Journal of Biodiversity and Environmental Sciences (JBES)
ISSN: 2220-6663 (Print) 2222-3045 (Online)
Vol. 4, No. 1, p. 39-46, 2014
http://www.innspub.net

RESEARCH PAPER OPEN ACCESS

Changes of chemical properties of soil in steppe and semi steppe Rangelands of Iran

Fariba Shahsavand[1*], Hossein Arzani2, Ali Tavili[2], Mohammad Jafari[2], Shahram Khaliqi Sygarudi[2]

[1]*1Department of Range Management, Science and Research Branch, Islamic Azad University, Tehran, Iran*

[2]*Faculty of Natural Resources, Tehran University, Tehran, Iran*

Article published on January 02, 2014

Key words: Climate,Soil, Steppe rangelands, Semi-stepperangelands, Iran.

Abstract

In this paper,soil chemicalchanges in the arid and semi-arid areas areinvestigated. So the characteristics such as PH, Electrical conductivity,Phosphorus,Potassium, Nitrogen, soil organic Carbon in the Steppe areas (Saveh) and Semi-steppe (Isfahan) were studied, that each district had three sites ranges. Data were collected and analyzed in a completely randomized design. Analysis of variance was used for generally comparisons and comparison of average treatment by Duncan's multiple range test was performed. Results indicate there were significant differences in all parameters between Semi-steppe and Steppe regions of the studied areas.So that there were the maximum amount of Phosphorus, Potassium, PH and Electrical conductivity in Steppe regions and the maximum amount of organic Carbon and Nitrogen in Semi-steppe regions. Accordingly, the climate can have a significant impact on changes in soil chemical properties.

***Corresponding Author:** Fariba Shahsavand ✉ shahsavand@yahoo.com

Introduction

Soil is one of the major factors of each eco system. Soil is the product of Climate and coverage vegetation on the rock or parent material. Soil is almost the main source of all necessary minerals for organisms growth. Physical and chemical properties of soil vary based on the climate and the coverage in which it produces. These characteristics have a great influence on germination, growth and pattern of plants distribution, so the change in the composition of vegetation in an area ,indicates changes off actors in which the plant is directly or indirectly affected by it .With regard to the important role of plants in ecosystem and different usage of it directly or indirectly by human beings, the necessity of the relation between plants and environmental factors specially soil can be an inevitable parameter, because with recognition of this kind of relationships; reasons of distribution , and density of coverage vegetation and habitats power can be determined.

There is a close relationship between the factors of soil and coverage vegetation parameters. Identifying these kinds of relations can play a major role in maintaining the coverage vegetation of catchment areas, soil and water conservation and erosion control.

Kosmas *et al.* (2000) during researches in the Lsvs area (Greece) concluded that among the factors that made the soil (PH, depth, EC, exchangeable Sodium and Potassium), soil depth is an essential factor inthe survival of perennial plants. Grongroft *et al.* (2003) in a study conducted on five sites in Namibia found that the two sites, due to the high amount of soil`s PH and their PH variability in relation to other habitats, species diversity are more. While in these habitats, soil sand content is lower than in other habitats.

Jafari *et al.*(2003) in investigating the effects of environmental factors on the distribution of vegetation types in the mountain ranges of Yazd concluded that soil characteristics such as salinity, texture, Potassium, Gypsum and Lime are effective in plants distribution. Jafari *et al.* (2002) showed that the most important effective soil properties in separation of rangeland vegetation types of Poshtkuhin Yazd are; electrical conductivity, texture, Potassium salts, Gypsum, and Lime, and each plant species due to habitat conditions, ecological demands and scope tolerance is associated with some soil properties. Tahmasbi (2003) in a study on the relationship between vegetation and soil factors, came to this conclusion that among the factors of soil; Phosphorus, Clay, PH and EC had the highest effect on canopy coverage and plant species. The purpose of this article is to study chemical properties of soil in Steppe and Semi-steppe areas and recognition of climate role on changes of chemical properties of soil.

Materials and methods

Study area

Stepperangelands

Studied areas are located in 60 km northeast of Savehin Markazi province, east of lengths between 50° and 36° to 50° 45´ north latitudes and 35°24´and 35° 32´. According to the long-termstatic in Sinoptic station in Saveh the average annual precipitation and mean annual temperature are 200 mm and 19°c respectively. The climate of area based on Domarten classification is ultra cold dry desert. The average height of area is 1325 meters above sea level and the soil`s kind is sandy clay loam. Study areas include:

Kachalu Range

The siteis located in 65 km of East of the city. The average height of the area is1125meters above sea level and the average annual precipitation is about 152 mm in accordance with Domarten`s classification. Vegetation type in this area is *Stipabarbata-Artemisia sieberi* and can be accounted as winter pasture.

Nemati Range

This rangeland is part of winter pastures and for 6 months per year is grazed as rest-rotational with moderate grazing intensity. *Artemisia sieberi – Salsolalaricina* is the main type in this rangeland.

Mid May is the time of entering of livestock to this area and the time of exiting is early November.

Khoshkrud Range

The site is located in 56 km North East of Saveh city. The average height of area is 1405 meters above sea level and the average annual precipitation is about 190 millimeters per year which based on Domarten`s classification the climate is dry desert. Vegetation type in this area is *Noaeamucronata-Hultemiapersica* and can be accounted as winter pasture.

Semi-steppe rangelands

Vardasht Range

This site is located in Semirom Sefli around Isfahan city longitude 51°, 39′ and 1′of latitude 31° 36′30 ″actually. The average height of area is 2,503 meters of sea surface level. And the average precipitation is 491 mm. The dominant vegetation type is *Scariolaorientalis-Bromustomentellus* and is among the ranges with average temperature. The extent of this type of area is 4590 hectares. Sheep and goat are the dominant livestock, and the dominant race in this area is Turkic Qashqai. Soil texture is sandy clay and it has granular structure.

Pashmakan Range

This site is located in Semirom Olia one of Isfahan`s city with latitude 51°, 30′and 14″in length east and latitude 31°, 23′and 38″north. The average height of the area is 2900 meters above sea level and the average precipitation is 681 mm. Dominant vegetation type of this area is *Astragalussusianus-Bromustomentellus* and can be accounted as rangeland with medium temperature. This type includes 40,500 hectares measurement in the province which includes the 6 % of pastures(ranges) of province. Sheep is the dominant livestock and also there are a few numbers of goats in cattle. The dominant race of sheep in this area is the Turkic Qashqai. The soil texture in most of the area is sandy clay loam with Limestone formations. The amount of Lime in underground part is high but it is not a limiting factor.

Akhcheh Range

This site is located in Feridounshahr longitude 50° east and latitude 33°1′ and 36″ and 2′and 18″ north. The average height of area is 2800 meters above sea level and the average precipitation is 624 mm. The dominant vegetation type is *Scariolaorientalis-Cousiniacylindracea* and is among low-grade pasture. This type includes 1510 hectares measurement in the area and includes the 02/0% of pastures (ranges) of province. Sheep and go at are the dominant live stock and dominant race is Lori-Bakhtiari sheep.

Materials and methods

To investigate the changes of soil parameters in the Steppe and Semi- steppe areas four transects with 400 length intervals with 100 m were considered together .Soil samples were taken at the depth of 0-20 cm as random-systematic along transects. Soil samples were dried in an oven at 105°C for 24 h, and ground, the passed through a 2mm sieved to get 2 mm fractions. Soil chemical properties including organic carbon (OC), total nitrogen (N), total phosphorus (P), potassium (K), pH, EC were measured. The OC% was determined according to the Walkley and Black (1934) method, and total N was determined using the Kjeldahl procedure (Bremner and Mulvaney, 1982). Available phosphorus (P) was analyzed according to Olsen et al. (1954). Soil potassium (K) content was determined by normal ammonium acetate method. Soil pH and electrical conductivity (EC) were determined (saturated paw method, AFNOR, 1987) by pH meter and conductivity meter, respectively. One way Anova was used to analyze the variance. We used Duncan test to perform comparisons. All the data was run using SAS software statistical program.

Results and discussion

Phosphorus

Data analysis showed that the amount of this element in various climatic zones is different and it is

significant at the 1% level. The average amount of phosphorus in the Steppe areas is 81/11 and in the Semi-steppe areas is 8/10 (Figure 1). These results indicate that the amount of this element in the Steppe areas is more than this amount in Semi-steppe areas. One reason for this could be overgrazing in Steppe areas. This range as Gheshlaghi ranges (winter pasture) is strongly grazing by livestock specially by cattle. Increasing phosphorus can be because of accumulation of animals` waste in theseareas. Haynes and William (1993) stated that more than 65% of the P in the diet consumed by cows is returned as faeces to pastures. Soil P increase has been reported under manure (Williams and Haynes, 1993 and During and Weeda, 1973).

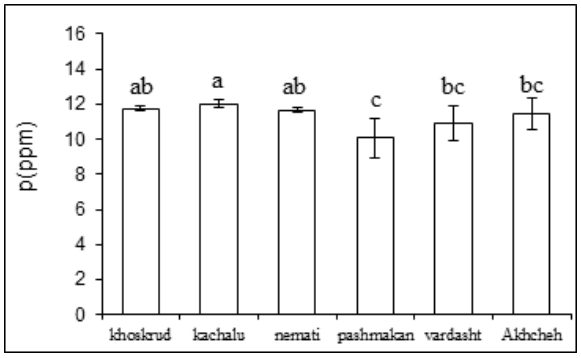

Fig. 1. The rate of phosphorus in steppe and semi steppe region.

However Hosseinzadeh *et al.* (2010) and Garcia *et al.* (2011) ascertained that amount of phosphorus in ungrazed area was higher than the grazed area. The increase may have been due to the effect of climate conditions and soil fertility. El-Dewiny *et al.* (2006) stated that causing the degradation of organic matter, large amounts of available phosphorus are released. Subsequently, the availability of Phosphorus of the area with high vegetation is greater than that of the area with higher grazing intensity and less organic matter.

Potassium

Data analysis showed that the amount of this element varies in different regions and is significant at the 1% level. There is the maximum amount of potassium in the Steppe area and the site Kachalu (492ppm), respectively. Pashmakan site on Semi-steppe area has the least amount of potassium (324ppm), respectively (Fig. 2).

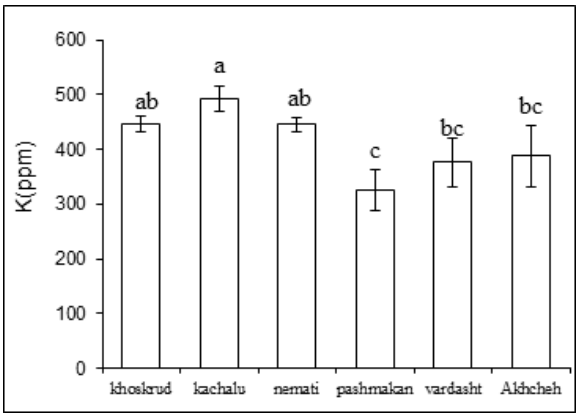

Fig. 2. The rate of potassium in steppe and semi steppe region.

One of the reasons of increasing the amount of Potassium in Steppe areas can be low percentage of vegetation coverage in these areas, because soil`s Potassium can be used in a low range by plants, so this factor is one of the main factors in Potassium increase.

Positive effect of livestock on soil`s Potassiumthrough traffic and livestock waste in these pastures like Phosphorus is of another reasons, for increasing the amount of Soil`s Potassium in Steppe areas. Also decreasing the amount of Potassium in Steppe areas can be due to increasing the usage of this element by the large amount of vegetation in the area. In the other hand Zhan-Bin and Qing-Yi (2013) reported that the potassium concentration significantly increased in the first two years of vetch plant. But Three years after vetch planting, Potassium density at 0-20 cm soil layer was significantly lower than that from non-vegetated field sites, which could be attributed to high plant uptake.

Nitrogen and soil organic Carbon

The results of the analysis of variance showed that there is a significant difference in the Steppe and Semi-steppe regions. The most amount of Nitrogen is in Akhcheh site (0.106)of Semi- steppe region and the lowest amount in Kachalu site (0.023) of Steppe area.

Semi- steppe areas significantly has high amount of Nitrogen. In areas which precipitation is high and there is more vegetation coverage decomposition of organic matter is more, so there will be more Nitrogen. Also in areas where there is Legomynoz tribe Nitrogen is greater. Data analysis showed that organic Carbon amount in Semi-steppe and Steppe areas under study was different and is significant at 1% (Figure 3). The most amount of organic Carbon is in Akhcheh (Semi-steppe) and the lowest amount in theKachalu (Steppe area), respectively. The amount of organic Carbon in Semi-steppe area varies from 0.773 to 0.036 and in Steppe area from 0.302 to 0.351 respectively (Fig. 4).

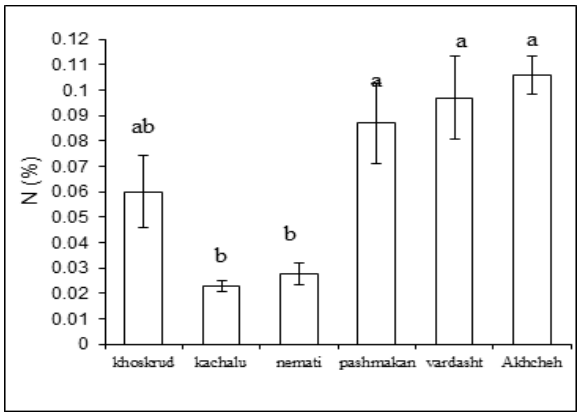

Fig. 3. The rate of nitrogen in steppe and semi steppe region.

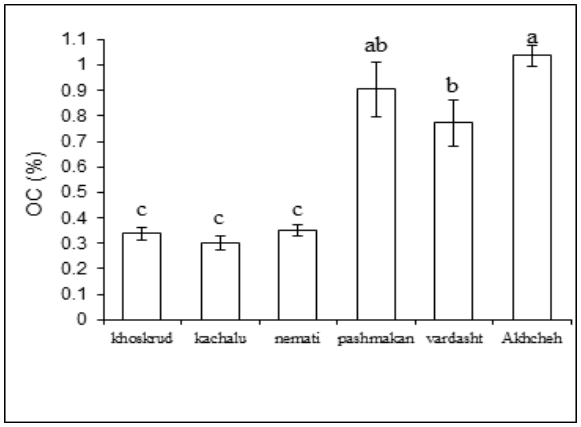

Fig. 4. The rate of organic carbon in steppe and semi steppe region.

Loss of soil organic matter can be due to drought and increasing soil temperatures (Schuman *etal.*2009). Also, according to (Jones and Donnelly, 2004) environmental conditions such as drought and climatic changes can affect on soil Carbon amount. Based on a lot of studies, low percentage of vegetation coverage and reducing primary production causes reducing organic matter back into the soil (Huong *et al.* 2007, Pie *et al.*, 2008, Kumbasil *et al* ., 2010) , which consequently reduces litter and changes in the abundance of legumes and cause changes in Nitrogen stabilization. Also decreasing plants underground organs(parts), decrease Nitrogen and Carbon entrance from root to soil(Pin ~ eiro *et al.*, 2009). Also, Zhan-Bin and Qing-Yi (2013) stated that Nitrogen stabilization by butterfly species and Biomass returning of this plant to soil makes total Nitrogen and organic matter in the soil increases. Al-Sheikh *et al.* (2009) observed that the amount of organic Carbon in Semi –steppe is more than arid area. They stated that such differences can be due to changes in precipitation amount. Sarah (2004) reported organic matter amount varies from 1.5% to 6% of the arid area to Mediterranean area.

Soilacidity

According to the data analysis there is significant differences in amount of soil PH between Semi-steppe and Steppe areas under study. The results indicate that the climate has effect on soil PH. The average amount of PH in Steppe area is 8.05andin Semi-steppe area it is 7.66 (Figure 5). In areas which precipitation is greater due to the deep movement of solute the soil pH is lower. In arid areas which evaporation from the soil surface is high solute rises to the soil surface.

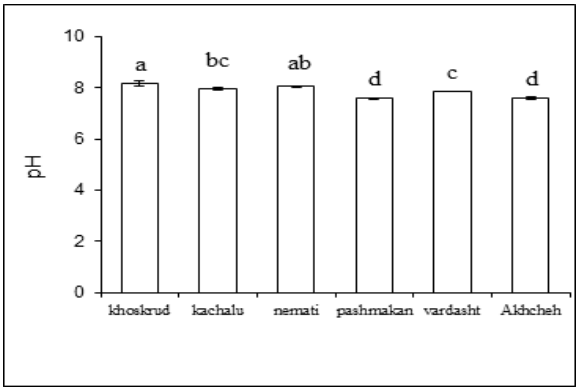

Fig. 5. The rate of pH in steppe and semi steppe region.

Javadi *et al.* (2005) and Hosseinzadeh *et al.* (2007) believes the relationship between organic Carbon content and pH amount is one of the reasons for the decrease of soil pH in areas with high vegetation coverage, which by increasing organic matter in the soil of these areas has been the reason for production of Carbonic Acid. But the permanent production of it in a soil with high root density may dissolve lime and leach it from the soil. Going Lime out of the soil reduces soil acidity. Kohandel *et al.* (2007) and Al-Sheikh *et al.* (2009) also mentions to the alignment of soil acidity and Nitrogen.

In this research as mentioned before significantly the organic matter of soil in Semi-steppe areas is much more than Steppe areas and based on above mentioned reasons it is expected that soil acidity be much more in Steppe areas.

It seems the soil acidity is not dependent on organic matter, and it may be dependent on the Carbon content and parent materials. Khresat & Taimeh, (1998) observed that acidity increases with increasing Calcium Carbonate. In addition, Moradi *et al.* (2008) observed a negative relationship between coverage percentage and soil pH, and they stated that PH is related to the parent material and the changes that occur during the formation. During different researches which have been done it is obvious that sloping areas have a strong correlation with precipitation. In mountainous and sloping areas due to lower feeding of livestock, vegetation coverage is much more than the other parts.

Electrical conductivity

Based on the results there are significant differences between Steppe and Semi-steppe areas considering conductivity. The highest amount of electrical conductivity is in Kachalu (Steppe) with 0.407 and the lowest amount of it is in Akhcheh (Semi-steppe) with 0.175 (Figure 6). The rate of Soil`s ECisa function of solution temperature. With increasing one degree Celsius (temperature between15 to35degrees) it increases 2 percent. Usually, high temperature and low environmental humidity causes relative humidity and increases evaporation, so the salt comes from the bottom to the top surface which this quality is dominated in hot and dry climates.

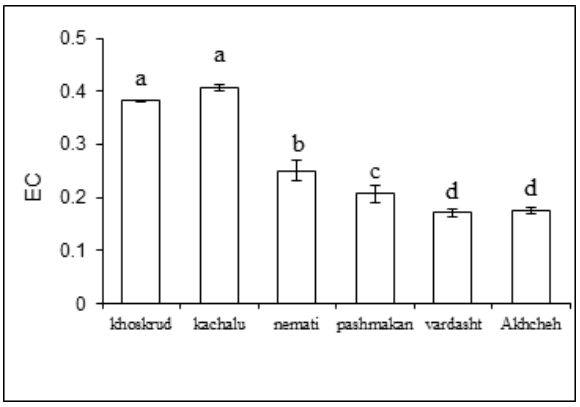

Fig. 6. The rate of EC in steppe and semi steppe region.

Moradi *et al.*(2008) declared EC is one of the most effective factors on density of most species. In fact, this factor has the most percentage of changes on canopy coverage and density of plants species which is based on Hodgkinson (1987) and Tahmasbi (2003) final results. Bowman *et al.*(1985) in their studies about density, get to the same results.

Conclusions

The study on chemical properties of soil for determining the type and amount of forage and pasture management which is appropriate for that area is of great importance.

References

Al-Seekh A, Mohammad A, Amro Y. 2009. Effect of Grazing on Soil Properties at Southern Part of West Bank, Rangeland. Hebron University Research Journal. 35 – 53.

Bowman RA, Mueller DM, McGinnis WJ. 1985. Soil and vegetation relationship in a central plains salt grass meadow. Journal of Range management **38**, 325-328.

During C, Weeda WC. 1973. Some effects of cattle dung on soil properties, pasture production, and

nutrient uptake. I. Dung as a source of phosphorus. N. Z. J. Agric. Res. **16**, 423-430.

El-Dewiny CY, Moursy KHS, El-Aila HI. 2006. Effect of organic matter on the release and availability of phosphorus and their effects on spainch and radish plants. Research Journal of Agriculture and Biological Sciences **2**, 103-108.

Garcia M, Sampaio A, Nahas E. 2011. Impact of different grazing systems for bovine cattle on the soil microbiological and chemical characteristics. R. Bras. Zootec **40**, 1568-1575.

Grongroft A, Petersen A, Miehlich G. 2003. Edaphical diversity and biodiversity in mutual dependency, Project ID,01LC0024, Biota Africa SO2.

Haynes RJ, Williams PH. 1993. Nutrient cycling and soil fertility in the grazed pasture ecosystem. Adv. Agron **49**, 119-199.

Huang D, Wang K, WL. Wu. 2007. Dynamics of soil physical and chemical properties and vegetation succession characteristics during grassland desertification under sheep grazing in an agro-pastoral transition zone in Northern China. Journal of Arid Environment **70**, 120-136.

HosseinzadehG, Jalilvand H, Tamartash R. 2010. Short time impact of enclosure on vegetation cover, productiveity and some physical and chemical soil properties. Journal of Applied Science **10**, 2001-2009. (in Persian).

HodgkinsonHS. 1987. Relationship of saltbush species to soil chemical properties, Journal of Range management **40**, 23-26.

JonesMB, Donnelly A. 2004. Carbon sequestration in temper ate grassland ecosystems and the influence of management, climate and elevated CO2.New PhytoZ **164,** 423–439.

Jafari M, ZareChahouk M, Tavili A, Azarnivand A, ZahediAmiri H. 2003 . Effective environmental factors in the distribution of vegetation types in Poshtkouh rangelands of Yazd Province, Journal of Arid Environments, 15.(in Persian).

Jafari M, ZareChahouki MA, Azarnivand H, Baghestani N, Zahedi Amiri GH. 2002. Relationships between Poshtkouh rangelands vegetation of Y azd province and soil properties using multivariate analysis methods. Iranian Journal of Natural Resources **55**, 433-450. (in Persian).

Javadi SA, Jafari M, Azarnivand H, Alavi SJ. 2005. an Investigation Of The Grazing Intensity Effects On Variations Of Soil Organic Matter And Nitrogen In Lar Rangeland Iranian Journal Of Natural Resources **58**,711-718.(in Persian).

KumbasliM, Makineci2 E,CakirM. 2010. Long term effects of red deer (Cervuselaphus) grazing on soil in a breeding area. Journal of Environmental Biology **31**, 185-188.

Khresat SA, Taimeh AY. 1998. Properties and characterization of Vertisols developed on limestone in a semigarid environment. Journal of Arid Environment **40**, 235-244.

Kohandel A, Arzani H, Tavassol M. 2009. The Effects of Different Grazing Intensities on Nitrogen, Phosphorus, Potassium and Organic Matter in Step Rangelands.Jwmseirn **3,** 59-65. (in Persian).

Kosmas C, Gerontidis ST, Marathianou M. 2000. The effect of land use change on soil and vegetation over various litho logical formation on Lesvos(Greece), Catena **40**, 51-68.

Liebig MA, Gross JR, Kronberg SL, Hanson JD, Frank AB, Phillips RL. 2006. Soil response to long term grazing in the northern Great Plains of

North America. Agriculture, Ecosystems & Environment **115**, 270-276.

Moradi HR, Mirnia SK, Lahorpori S. 2008. Effect of Grazing Intensities on the Soil physical properties and Vegetation cover of Charandoo Summer Rangelands in Kurdistan Province, Iranian Journal of Range and Desert Research **15,**(in Persian).

Pin˜eiroG, Paruelo J, Jobba´gy E, Jackson R, Oesterheld M. 2009. Grazing effects on belowground C and N stocks along a network of cattle exclosures in temperate and subtropical grasslands of South America. GLOBAL BIOGEOCHEMICAL CYCLES **23**, GB2003, doi:10.1029/2007GB003168

Sarah P. 2004. Special pattern of soil moisture as affected by shrubs, in different climatic conditions. Environmmental Monitoring and Assessment **73**, 237-251.

Schuman GE, Ingram LJ, Stahl PD, Derner JD, Vance GF, Morgan JA. 2009. Influence of Management on Soil Organic Carbon Dynamics in Northern Mixed-Grass Rangeland. Soil Carbon Sequestration and the Greenhouse Effect, 2nd edition. SSSA Special Publication 57.

Tahmasebi A. 2003. Stady of Vegetation Cover and Soil in Reiation to Geomorphology Units Watershed using GIS. Thesis submitted for M SC. Tarbiatmod ares University. 67. (in Persian).