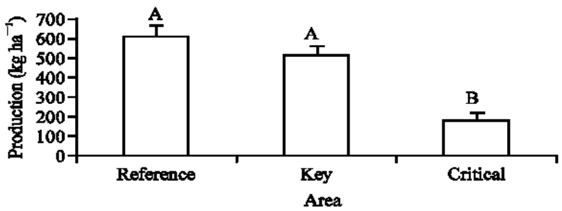

Fig. 2: Production related to several palatable species in different grazing areas (p<0.01)

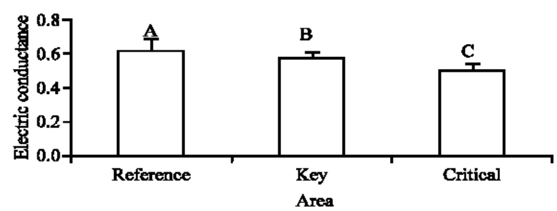

Fig. 3: E electrical conductivity of different grazing areas (p<0.01)

Table 2: Soil surface cover in different grazing areas

Area	Bare soil (%)
Reference	0.44^{B}
Key	1.36^{B}
Critical	22.56^{A}

Means with the same letter are not significantly different

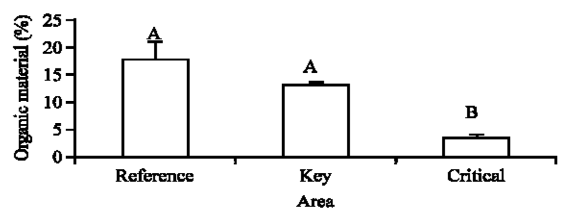

Fig. 4: Organic mater in different grazing areas (p<0.01)

Festuca ovina L., *Trifolium repons* L., *Plantago lanceoluta* L. *Ere mopoa Persia* T., *Dactylis* glomeratal L., *Onobrychis cornuta* L.

Soil surface cover: Inside and outside of reference area showed no significant difference in terms of their soil surface cover. Results of variance analysis revealed no significant difference between rock and gravel percentage of soil in three studying areas. The highest and the lowest percentage of bare soil were observed in critical (22.56%) and reference areas (0.44%), respectively. So that, average bare soil in critical area had a significant difference with key and reference areas (p<0.01) however, no significant difference was shown between average bare soil of key and reference areas (Table 2).

Enclosure effects on soil characteristics

Soil Electrical Conductivity (EC): The amount of EC in three areas in terms was varied (p<0.01) (Fig. 3) however there was no statistically significant difference between the first and second soil horizons. The reference area and the critical area showed the highest (0.78 mz cm^{-1}) and the lowest 0.4 mz cm^{-1} of EC.

Acidity (pH) and Organic Matter (OM): Soil acidity was not significant differed among three areas and among soil horizons. The highest percentage of soil acidity was measured in the reference area. Also the greatest amount of organic matter was seen in the reference (18.02%) and the lowest one was related to the critical area (3.6%) (Fig. 4); however organic matter in two soil depths was not varied.

Nutrients: Nitrogen of the critical area was significantly differed with reference and key areas at the 5% level (Fig. 5). However, no significant difference was found between the first and second soil horizons.

Based on the results of data analysis, there was a significant difference at one percent level between the reference area and other two areas in terms of average phosphorus of soil. The highest amounts of phosphorus had been existed in the reference area (33.67 mg kg^{-1}) and the lowest amounts of this element was measured in the critical area (8.45 mg kg^{-1}) (Fig. 6). The amount of soil phosphorus in two depths of soil showed no variations.

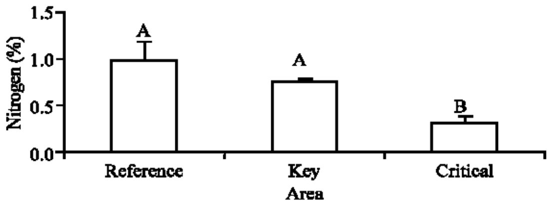

Fig. 5: Nitrogen percentage of different grazing areas ($p<0.05$)

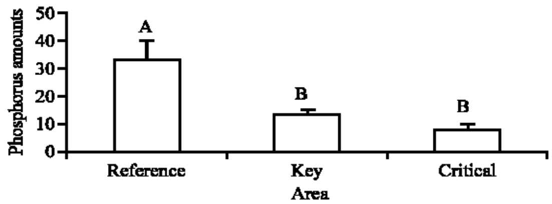

Fig. 6: Phosphorus amounts among different grazing areas ($p<0.01$)

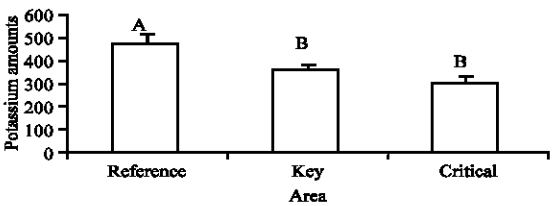

Fig. 7: Potassium amounts in different grazing areas ($p<0.01$)

Results of absorbable potassium showed the highest amounts in the reference area (480.75 mg kg^{-1}) and the lowest in the critical area (304.25 mg kg^{-1}) ($p<0.01$) (Fig. 7).

Bulk Density (BD) and texture: According to the results of data analysis, no significant difference existed neither among reference, key and critical areas nor among different soil horizons. Moreover, sand and clay percentages of soil in different grazing intensity and different soil horizons showed no significant difference. However the amounts of silt in key and reference area have showed that significant difference at the 1% level (Fig. 8). There was no statistical difference between the first and second soil horizons.

Effects of enclosure on vegetation cover: Based on the results of measuring the crown closure percentage related to different species in three studying areas, total crown cover of different species had been significantly increased both quantitatively and qualitatively inside the reference area. This increase is due to the adequate available moisture in the reference area; while grazing effects outside the reference area don't let all vegetations use the soil moisture.

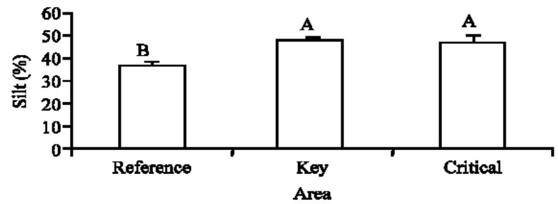

Fig. 8: Silt percentage in different grazing areas ($p<0.01$)

Fig. 9: Reference area (Type *Onobrychis cornuta* L.)

Grazing intensities and animal transit outside the reference area lead to reduce the vegetation cover and to increase bare soil and gravel percentages. Class I vegetations had the highest crown cover percentage inside the reference area. Class II vegetations constituted the largest crown cover in the key area. Heavy grazing intensities results in increasing class III vegetation species. Due to the excessive grazing, intensities water erosion, compacted soil by animals and have enough humus soil degradation, crown cover percentage of class I species was greatly reduced in the critical area. In addition, increased silt content of soil in the critical area comparing the closed area is an indicative of soil erosion in this area (Fig. 8). Shrub coverage had been increased since the grazing was prevented in the studying area.

The index vegetation type in the reference area was *Onobrychis cornuta* L. (Fig. 9). Low grazing decreased the shrub species such as *Onobrychis cornuta* L. in the key area; however, these species still remained the index species as the same as in the reference area (Fig. 10). In the critical area, the dominant species changed from *Onobrychis cornuta* L. to *Cirsium arvense* L. and *Onobrychis cornuta* L. due to the overgrazing operations and the resulted reduction of soil nutrients in this area (Fig. 11). These results are in accordance with Bastin *et al.* (2003) findings indicating that shrub densities were significantly decreased outside the reference area.

Fig. 10: Key area (Type *Onobrychis cornuta* L.)

Fig. 11: Critical area (Type *Cirsium* arvense L. *Onobrychis cornuta* L.)

In total high grazing intensities impose negative effects on the vegetation cover of the study area and eliminate the desirable species such as *Festuca ovina* L., Dactylis *glomerata* L., *Eremopoa persica* T., *Trifolium repens* L. and *Lotus corniculatus* L. Therefore, non-delicious, attacker and sharp species including *Onopordon heteracanthum* c., *Peteris critica* L., *Cirsium arvense* L., *Eryngium caeruleum* M. grow and increase in a better condition.

Kraaij and Milton (2006) obtained the same results in a 10-year enclosure showing the improved conditions of enclosure rangelands. According to Kauffman *et al.* (1983) productivity of desirable species in enclosure treatment is higher rather grazed area. Sinclair (2005) studied the vegetation cover of shrubberies after preventing livestock entrance. Results of his study showed that the vegetation cover was significantly increased. Kirkpatric and Bridle (2005) found that bare soil surface was increased in plots grazed by livestock. In addition lower amounts of tall shrubs existed in grazed areas by compared with enclosure area. But Noor *et al.* (1991), in a study of enclosure after six years at Banda Shah Kohat concluded that between mean productivity of grasses, forbs and shrubs in and out of enclosure was not significantly differed.

Effects of enclosure on soil characteristics

Electrical Conductivity (EC): Results of this study showed a significant reverse relationship between soil electrical conductivity and grazing intensity, i.e., by increasing the grazing intensity from reference toward critical area, soil electric conductance was decreased. The higher electric conductance in the reference area is due to their higher amounts of soil organic matters and vegetation cover as compared with two other treatments. In other words, heavy grazing intensities decreases the vegetation cover which results in more soil erosion and leaching and electric conductance in critical area than key and reference areas.

Organic Matters (OM): As it is shown in figure four, a negative relationship existed between the grazing intensity and soil organic matter. Organic matter decreases by increasing the grazing intensities. More amounts of organic matter in closed area possibly a result of its permanent vegetation cover; while the overgrazing processes in the critical area causes to decrease the organic matter. These results have agreement with the finding of Tukel (1984), Givi *et al.* (2001) and Mousavi (2001). This study was contradictory with Mohammadi *et al.* (2001) which resulted that the amount of organic matter in enclosure and critical regions was approximately equal.

Total Nitrogen (N): Soil nitrogen variation is the same as the changes in its content of organic materials. Grazing treatments lead to reduce the soil Nitrogen content (Fig. 5). As the grazing intensity increases, higher percentages of mineral soil nitrogen would get more inactive; therefore less amounts of dynamic exchanging nitrogen would be released (Sanadgol *et al*., 2002). In the other hand, areas which non-grazed by animals had higher soil nitrogen content due to their dense vegetation cover, particularly nitrogen stabilizing plants like legumes and large volumes of plant roots in their soils. These findings are in agreement with Dormaar *et al.* (1989), Frank *et al.* (1995), Dormaar and Willms (1998), Mousavi (2001), Mohammadi *et al.* (2001) and Sanadgol *et al.* (2002). These studies had also proved that soil nitrogen content decreases with heavy grazing treatments. Sharif *et al* (1994) concluded that between two treatments of heavy grazing and non-heavy grazing nitrogen content of soil was not varied.

Available phosphorus (P): There were abundant amounts of absorbable phosphorus in the soil of reference area however, by increasing the grazing intensities in other areas; this element had been gradually decreased as shown in Fig. 6. High amount of soil phosphorus in reference area may be due to the dominant positive effects of vegetation remains and high volumes of plant's organs. In general, soils containing more organic matter have more organic phosphorus content as well (Salardini, 1983). More vegetation remains, significantly increases soil phosphorus in reference area. Since when humus decomposes, phosphorus gradually releases in the soil (Nourbakhsh and Karimianeghbal, 1997). According to Zarrinkafsh (1988), soil contain organic and mineral phosphorus, soils having high amounts of organic matter contain higher has percentages of organic phosphorus in their surface horizon. Tukel (1984), Dormaar and Willms (1998), Mousavi (2001) and Mohammadi *et al.* (2001) have also reported the same result indicating higher percent of soil phosphorus in reference areas comparing with non-grazed areas. Sanadgol *et al.* (2002) studied short time impact of grazing on some soil properties in Haman Abesard in IR-Iran Rangeland Research Station showed that the amount of phosphorus in soil at continues grazing was greater than that of enclosure region.

Available potassium (K): Results of this study showed more soil potassium content in reference area. Grazing had negative effects on soil potassium content. Therefore, as we go toward the critical area soil potassium decreases (Fig. 7). Higher soil leaching rates caused in lower potassium content in critical area. Malakouti and Homaei (1994) expressed that potassium is cashed more easily than phosphorus from soil profile.

Outside the reference area, forage grazed by animals used soil potassium re-growth. This potassium reduction can be compensated by animal's excrements. This result is in accordance with findings of Sanadgol *et al.* (2002) and Mohammadi *et al.* (2001). Mousavi (2001) in study of enclosure after 13 years in semi-step of Semnan rangeland revealed that the amount of potassium at out of enclosure was more than that of in enclosure region.

Silt: Silt content of soil increased outside the reference area (Fig. 8) due to higher erosion of soil and lack of cohesion in silt (Refahi, 2000). Wischmeier and Mannering (1965) had also found that a little variation in silt content significantly change the soil texture component. This relation may be influenced by clay and organic soil percentages. A comparison between soils containing the same amounts of silt showed that the soil having more organic matter and clay content had been experienced lower erosion.

CONCLUSIONS

A five-year grazing prevention in the study rangeland led to increase the vegetation cover and the plants remain restoration into soil. Moreover, in reference area increased percentages of nitrogen, phosphorus, potassium, organic matter and electrical conductivity in soil surface. The reference area had a more desirable condition as compared with critical and key areas. Short time enclosures didn't influence on soil texture which is a perennial characteristic and it needs a long time to be affected. In some cases, differences in soil factors depended upon its natural conditions resulted from erosive, edaphic and geomorphologic operations. As the result of enclosing treatment, the rangeland was significantly improved in terms of its productivity and vegetation cover. Thus, as we progress from critical toward reference areas, class III and invader species were gradually disappeared and replaced by high quality palatable species. According to the results of this study, semiarid and humid areas had undergone greater changes in a shorter period comparing the dry climatic conditions due to availability of desirable palatable plant species. Adequate humidity and proper climatic condition in our study area, a short term enclosing treatment (5 years) imposed substantial improvement in productivity, vegetation cover and some of soil characteristics.

Some factors including adjacency to rural areas, located at lower slopes, less accessibility to water resources, overgrazing and continuous livestock traffic; soil and vegetation cover of the study area became more sensitive against heavy rainfalls and erosion. While the soils under dense vegetation cover in the reference areas are more resistant against rainfall made erosions even in steep slopes. Thus, the higher chemical and physical qualities of soils in the reference area could be attributed to its dense forage coverage.

REFERENCES

Ahmadi, A. and A. Sanadgol, 2007. Studying the effects of moderate grazing on rangeland condition and live stock production in Geladam Research Station, Salmas, Iran. Iranian J. Range Desert Res., 1: 80-87.

Ahmadi, Z., G. Heshmati and M. Abedi, 2009. Investigation the improvement operations affection on ecological indexes of rangeland health (Jahan Nama Garden, Golestan province). Iranian J. Range Desert Res., 16: 55-65.

Andrieu, N., E. Josien and M. Duru, 2007. Relatiinship between diversity of grassland vegetation, field characteristics and land use management. Agric. Ecosyst. Environ., 120: 359-369.

Bastin, G.N., J.A. Ludwing, R.W. Eager, A.C. Liedloff, R.T. Andison and M.D. Cabiac, 2003. Vegetation changes in semiarid tropical Savanna, northern Australia: 1973-2002. Rangeland J., 25: 3-19.

Brand, M.D. and H. Goetz, 1986. Vegetation of exclosure in Southwestern north Dakota. J. Range Manage., 39: 434-437.

Descheemaker, B., J. Nyssen, J. Poesen and R. Dirk, 2006. Litter production and organic matter accumulation in exclosure of Tigray highland, Ethiopia. For. Ecol. Manage., 233: 21-35.

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

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

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: 470-474.

Givi, J., J. Mohamadi and A. Asadi-Brojeni, 2001. The role of rangeland management in soil-water and vegetation cover conservations. Proceedings of 2nd International Seminar on Rangeland Management (ISRM'01), College of Natural Resources, Tehran University, Iran, pp: 292-296.

Hileman, B.J., 2008. Forage response to simulated sheep grazing of leafy spurge. M.Sc. Thesis, Montana State University. Bozeman, Montana.

Hoveizeh, H., B.M. Pour and H. Salehi, 2001. Studying the enclosure effects on rangeland conditions of khozestan. Proceedings of the 2nd National Seminar on Range Lands and their Management in Iran. (NSRLMI'01), College of Natural Resources, Tehran University, pp: 134-140.

Kassahun, A., H.A. Snyman and G.N. Smit, 2008. Livestock grazing behavior along degradation gradient in the Somali region of Eastern Ethiopia. Afr. J. Range Forage Sci., 25: 1-9.

Kauffman, J.B., W.C. Krueger and M. Vavra, 1983. Effects of late season cattle grazing of riparian plant community. J. Range Manage., 36: 541-548.

Khatir, S.J., 2007. Studying the vegetation cover changes in grazed and non-grazed areas of Chat rangelands at Gonbad, Iran. J. Wilerness Rang. Res., 26: 88-96.

Kirkpatric, J.B. and K.L. Bridle, 2005. Comparative effects of stock and wild vertebrate herbivore grazing on treeless sub alpine vegetation, eastern central plateau, Tasmania. Aust. J. Bot., 47: 817-834.

Kraaij, S. and J. Milton, 2006. Vegetation changes (1995-2004) in semi-arid Karoo shrub land, South Africa. J. Arid Environ., 64: 174-192.

Liu, S.L., F.Y.H. Lu and L.D. Chen, 2002. Effects of reforestation and deforestation on soil properties in humid mountainous areas: A case study in Wolong Natural Reserve, Sichuan Province, China. Soil Use Mmanage., 18: 376-380.

Malakouti, M. and M. Homaei, 1994. Soil Fertility in Arid Areas (Problems and Solutions). Publications of Tarbiat Modarres University, Iran, pp: 494.

Mesdaghi, M., 1998. Management of Iranian Rangeland. Emam Reza University Publication, Iran, pp: 259.

Mesdaghi, M., 2001. Vegetation Covers Analysis. Mashhad University Publication, Mashhad, Iran, pp: 287.

Moghaddam, M., 2000. Rangelands and Rangeland Management. Publication Institute of Tehran University, Tehran, Iran, pp: 470.

Mohammadi, J., F. Reisi and A. Asadi-Borojeni, 2001. Geostatic analysis of long term enclosure and intensity grazing on spatial variation of some soil properties. Proceedings of the 2nd International Pasture and Rangeland Seminar of Iran (IPRSI'01), Faculty of Natural Resources, Tehran University, pp: 157-164.

Mousavi, M., 2001. Studying enclosure effects on vegetation cover and soil changes in rangelands of Reza Abad, Semnan. Proceedings of 2nd National Seminar on Rangelands and their Management in Iran. (NSRMI'01), Colledge of Natural Resources. Tehran University, pp: 254-262.

Noor, M., M. Khan and G. Nabi, 1991. Effect of 6 years livestock exclusion on palatable range vegetation of Banda Sha Kohat. Pak. J. For., 41: 126-129.

Nourbakhsh, F. and M. Karimianeghbal, 1997. Soil Fertility. Ghazal Publications, London, pp: 299.

Refahi, H., 2000. Water Erosion Control. Tehran University Publications, Tehran, Iran, pp: 551.

Riginos, C. and J.E. Herrick, 2010. Monitoring Rangeland Health: A Guide for Pastoralists and Other Land Managers in Eastern Africa. Version 2, ELMT-USAID/East Africa, Nairobi, Kenya, pp: 96.

SAS Institute Inc., 1997. SASS/TAT User's Guide. Version 6, 4th Edn., SAS Institute Inc., Cary, NC, USA., pp: 1027.

Salardini, A., 1983. Soil Fertitily. Tehran University Publications, Tehran, Iran pp: 440.

Sanadgol, A., M. Moghaddam and M. Jafari, 2002. Effect of short term grazing on soil's physical and chemical characteristics in *Bromus tomentellus*. Iran. J. Nat. Resour., 55: 581-596.

Sharif, A.R., M.E. Biondini and C.E. Grrgiel, 1994. Grazing intensity affection litter decomposition and soil nitrogen mineralization. J. Range Manage., 17: 444-449.

Sinclair, R., 2005. Long-term changes in vegetation, gradual and episodic, on the TGB Osborn vegetation reserve, Koonamore, south Australia. Aust. J. Bot., 53: 283-296.

Tavakoli, H., 2001. Studying the vegetation cover and production percents in semidry rangelands under different management procedures. Proceedings of 2nd National Seminar of Rangelands and Rangeland Management in Iran (NSRRMI'10), College of Natural Resources, Tehran University, pp: 128-133.

Tukel, T., 1984. Comparison of grazed and protected mountain steppe rangeland in Ulukisla, Turkey. J. Range Manage., 37: 133-135.

Verdoodt, A., S.M. Mureithi, L. Ye and E. van Ranst, 2009. Chronosequence analysis of two enclosure management strategies in degraded rangeland of semi-arid Kenya. Agric. Ecosyst. Environ., 129: 332-339.

Wellstein, C., A. Otte and R. Waldhardt, 2007. Impact of site and management on the diversity of central European mesic grasslands. Agric. Ecosyst. Environ., 122: 203-210.

Wischmeier, W.H. and J.V. Mannering, 1965. Effect of organic matter content of the soil on infiltration. J. Soil Water Conserv., 20: 10-152.

Zarrinkafsh, M., 1988. Practical Soil Science. Tehran University Publications, Tehran, Iran, pp: 247.