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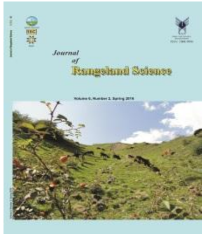

Research and Full Length Article:

Impacts of Land Use Changes on Soil Carbon and Nitrogen Stocks (Case Study: Shahmirzad Lands, Semnan Province, Iran)

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Abstract. Soil carbon and nitrogen contents play an important role in sustaining soil physical and chemical quality and lead to healthy environments. Conversion of rangelands to arable lands might change carbon and nitrogen sequestration. In order to evaluate the effects of land use changes on soil Organic Carbon (OC) and Nitrogen stock (N), forty soil samples were collected from four depths in two sites of rangelands (*Astragalus parrowianus* and *Acantholimon erinaceum*) and one site of walnut garden in north west of Shahmirzad, Semnan province, Iran. The soil properties were measured as gravel percent, particle size distribution, bulk density, OC and N. Results of analysis of variance showed no significant difference of soil OC among garden and rangelands but there was a significant difference for N and higher values were obtained in the garden site. The C/N ratios were similar in both rangelands and they were significantly higher than that for garden. Moreover, the values of OC, N stock and C/N ratio were lower in subsurface layer of soils. The correlation between traits indicated that the values of OC, N and C/N ratio had a significant correlation with soil particle size distribution. Both N and OC stock were positively correlated with clay, soil N content, soil OC and negatively correlated with sand%, silt%, gravel and bulk density. It was concluded that by land use changes from rangeland to garden, the OC values were constant; the C/N ratio were decreased whereas the soil N values were dramatically increased.

Key words: C/N ratio, Land use change, Shahmirzad town, Soil Organic Carbon (OC) stock, Soil total nitrogen (N) stock

Introduction

Human life on earth particularly in the recent decades has drastically changed the earth surface including degradation of rangelands and forests in wide areas and development of dry farming lands (Mahdavi, 2007). Soils play many important roles in carbon and nitrogen cycles and accumulation including approximately 75% Organic Carbon (OC) and 95% Nitrogen (N) (Schlesinger, 1997).Pasture provides a quick way to build carbon for two reasons: first, where perennial plant species are used, plants are growing continually rather than seasonally; second, Minimal disturbance related to cropping and third, No erosion, if well managed (Kirkegaard *et al.*, 2007).

Concentrations of OC and N are good indicators of soil quality and productivity due to their favorable effects on physical, chemical and biological properties (Bauer and Black, 1994). Soil N concentration and its availability influence world productivity directly. Soil OC sequestration is gaining global attention because of the growing need to offset the rapidly increasing atmospheric concentration of carbon dioxide (CO_2). This carbon dioxide enrichment is associated with an increase in global warming potential and changes in the amount and effectiveness of precipitation (Lal and Follet, 2009). The increase in N_2O atmosphere concentration is directly associated with large-scale human interference in the N cycle which is largely affected by agricultural activities (Prather *et al.*, 1995). As the tropical ecosystems are converted to agriculture, pasture or silviculture, there is an increasing potential for tropical soil N_2O emission to become more significant (Duxbury, 1994). Therefore, understanding soil carbon and N storage potential and developing effective methods to decrease the atmospheric CO_2 and N_2O concentration are essential (Fu *et al.*, 2010). The soil C/N ratio is a soil fertility indicator due to the close relationship between soil OC and N. The soil C/N ratio is often influenced by many factors such as climate (Miller *et al.*, 2004), soil conditions (Ouedraogo *et al.*, 2006), vegetation types (Diekow *et al.*, 2005; Puget and Lal, 2005) and agricultural management practices (Zhang *et al.*, 2009).

Soil particle size distribution protected soil organic matter from being decomposed by physical, chemical and biological mechanisms (Krull *et al.*, 2003). According to some evidence, clay concentration affects OC accumulation in different ratios. It was found that maximum and medium OC increased with increasing clay content in soil (Burke *et al.*, 1989).

Land use involves the management and modification of natural environment or wilderness into built environment such as settlements and semi natural habitats such as arable fields, pastures and managed woods. It has been defined as the arrangements, activities and inputs that people undertake in a certain land cover type to produce, change or maintain it (FAO, 1997).

Land use change is considered as the second greatest cause of carbon emissions after fuel consumption (Watson *et al.*, 2000). Land use change has contributed to soil degradation and soil loss leading to a decrease in soil carbon storage worldwide (Eaton *et al.*, 2008). Long term experimental studies have confirmed that OC is highly sensitive to Land use changes (Smith, 2008). Thus, even a relatively small increase or decrease in soil carbon content due to the changes in land use or management practices may result in a significant exchange of carbon between the soil carbon pool and the atmosphere (Houghton, 2003). Recently, it has been shown that soil erosion by water and/or tillage has a significant impact on this large pool of OC (Lal, 2003; Van Oost *et al.*, 2005).

Although increasing attention is given to the change of carbon in global vegetation and soil because of "greenhouse effect", the dynamics of soil nitrogen following land use changes and the relationship between soil carbon and nitrogen are two important ecological research focuses (Yang *et al.*, 2004).

Some studies have been done to survey the result of land use changes from natural lands and pastures to agricultural and arable lands on variation of carbon and nitrogen stocks. They investigate long term impacts of land use changes on the dynamics of tropical soil carbon and nitrogen pools and their results show that soil OC and N in surface soils in shifting cultivation and rubber tree plantations decreased significantly as compared to secondary forests. Moreover, they indicated that C and N losses were mainly occurred in 0-20 cm surface soil, followed by 20-40 cm layer (Yang *et al.*, 2004). Parras-Alcantara *et al.* (2013) compared arable crops, olive grove and vineyards and showed that conversion from arable crops to vineyard and olive grove involved the loss of OC stock and the loss of N stock. Regarding stratification ratios after 46 years, land use changes showed the opposite effects. Their findings indicated that when site history was controlled by considering only pastures formed directly from cleared forest, carbon and nitrogen accumulation was the dominant trend in pasture soils. Absence of a correlation between carbon and nitrogen accumulation and soil texture suggested that site history management may be more important than soil type as the determinants of direction and magnitude of changes in soil OC and N stocks (Neill *et al.*, 1997). Jafarian *et al.* (2013) compared soil physical and chemical properties in grassland and shrub land communities of Iran and concluded that soil condition in the shrub land was more desirable than grassland because there was a greater percentage of vegetation and grazing intensity was less. Climate, land use and management are highly influential in carbon variability in Spanish soils (Munoz-Rojas *et al.*, 2012; Ruiz *et al.*, 2012) mainly in semiarid regions characterized by low levels of soil OM content (about 10 g kg^{-1}) (Acosta-Martinez *et al.*, 2003). Soil depth has a decisive influence on OC stocks (Gruneberg *et al.*, 2010). Nosetto *et al.* (2006) explored the possibilities of semi-arid ecosystems to sequester carbon by the means of rangeland exclusion and afforestation with *Pinus ponderosa* in Argentina. After 15 years, since trees were planted, carbon gains in the afforested stands were higher than below-ground. Root biomass differences explained below-ground carbon contrasts whereas soil OC showed no differences with afforestation. Also, grazing exclosures did not result in significant changes in the OC storage in comparison with the adjacent grazed stands suggesting a slow ecosystem recovery in the time frame of this study. Moreover, neither soil OC nor root carbon showed significant differences between the grazed and non-grazed conditions.

The aim of present research was (i) to determine the OC, N and the C/N ratio in different types of land uses and their variation; (ii) to study the vertical distribution of OC, N and the C/N ratio in different depths of soil layer; (iii) to determine the most effective factors with the highest correlation on OC, N stocks and the C/N.

Materials and Methods

Study area

The study area comprises 700 ha located in the northeast of shahmirzad town in Semnan province, Iran (35°46′22″N 53°19′43″E) (Fig. 1). The range of altitude above sea level is 2300 to 2900 m. The mean annual temperature is 9.5°C, annual precipitation is287 mm and the humidity is variable between 58 till 79%.The climate was arid with Xeric soil moisture and Mesic temperature regime of important parts of the plain. An Aridic soil humidity regime is seen in parts of plain (Soil Survey Staff, 1996). largest of its kind (*Juglans regia*, literally "royal walnut") in the world (FAO, 2011).

The history of land use changes from rangelands to walnut garden returned to 1988. Rangelands contained *Astragalus parrowianus* and *Acantholimon erinaceum* vegetation types with high density of *Astragalus* in most of the area, especially in the eastern part (Fig. 2). The study area divided in to three plots with different vegetation and cover (*Astragalus*, *Acantholimon* and garden) and to survey the soil description in each plot and develope layer recognition, soil profiles with ten replications in each land use were taken to indicate the variation of soil OC and N stock with depth. Soil profile description showed that there were no evidence of existence of organic matter and developed layer up to 100 cm depth in each plot, especially in rangeland soils.

Laboratory analysis

Soil samples were taken from four depths of 10 profile of each land use (0-25, 25-50, 50-75 and 75-100cm). The samples were air dried and sieved through a 2 mm mesh for chemical analysis. The samples were treated with H_2O_2 and sodium acetate 1N to remove organic matter and calcium carbonate in particle size distribution test using Bouyoucos hydrometer method (Bouyoucos, 1962). The fraction of particles with a diameter greater than 2mm was determined by wet sieving. Soil bulk density analysis was done using a steel cylinder which is 4 cm in diameter and 5 cm in height (Blake and Hartge, 1986). OC was determined by wet oxidation with dichromate according to the Walkley and Black system (Walkley and Black, 1934). N was determined using the Kjeldahl method (Bremner, 1996). The soil C/N ratio was calculated by dividing OC (grkg^{-1}) by N (grkg^{-1}). The OC and N stock (Mg ha^{-1}) were calculated for each horizon according to Wang and Dalal (2006) as follows (Equation 1):

Most of soils are alkalin with high depth, low slope and the average infiltration. The shahmirzad garden is noted by the UN and FAO as the

$$OC,Ntock = OC,N_{Concentration} \times BD \times d \times (1 - \delta_{2mm}\%) \times 0.1 \quad \text{(Equation 1)}$$

Where

d= the thickness of soil layer (cm),

δ_{2mm}= the fractional percent (%) of more than 2mm in the soil,

BD = the bulk density (g cm^{-3})

The collected data were subjected to one-way analysis of variance (ANOVA). Means comparison was made between land use practices using Duncan method and also between soil depths of layers for each land use. Pearson correlations between pairs of traits were calculated. SPSS version 13 (SPSS Inc, 2004) was used for the analysis of data.

Fig. 1. The study area of Walnut garden and contiguous rangelands

Results

Descriptive statistics of mean values of soil properties in the rangelands (*Acantholimon* and *Astragalus*) and garden (walnut) communities are presented in Table 1. The principal properties of these soils showed high values of particles with a diameter greater than 2mm (gravel) in both study areas, especially in pastures that are not plowed and cultivated. Soil particle size distribution results showed loamy sand

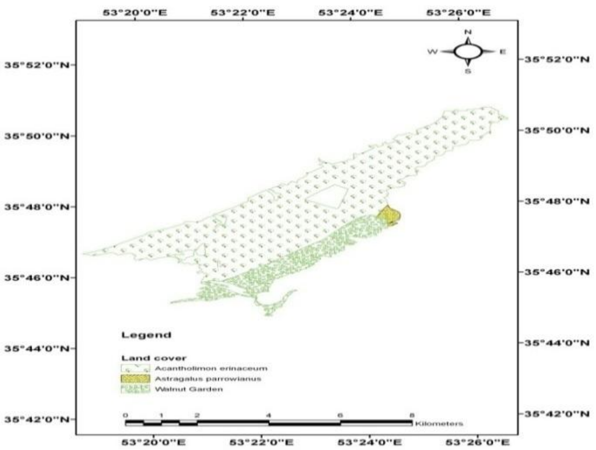

Fig. 2. The land cover map of study area

soil texture with high values of sand and low percent of clay in most of soils. Bulk density values depend on soil texture and OC content indicating high values of bulk density in the study area. The soil OC content was very low (<5mg kg^{-1}) in rangelands and agricultural lands that can determine the unsuitable agricultural management besides the weather and soil conditions in the arable lands. The most important factors that can protect soil N from leaching and ammonia evaporation are clay and OC content. The lack of these parameters in the study area resulted to low value of N content even in garden land using nitrogen fertilizers for better growing.

The soil OC contents were ranged between 1.98 and 4.9 g/kg and its content in all types of lands was low and there was no significant difference between total soil OC values in different types of land use (Table 1). The N values changed from 0.11 to 0.33 g/kg and was the lowest in *Astragalus* type while garden lands showed the maximum level (Table 1). The N content with increasing depth has been decreased, especially from first surface layer to below ones (Table 1). The C/N ratio is dependent on OC and N content and despite the lack of OC and N, it showed high values of it in rangelands and moderate values in gardens. The variations of C/N ratio were ranged from 12.08 in garden land up to 27.86 in *Astragalus* type and their values in different depths after a significant increment in first surface layer were similar except second depth of *Astragalus* type (25-50cm) that showed the highest accumulation of C/N rather than different depths and land uses (Table 1). The means comparisons of soil properties between different types of land uses and soil layers are presented in Table 2. The results showed that the values of OC stock have a significant decrease with increasing depth. *Acantholimon* rangeland with the average values of 18.57 indicated the highest amount of OC stock in different types of land uses and soil layers in the study area (Table 2). The values of soil N stock in walnut garden indicated higher values than *Acantholimon* and *Astragalus* rangelands, respectively. These contents were decreased in subsurface layers of soil (Table 2). *Astragalus* rangeland demonstrated higher values of C/N ratio stock than *Acantholimon* rangeland and walnut garden, respectively. The value of C/N stock in second layer of *Astragalus* rangeland (25-50 cm) was more than the other layers. Unlike this, in all cases, the values of C/N ratio stock were decreased in below layers in different land uses (Table 2). The correlation matrix between the measured soil characteristics and OC, N stock and C/N is represented in Table 3. The results showed that both N and OC stock were positively correlated with clay, soil N content, soil OC and negatively correlated with sand%, silt%, gravel and bulk density (Table 3).

Table 1. Basic physical and chemical properties in rangelands (*Acantholimon erinaceum*, *Astragalus parrowianus*) and arable lands (walnut garden) in study area, Data are means ± SD

Soil type land use	Depth (cm)	Gravel	Sand	Silt	Clay	Bulk density (mg m^{-3})	N (g/kg)	OC (g/kg)	C/N
Acantholoimon erinaceum	0-25	17.6(a)A±2.25	68.5(a) A±4.45	23.3(c) A±4.6	8.15(a) B±0.58	1.85(b) A±0.06	0.22(a)A±0.01	4.90(a) A±0.83	21.9(a) A±3.85
	25-50	15.3(b) B±1.31	70.0(a) A±4.97	25.0(b) B±4.69	5.00(c) B±0.47	1.81(b) A±0.09	0.19(b) B±0.02	3.65(b) A±0.53	19.2(b)B±3.21
	50-75	12.3(c) B±1.04	66.1(a) A±4.00	29.0(a) B±3.93	4.85(c) C±0.52	1.90(a) A±0.09	0.15(c) B±0.01	2.92(c) A±0.37	19.4(b) B±3.37
	75-100	13.8(d) B±1.17	66.0(a)B±3.62	26.5(b) B±3.07	7.50(a) A±0.57	1.94a) A±0.09	0.13(c) B±0.01	2.33(d) A±0.30	17.7(c) B±2.94
Astragalus parrowianus	0-25	19.1(b) A±2.11	70.1(a) A±5.33	22.0(c) B±5.68	7.90(b) B±0.87	1.78(b) B±0.04	0.21(a) A±0.01	4.69(a) A±0.34	22.6(b) A±3.97
	25-50	22.9(a) A±3.28	67.6(a) B ±4.77	23.2(c) C±4.76	9.10(a) A±1.04	1.85(a) A±0.05	0.14(b) C±0.02	3.90(b) A±0.53	27.8(a) A±4.51
	50-75	17.1(c) A±1.89	63.5(b) B ±4.30	30.1(a) B±5.23	6.30(c) B±1.15	1.86(a) A±0.05	0.12(c) C±0.01	3.12(c) A±0.43	25.1(a) A±4.23
	75-100	16.3(d) A±1.80	68.1(a) A±4.51	25.4(b) B±5.20	6.50(c) A±1.20	1.90(a) A±0.05	0.11(c) C±0.01	2.90(d) A±0.40	25.1(a) A±4.11
Walnut Garden	0-25	13.2(a) B±0.75	68.6(a) A±6.03	21.3(c) B±5.87	10.1(a) A±0.47	1.74(b) B±0.09	0.33(a) A±0.05	4.43(a) A±0.20	13.2(a) B±2.56
	25-50	12.1(a) C±1.11	63.3(b) C±7.35	28.2(b) A±7.27	8.50(b) A±0.53	1.78(b) A±0.06	0.27(b) A±0.05	3.53(b) A±0.40	12.9(a) C±2.18
	50-75	11.5(a) B±1.05	57.5(c) C±6.61	34.3(a) A±6.43	8.10(b) A±0.63	1.83(a) A±0.07	0.22(c) A±0.04	2.64(c) A±0.30	12.0(a) C±2.34
	75-100	12.1(a) B±1.10	59.6(c) C±6.28	34.0(a) A±6.09	6.40(c) A±0.70	1.87(a) A±0.07	0.16(d) A±0.03	1.98(d) A±0.23	12.1(a) C±2.71

The means of column followed by similar lowercase letters indicate no differences between types of land use for each soil layers
The means of column followed by similar uppercase letters indicate no differences between soil layers within each land use

Table 2. Mean comparison of N, OC and C/N Stock between different type of land use and soil layers (depth) in study area, Data are means ± SD

Soil type of land use	Depth (cm)	N Stock (Mg/ha)	OC stock (Mg/ha)	C/N stock
Acantholimon erinaceum	0-25	0.85(b) A±0.05	18.57(a) A±3.94	21.97(a) A±4.12
	25-50	0.72(b) B±0.07	13.9(a) B±2.55	19.28(b) B±3.27
	50-75	0.63(b) C±0.07	12.19(a) B±1.87	19.41(b) B±3.15
	75-100	0.55(b) C±0.06	9.75(a) C±1.53	17.75(b) B±2.88
Astragalus parrowianus	0-25	0.74(b) A±0.06	16.86(a) A±1.67	22.66(a) B±2.61
	25-50	0.50(c) B±0.10	13.89(a) B±2.55	27.86(a) A±5.03
	50-75	0.48(c) B±0.04	12.05(a) B±2.06	25.12(a) B± 3.58
	75-100	0.46(b) B±0.05	11.54(a) B±1.95	25.12(a) B±4.16
Walnut Garden	0-25	1.26(a) A±0.22	16.76(a) A±2.06	13.26(b) A±3.07
	25-50	1.07(a) B±0.19	13.81(a) B±2.09	12.93(c) A±3.47
	50-75	0.89(a) C±0.16	10.75(a) C± 1.62	12.08(c) A±3.25
	75-100	0.67(a) D±0.11	8.17(a) D±1.24	12.19(c) A± 2.98

The means of column followed by similar lowercase letters indicate no differences between types of land use for each soil layers
The means of column followed by similar uppercase letters indicate no differences between soil layers within each land use

Table 3. The correlation matrix between measured soil characteristics and OC, N stock and C/N

	Sand	Silt	Clay	Gravel	Bulk Density	N	OC	N Stock	OC Stock
Silt	-0.945**								
Clay	-0.188*	0.177							
Gravel	0.448**	-0.448**	-0.019						
Bulk density	0.244**	0.231*	-0.171	0.071					
N	-0.373**	-0.340**	0.282**	-0.287**	-0.581**				
OC	-0.640**	-0.617**	0.454**	-0.401**	-0.374**	0.433**			
N stock	-0.370**	-0.336**	0.292**	-0.290**	-0.285**	0.992**	0.425**		
OC stock	-0.627**	-0.604**	0.450**	-0.434**	-0.228*	0.355**	0.987**	0.363**	
C/N	-0.394**	-0.418**	0.414**	-0.623**	-0.194*	-0.563**	0.438**	-0.576**	0.496**

*and**= significant at the 0.05 and 0.01 probability levels respectively

Discussion

There was no significant difference between total soil OC values in different types of land uses (Table 1). It can return to soil aeration regarding the plowing activity in agricultural lands, pH level and microbial population that is different in agricultural lands and rangelands by cultivation, irrigation, use of pesticides, fertilizers and maintaining or burning crop residues and many agricultural management practices (Eswaren *et al.*, 1993). Unlike this in all cases, the soil OC stock concentration significantly decreased with increasing depth (Table 2). According to the study of Parras-Alcantara *et al.* (2013) on the arable crop, vineyard and olive groves of Mediterranean agricultural area soils present a low OC content due to high mineralization of the OM and the absence of harvest residues after periods of drought. This research showed similar results in topsoil in both arable lands and rangelands.

The N stock in garden showed the highest value while in *Astragalus* type, it was the lowest. Its content was decreased in lower layers. The availability of N in the soils is determined by processes of N mineralization, immobilization, denitrification and organic matter decomposition (Yano *et al.*, 2000). The cycle of N in the forests can strongly influence the C cycle as N is often the limiting nutrient in tree growth. In addition, the uptake of C depends on N availability in the plants both directly as a part of the process of photosynthesis and indirectly by influencing the structure and size of the plant-leaf development (Eliasson, 2007, Van Minnen, 2008). The vertical distributions of soil nutrients to understand the importance of plants in structuring showed that the total N, extractable P and exchangeable K were the nutrients with consistently higher concentrations in the topsoil (Jobbagy and Jackson, 2001).

Totally, The C/N ratio variations in surface layers were higher than subsurface layers. Subsurface layers in each land use indicate similar amounts and their changes are not noticeable.

However, with respect to the close connection between C and N, such indices as the C/N ratio in the terrestrial systems are often used to indicate the fertility of soil and changes of index can indicate the differences in the rates of litter decomposition (Van Minnen, 2008). Sa *et al*. (2001) observed an increase in the soil C/N ratio in depth which may be attributed to high C/N soluble organic compounds leaching into deeper layers (Diekow *et al.*, 2005).

Organic carbon stock rate can be affected by forage type, fertilization, forage utilization, animal behavior and soil sampling depth. A fundamental issue has been analyzed concerning the impact of land use changes on OC, N stock and C/N ratio. The changes from *Acantholimon* and *Astragalus* types to walnut garden have not caused significant differences in soil OC value (Table 2). This result indicates that agricultural activities and gardening had no impact on soil OC stock. Most studies showed a decline in soil carbon after cultivation with the average decline about 30%. A survey on the soil OC upon conversion of forest to agricultural land showed a similar decline (Murty *et al.*, 2002).

The variation of OC stock in different depths of lands showed that surface layer (0-25cm) had the highest value and it significantly decreased in below depths in different types of land uses. Also, there was no significant difference between surface layers of different kinds of land uses (Table 2). The loss of soil OC after conversion of forest to cropland varies significantly with soil sampling depth. The conversion has no influence on soil carbon stocks beyond 60cm depth, but it significantly reduced carbon above 60cm depth (Guo and Gifford, 2002). They reported that OC stock could be depleted by the conversion of natural vegetation to cropland due to the reduced organic matter inputs and tillage effects that increased decomposition rates (Post and Kwon, 2000).

After conversion of rangelands (*Acantholimon* and *Astragalus*) to garden, N content significantly increased to 74% and 85% in surface layer, respectively (Table 2). Increment soil N in garden in comparison with the rangelands was replicated in all depths. Moreover, the soil N in different types of land uses has been decreased with increasing depth in below layers. The intensity descent in garden and *Acantholimon* type were similar but *Astragalus* type showed higher intensity descent than the other lands (Table 2). Microbial mineralization/immobilization of soil N can be broadly estimated using soil organic C/N. Based on researches on conversion rates of decomposable organic matter by soil fungi and bacteria, soil organic C/N of 20 is generally considered to be a threshold point where either net N mineralization or net N immobilization occurs (Bengtston *et al.*, 2003). Brady and Weil (2008) reported that the C/N ratio for the cultivated surface horizons ranges from 8:1 to 15:1 with a median as almost 12:1. The ratio is generally lower for subsoil while little variation in the C/N ratio is found in similarly managed soils in a given climatic region. The C/N ratio was higher under *Astragalus* lands than *Acantholimon* lands and garden. This is in conformity with the results of Blanco-Canqui and Lal (2008) and Lou *et al.* (2012) who reported high values of C/N ration in cultivated lands which may be explained by higher contribution of residue input under different tillage. The variation of C/N ratio in different land uses was different. So in *Acanthollimon* rangelands, insignificant differences were shown after a little increase in surface layer (0-25cm) (Table 2). *Astragalus* pasture showed the highest values between soil depths and land uses with 27.86 in the second layer while other depth values had peaks and troughs (Table 2). The variation of C/N ratio values in garden land was similar and showed no significant changes while its value was lower than the other land uses. Yang *et al.* (2010) studied the C/N stoichiometry of alpine grasslands on the Tibetan Plateau and found that it remained relatively stable at different soil depths with the results producing a slope that did not vary significantly from 1.0. As well, the C/N ratio values showed high accumulation of it in the study area and immediate needs to amendment.

Correlation of soil texture with OC, N stock and C/N

The Pearson correlation matrix for all parameters was computed to interpret the data. For correlation significance, the criteria values of probabilities ($p<0.05$ and $p<0.01$) are used. Table 3 showed that the soil particle size distribution has the most important effect on soil OC, N stock and C/N ratio expect gravel, N and OC that have direct effects. In this case, silt, sand and bulk density that are dependent on soil texture showed a significant negative correlation with OC, N stock and C/N ratio while clay percent showed the highest positive significant correlation ($p<0.01$) (0.45, 0.29 and 0.41, respectively). These findings confirm the previous studies that indicated the role of soil texture in OC, N and C/N ratio. Jiao *et al*. (2012) showed that the mineral composition and textural class of soil significantly affected other soil properties including OC and N. As the clay content increases, they are combined with OC aggregate stability. It affects the increase in soil aggregation and clay content and indirectly affects OC stores by absorbing organic materials in soil. For this reason, soil texture also plays direct and indirect roles in chemical and physical protection mechanisms (Plante *et al*., 2006).

Conclusions

Rangelands have a large potential to sequester C because they occupy about half of the world's lands and store global soil OC. The stored OC varies along the profile with higher values in surface layers affecting human activities. N concentrations relied on OC and were high in the areas where the OC was high showing a negative C/N correlation. The conversion of pastures to gardens had no significant changes on OC while the N values showed a significant increase using nitrogen fertilizers. Also, *Acantholimon* rangelands indicated higher N stock accumulation than *Astragalus* in different depths. The comparison of C/N values in different land uses showed that garden had the best values while its value in the rangelands was exceeded from the recommended value, especially in *Astragalus*. The variation of OC, N and C/N in different depths of soil showed a gradual decrease from surface layer to below layers. Also, findings indicated better values of soil properties in gardens than rangelands and *Acantholimon* than *Astragalus*. Overall, our knowledge about the effects of rangelands on OC and N stocks is limited. But if rangelands remain abandoned for any length of time, carbon and nitrogen accumulations in above ground plant biomass may outweigh any changes to OC, N stocks and thus, the soil characteristics can be compared between different types of land uses.

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اثرات تغییر کاربری اراضی بر ترسیب کربن و نیتروژن خاک (مطالعه موردی: اراضی شهمیرزاد استان سمنان)

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چکیده. میزان کربن و نیتروژن خاک نقش مهمی در حفظ کیفیت فیزیکی و شیمیایی خاک و کمک به حفظ محیط زیست ایفا می‌کنند. ادامه تبدیل اراضی مرتعی به اراضی قابل کشت موجب تغییر در ترسیب کربن و نیتروژن خاک شده است. به منظور ارزیابی اثرات تغییر کاربری اراضی بر ترسیب کربن آلی و نیتروژن خاک، این تحقیق در دو منطقه اراضی مرتعی (***Astragalus parrowianus*** و ***Acantholimon erinaceum***) و باغ گردو در شمال غربی شهمیرزاد در استان سمنان به اجرا درآمد. تعداد ۴۰ نمونه خاک از چهار عمق نمونه برداری شد. مقادیر درصد سنگ و سنگریزه، فراوانی نسبی ذرات خاک، وزن مخصوص ظاهری، کربن آلی خاک و نیتروژن کل خاک اندازه‌گیری شد. نتایج تجزیه آماری اختلاف معنی داری در مقادیر ترسیب کربن آلی خاک میان باغ و اراضی مرتعی نشان نداد در حالی که ترسیب نیتروژن خاک در باغ گردو نسبت به اراضی مرتعی از لحاظ آماری بیشتر بود. نسبت کربن به ازت C/N در اراضی مرتعی بطور معنی داری کمتر بود. علاوه بر این، با افزایش عمق خاک مقادیر ترسیب کربن آلی، نیتروژن کل خاک و نسبت C/N، کاهش یافت. نتایج همبستگی بین صفات نشان داد که صفات ترسیب کربن آلی و ازت خاک و نسبت C/N، با درصد رس همبستگی مثبت و با مقادیر شن و سیلت همبستگی منفی و معنی دار داشتند. به طور کلی، بر خلاف کربن آلی خاک که مقدار آن در هر سه منطقه ثابت بود، تغییر کاربری اراضی از مرتعی به اراضی باغی سبب افزایش در میزان ترسیب نیتروژن و کاهش نسبت C/N در خاک شد.

کلمات کلیدی: نسبت کربن به ازت (C/N)، تغییر کاربری اراضی، شهمیرزاد، ترسیب کربن (OC)، ترسیب نیتروژن (N)