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The Response of Topsoil Properties and Nitrogen Transformation to Land Cover in a Semi-arid Rangeland (Case Study: Kojur Rangeland in Mazandaran Province, Iran)

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Abstract:

The role of different plant covers (i.e. *Artemisia aucheri* Boiss, *Cousinia commutate* Bunge and *Agropyron longiaristatum* Boiss) in topsoil properties and Nitrogen transformation is less known under semi-arid mountains. The main objective of this research was to study the effect of land covers on topsoil properties and nitrogen transformation. The study was carried out for investigating the soil properties of Grazing Exclusion (GE), Grazed Rangeland (GR) and Rainfed Agriculture (RA) in Kojur, Mazandaran province, Iran. Thirty-six 1 m^2 plots were set at three treatments to sample the dominant plant species. Soil samples were then taken from the central part of each plot sample in an area of 20×20 cm and depth of 20 cm. Our findings demonstrated that the carbon (C) content of plant materials did not differ for studied land covers whereas GR and RA had higher N content (1.48 and 1.41%, respectively) and lower C/N ratio (13.33 and 14.45%, respectively). In the GE, N concentration of soil (with 0.34%) was 1.5 times more than that in GR and RA (0.20 and 0.21%, respectively). Soil nitrification and N mineralization rates were significantly higher in the GE (0.33 and 0.28 mg $kg^{-1}d^{-1}$ respectively) as compared to the RA (0.15 and 0.08 mg $kg^{-1}d^{-1}$ respectively) and GR (0.01 and 0.04 mg $kg^{-1}d^{-1}$ respectively). There were no significant differences among land covers for bulk density, available K, microbial respiration, and ammonification rates. According to the results, grazing exclusion with presence of grass species increases the organic C contents, total N, and eventually, N mineralization which totally leads to improved soil quality in these regions.

Keywords: Grazing exclusion; Grazed rangeland; Rainfed agriculture; Nitrogen mineralization

1. Introduction

The world's human population has grown fourfold only in the last century. This increase in population, due to improving agricultural and industrial techniques, has created increasing pressure on food production for feeding the growing numbers. Soil degradation as a result of human activity is an environmental problem that has been identified in many areas (Turmel et al., 2015). Lack of proper land management, clear-cutting the forest, biomass burning, conversion of natural ecosystems to agriculture and changing crop types, accelerating organic matter decomposition and aerobic respiration in the soil and help to mineralize and oxidize humus cause emits organic carbon in the form of carbon dioxide from the soil into the atmosphere (Sheydai Karkaj et al., 2017). The severity of food production over the years has caused damage to the health and quality of ecosystems soil (FAO., 2011). Animal grazing as a common type of rangeland management has an influence on regulating feeding cycles and energy flow (Sun et al., 2017). Research on the effect of herbivores on the regulation of

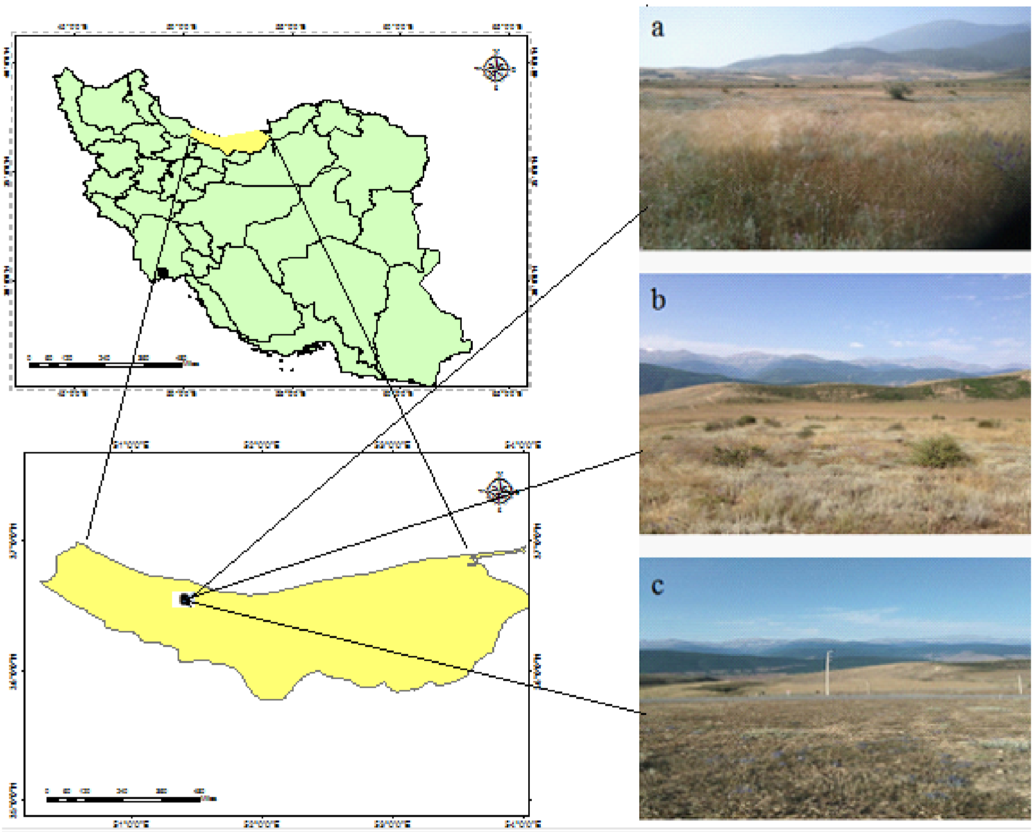

Figure 1. Site locations of the study area in Mazandaran province, north of Iran a) Grazing exclusion, b) Grazed rangeland, c) Rainfed agriculture.

organic carbon (C) and nitrogen (N) is important to evaluate the contribution of grassland ecosystems to global flows C and N (Gao et al., 2009; Sitters et al., 2020). One of the remarkable effects of soil properties on ecosystem global changes is the change in the plant species distribution and also the plant community structure (Orwin et al., 2010). At the plant community level, it is clear that plant diversity and the structure of plant communities can affect the density and function of soil microorganisms as well as the quality of soil input sources (De Deyn et al., 2011; Fahey et al., 2020). Animal grazing is one of the major factors in increasing the non-palatable plants and reducing vegetation cover, biomass and species diversity (Zhu et al., 2016). Changing the composition of plant species in rangelands depends on the intensity of livestock grazing. (Wei et al., 2011) showed that animal grazing activities can change the soil C and N cycle in grassland ecosystems. Zhong et al. (2014) found that heavy grazing pressures reduce soil C and N. Mofidi et al. (2012) and Liang and Niu (2018) showed that herbivores can influence the rate of N mineralization by affecting the rate of organic matter decomposition via dung and urine decomposition that can influence soil pH and electrical conductivity, and increase CO_2 exchange rates in the grazing land. The grazed lands increase the amount of organic matter than agricultural land soils because of more root biomass, the return of plant residues and organic matter cycles (Rumpel et al., 2015).Wright et al. (2004) showed that grazing pressures and the combination of forage species could have an interacting effect on C dynamics and N mineralization. The findings Pineiro et al. (2010) and Hao and He (2019) on the effects of animal grazing on soil and vegetation structure revealed no significant relationship between species composition, root biomass and also C and N. These findings show the complexity of interactions in grassland ecosystems (Mikhailova et al., 2000). In general, maintaining the content of soil organic matter is an important goal for any sustainable agricultural system (Blanchet et al., 2016). Reduction of soil organic matter can have adverse effects on some soil physico-chemical and biological properties (Wang and Wesche, 2016). The conversion of native meadows to the farmlands without sufficient fertility usually results in damage to soil characters (Raiesi, 2017). Feng et al. (2015) reported that soil N mineralization and total N are considered as two striking indices of N availability since they are able to straightly control the concentration of ammonium and nitrate in the soil and provide mineral N for plants. Nitrogen is one of the important elements and its lack of plant growth limitation in temperate rangeland ecosystems (Kahmen et al., 2008). Accoe et al. (2004) indicated that the N dynamics such as the N mineralization determine many shapes and roles of rangeland ecosystems. Zhou et al. (2017) proved that grazing stimulates N mineralization while Qasim et al. (2017) showed that grazing reduces N mineralization.

This study aimed to investigate: 1) if various land covers affect the plant quality (the N content of plant materials) and soil physical, chemical, biochemical features and 2) to examine possible regulating factors for N transformation rates

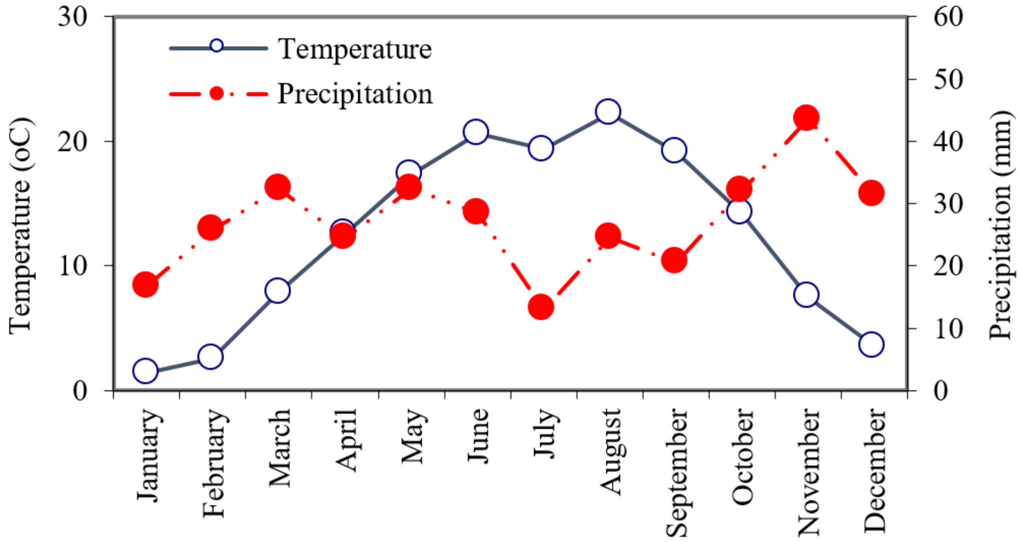

Figure 2. Mean monthly temperature and precipitation in the study area.

by analyzing the relationships between N transformation rates and several soil variables in the rangelands (GE: Grazing Exclusion -and GR: Grazed Rangeland), and Rainfed Agriculture (RA) systems under the semi-arid mountains of northern Iran.

2. Materials and Methods

2.1 Study area

The study was conducted in three rangelands, in Kuhpar experiment station (36°31′57″ N and 51°14′8″ E), in the western Mazandaran province of the Kojur Nowshahr, Iran. The areas include grazing exclusion (enclosed 30 years ago) with 30 ha and grazed rangeland (continual grazed) with 50 ha. Rainfed agriculture area (50 ha) was rangelands 30 years ago; they were cultivated with wheat and barley crops (Fig.1) and now abandoned as rainfed fields (Mohebbi et al., 2016). The study areas with a semi-arid mountain climate are located at an altitude of 1,600 m above sea level, and there was a flat territory with a low slope (<10%). Based on 30-year meteorological data from the area under study, the annual mean precipitation is 319 mm, the most rain occurs in November and its least is in July. The mean annual temperature was 10.4°C and the maximum and minimum average monthly temperatures were 22°C in August and 4°C in January (Fig.2) (Mohebbi et al., 2016). According to the USDA Soil Taxonomy, soil is classified as Alfisols, developed on dolomitic limestone belonging to the upper Jurassic and lower Cretaceous period and has loam-clay loam texture (Ghelichnia, 2006). In the grazed rangeland, animal unit month per hectare is 2.22. While livestock grazing is done 7 times more than the capacity of the rangeland. Vegetation cover of the area is often *Artemisia aucheri Boiss* (Mohebbi et al., 2016).

2.2 Data collection and soil analysis

Three sample plots (1 m^2) were set at 25 m intervals along each 50 m sampling transect, resulting in 12 samples at each land cover. Before soil sampling, for each sample unit, sampling of vegetation was performed to determine the coverage percent and the number of individuals of plant species. Then, the above-ground and underground organs of dominant plant species were extracted. Soil sampling was conducted in June 2016. In each land cover, 12 soil cores (20×20×20 cm) were taken at a randomized-systematic method and then to better soil uniformity, they were sifted (<2 mm) of stones and roots. The collected soils were eventually split into two subsamples: one of subsample was kept at 4 °C for incubation research and the other was air-dried for soil physico-chemical properties investigation. The total C and N contents of plant samples were determined in quadruplicate using dry combustion with an elemental analyzer (Fisons EA1108, Milan, Italy) calibrated using the BBOT [2, 5-bis-(5-tert-butyl-benzoxazol-2-yl)- thiophen] standard (Ther moQuest Italia s.p.a.). The obtained data were corrected for moisture content (Allison, 1975).

Soil bulk density was measured by Plaster's (1985) clod method. Soil texture was determined by the Bouyoucos hydrometer method (Bouyoucos, 1962). Soil water content was measured by drying soil samples at 105 °C for 24 h. Soil pH and EC were measured in H_2O using a 1:5 soil to solution ratio after the soil suspension had been equilibrated for 1 h on a shaker. Soil organic C was determined using the Walkey-Black technique (Allison, 1975) and the total N content was assayed using the Kjeldahl method (Bremner, 1960). Available P was determined with a spectrophotometer using the Olsen method (Homer, 1961), and available K, Ca (by ammonium acetate extraction at pH) were determined with an atomic absorption spectrophotometer)(Bower and Fireman, 1952) and microbial respiration was determined by measuring the CO_2 evolved in a 3-day incubation experiment at 25 °C (Alef, 1995). The buried-bag technique (Wang and Xing, 2010) was used to estimate soil N mineralization, nitrification, and ammonification rates. Two samples were taken: the first in June and the second in July 2016. One from each pair of samples was used to determine the initial concentrations of extractable NH_4^+ and NO_3^- , and the other was placed in a polyethylene bag and

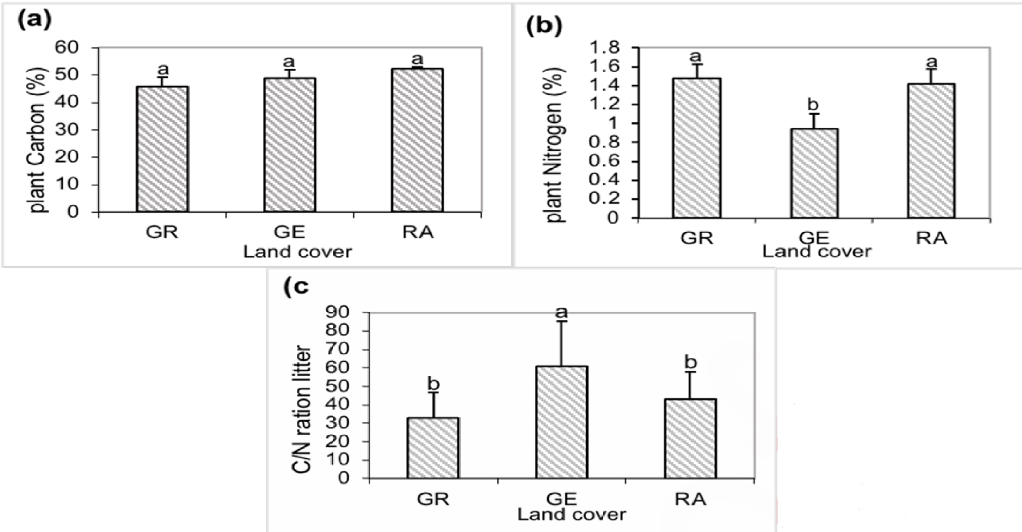

Figure 3. Mean of plant carbon (a), nitrogen (b) and organic C to nitrogen ratio (c) under different land covers. The studied different land covers were Grazed Rangeland (GR), Grazing Exclusion (GE) and Rainfed Agriculture (RA).

buried (in a 20 cm depth) in land cover. The incubation period was 30 days (Duran et al., 2009). Soil NH_4^+ and NO_3^- were extracted with a 2 M KCl solution (soil: solution, 1:5) and then filtered through a 0.45 μm filter. The extracted solutions were measured via colorimetric techniques at 645 and 420 nm to determine NH_4^+ and NO_3^- concentrations, respectively (Li et al., 2014). N mineralization was defined as the increase in NO_3^- and NH_4^+ over the incubation interval, and the increase in NO_3^- and NH_4^+ was used to indicate nitrification and ammonification rates, respectively (Asadiyan et al., 2013).

2.3 Data analysis

The normality of the variables was checked by the Kolmogorov -Smirnov test and Levene's test was used to examine the equality of the variances. One-way analysis of variance (ANOVA) was used to compare plant cover and soil properties data among the land covers. Duncan's multiple comparison test was further employed to test for differences at the 5% probability level. All statistical analyses were conducted using the SPSS v. 19.0 statistical software package. Factor analysis which includes principal component analysis (PCA) was used to determine relationships between plant cover and soil property under different land covers (Mc Cune and Mefford, 1999).

3. Results

3.1 Vegetation, plant cover and soil properties

According to the floristic list, in GR, GE and RA, the dominant species of areas were Artemisia aucheri Boiss, Agropyron longiaristatum Boiss, and Cousinia commutate Bunge, respectively (Table 1). Obtained data indicate that the C content of plant materials was not remarkably different among the three studied land covers (Fig. 3a). However, GR and RA had significantly higher N content of plant materials than GE (Fig. 3b). There was higher C/N ratio of plant materials in the GE and decreasing ratio for GR and RA (Fig. 3c). Total N was the highest quantity in GE compared to other studied lands whereas the greater concentrations of the C/N ratio and available nutrients (P and Ca) were detected in the RA. GE had dramatically higher sand content than GR and RA whereas the greatest amounts of silt, clay and water content were found under RA. Soil pH under GE, EC, and organic C under GR were the lowest compared to other land covers. There were no differences in bulk density, available K, and soil microbial respiration between land covers (Table 2).

3.2 Soil nitrogen transformation

The RA had higher NH_4^+ concentration in June whereas greater concentrations were detected under GE when compared with GR and RA in July (Fig. 4a). The soil nitrification and N mineralization rates under GE demonstrated higher values when compared with the other studied land covers (Fig. 4d, e). The concentration of NO_3^- and ammonification were not significantly different among land covers (Fig. 4b, c).

From the PCA output, the first PC was described more than 65% variance in plant cover and soil properties under the studied land covers (Fig.5). The left PC1 illustrates the status with good water content, the most alkaline soil, collection of nutrients element, and low N mineralization rate that can be attributed to the RA while the right PC1 offered circumstances with less alkaline soil, low components nutrients and more N mineralization rate related to the GE (Fig.5). GR was situated at the positive sector of PC2 (explained variance less than 40%), and is related to good quality of plant cover (Fig.5).

4. Discussion

4.1 Plant quality and soil properties

Good qualities (higher concentration of N with lower levels of C/N ratio) of plant cover were observed in GR and RA while GE displayed few plant cover qualities (lower aggregation of N with superior levels of C/N ratio). The

Table 1. Mean cover (%) of plant species in three land covers.

Species	Family	GR (%)	GE (%)	RA (%)
Agropyron longiaristatum Boiss	Gramineae	0.33	34.44	0.44
Artemisia aucheri Boiss.	Asteraceae	36.66	3.33	0
Cousinia commutate Bunge.	Asteraceae	0.54	0.22	38.50
Festuca ovina L.	Gramineae	3.10	7.8	2.33
Phleum paniculatum Huds.	Gramineae	3.21	0	1.88
Stachys laxa Boiss.	Lamiaceae	9.37	5.44	2.94
Medicago sativa L.	Leguminosae	0	7.66	0
Bromus tomentellus	Gramineae	0	1.66	0
Dactylis glomerata L.	Gramineae	0	3.33	1.10
Bromus tectorum L.	Gramineae	0	1.11	4
Eryngium planum L.	Apiaceae	0.21	0.66	7.10
Traxacum montanum.	Asteraceae	0	0.33	0.54
Coronilla varia (L.) Lassen	Leguminosae	0	0.33	0
Phlomis olivieri	Lamiaceae	0.33	0	0
Teucrium polium L.	Lamiaceae	1.10	0	0
Stachys byzantine K. Koch.	Lamiaceae	1.21	0	0.28
Astragalus gossypinus	Leguminosae	0.88	0	0
Plantago lanceolata L.	Plantaginaceae	0.54	0	0.28
Poterium sanguisorba L.	Rosaceae	0.21	0	0.16
Alyssum bracteatum Boiss.	Brassicaceae	0.21	0	1.46
Poa bulbosa L.	Gramineae	0.88	0	0
Bromus briziformis Fisch.	Gramineae	0.44	0	0
Astragalus mollis	Leguminosae	0.21	0	0
Salvia virygata	Lamiaceae	0	0	0.72
Hordeum fragile	Gramineae	0	0	1.33
Teucrium polium L.	Lamiaceae	0	0	2.21
Astragalus lentiginosus Dougl. ex Hook	Leguminosae	0	0	0.54
Geranium tuberosum L.	Geraniaceae	0	0	0.33
Gallium aparine L.	Rubiaceae	0	0	0.54

(a) The studied different land covers were Grazed Rangeland (GR), Grazing Exclusion (GE), Rainfed Agriculture (RA).

Table 2. Mean values and standard error (SE; n = 12) of the soil variable analyzed

Soil features	GR	GE	RA	F test	p value
	Mean±SE	Mean±SE	Mean±SE		
Bulk density ($g\,cm^{-3}$)	1.53 ± 0.15^a	1.51 ± 0.18^a	1.42 ± 0.16^a	1.39	0.20
Sand (%)	40.41 ± 4.73^b	48.16 ± 5.33^a	26.08 ± 6.61^c	47.70	0.00
Silt (%)	33.30 ± 4.69^b	$30.16 \pm 5.55b$	43 ± 5.49^a	19.35	0.00
Clay (%)	26.36 ± 3.24^b	21.50 ± 2.84^c	30.58 ± 2.96^a	27.09	0.00
Water content (%)	3.50 ± 0.00^b	3.50 ± 0.00^c	4.60 ± 0.01^a	7.92	0.00
pH(1:2.5H_2O)	8.05 ± 0.05^a	7.90 ± 0.07^b	8.06 ± 0.06^a	25.71	0.00
EC(ds/m)	0.16 ± 0.01^b	0.19 ± 0.02^a	0.18 ± 0.01^a	7.57	0.00
Organic C (%)	1.22 ± 0.16^b	2.13 ± 0.38^a	1.93 ± 0.33^a	30.71	0.00
Total N (%)	0.21 ± 0.05^b	0.34 ± 0.08^a	0.20 ± 0.08^b	13.46	0.00
C/N ratio	5.97 ± 1.71^b	6.56 ± 2.42^b	10.43 ± 3.32^a	9.90	0.00
Available P (mg kg^{-1})	9.80 ± 4.28^b	9.83 ± 2.03^b	12.91 ± 2.67^a	3.88	0.03
Available K (mg kg^{-1})	189.33 ± 17.56^a	191.83 ± 12.03^a	200.75 ± 8.71^a	2.44	0.10
Available Ca (mg kg^{-1})	329.55 ± 4.16^b	328.10 ± 5.48^b	341.01 ± 3.19^a	30.78	0.00
Microbial respiration (mg$CO_2 - C\,g^{soil}_{-1}\,day^{-1}$)	0.04 ± 0.03^a	0.04 ± 0.03^a	0.06 ± 0.04^a	1.73	0.19

(a) Different letters in each row indicate significant differences (p < 0.05 by Duncan test) under different land covers. The studied different land covers were Grazed Rangeland (GR), Grazing Exclusion (GE), Rainfed Agriculture (RA).

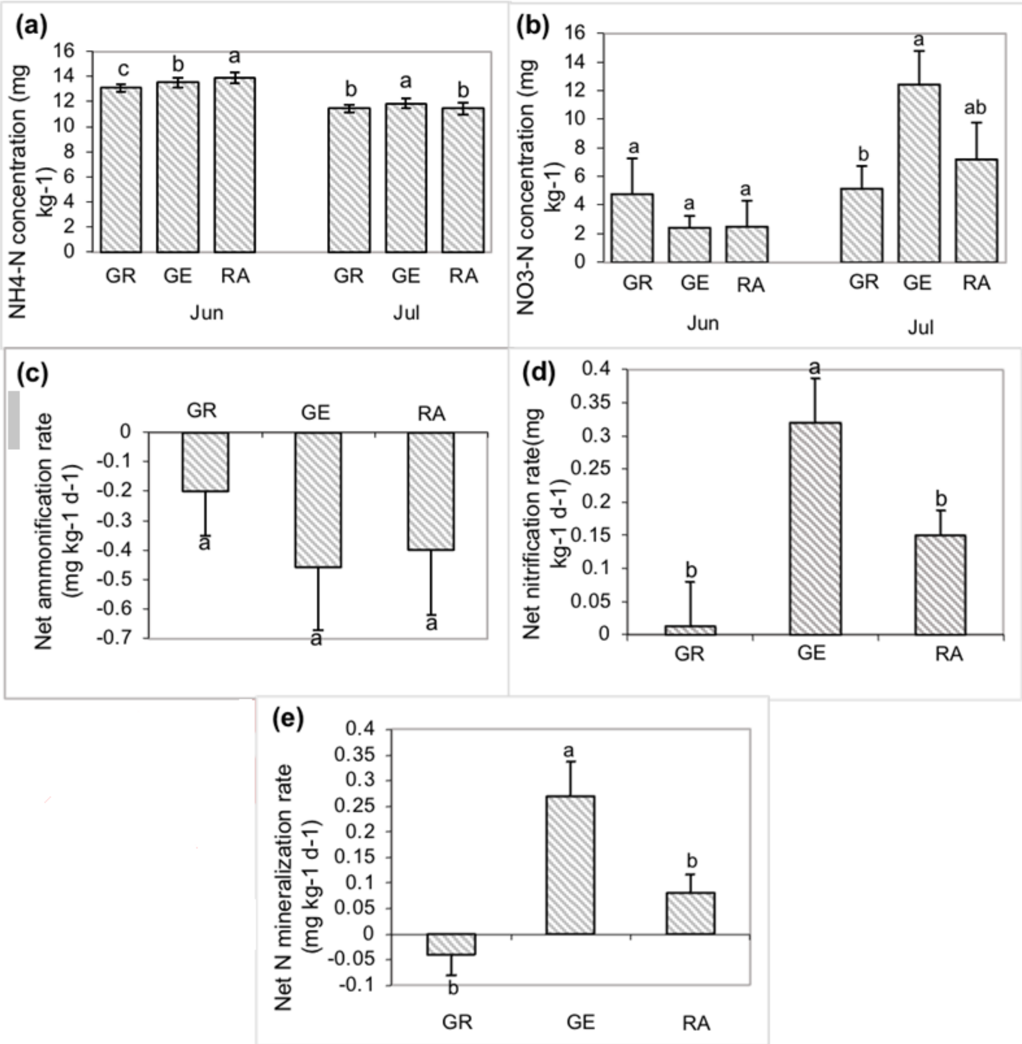

Figure 4. Mean of NH_4^+-N concentration (a), NO_3^--N concentration (b), net ammonification rate (c), net nitrification rate (d) and net N mineralization rate (e) in the top mineral soil under different land covers. The studied different land covers were Grazed Rangeland (GR), Grazing Exclusion (GE) and Rainfed Agriculture (RA).

grazing severity increases the toxicity of plants. The presence of nitrate in the secondary compounds of toxic plants (*Artemisia aucheri*) and also, promotion of fast growing species through grazing increases the N content and quality of plants (Arzani et al., 2006; Schrama et al., 2013). Although in many cases, grazing leads to soil compression, reducing soil porosity, enhancing soil bulk density (Wang and Wesche, 2016; Oduor et al., 2018), a notable difference was not seen in bulk density of soil in our study. In parallel to decreasing soil pH in GE, it could be pointed out that the density of organic matter is a construction that can lead to soil acidification under this land cover (Pei and Wan, 2008). Related to increase of EC in the GE, it can be known as leaching loss due to low grazing, increased organic matter, land cover (which is the relative area covered by physical materials of plant species in a plot) and infiltration (Aghajantabar Ali et al., 2015). According to the results of Mehrani et al. (2014) and Raiesi (2017), the highest soil pH and EC content was observed in the RA; it may be due to the specific biological properties of the soils of the study area. Generically, it can be mentioned that plant pH has an effect on soil pH (Kooch, 2012), so the soil pH and EC changes under different land covers may be caused by different plant species, properties and quality (Khajehzadeh et al., 2014; Ruwanza and Shackleton, 2016). According to our outcomes, the largest soil organic C amount belonged to GE and RA. Generally, the effect of the GE with more grass species on soil organic C was predominantly detected in the top 20 cm soil surface where nutrient and soil organic matter aggregation result from complex interchange between plant and soil biotic processes (Fahey et al., 2020; De Araujo Pereira et al., 2021). In addition to other reasons of increased soil organic C in the GE, plants have major production more than the time of breathing which contributory assemble soil organic C. The presence of most of the gramineous species in the GE enhances the organic matter of soil above ground and below ground due to lack of continuous woody structures and the overall higher decomposability (Deng et al., 2013). The soil organic C stock of the RA may be higher than the GR, due to organic manure and organic fertilizers applications and the effect of crop residues (Zhang et al., 2012; Conant et al.,

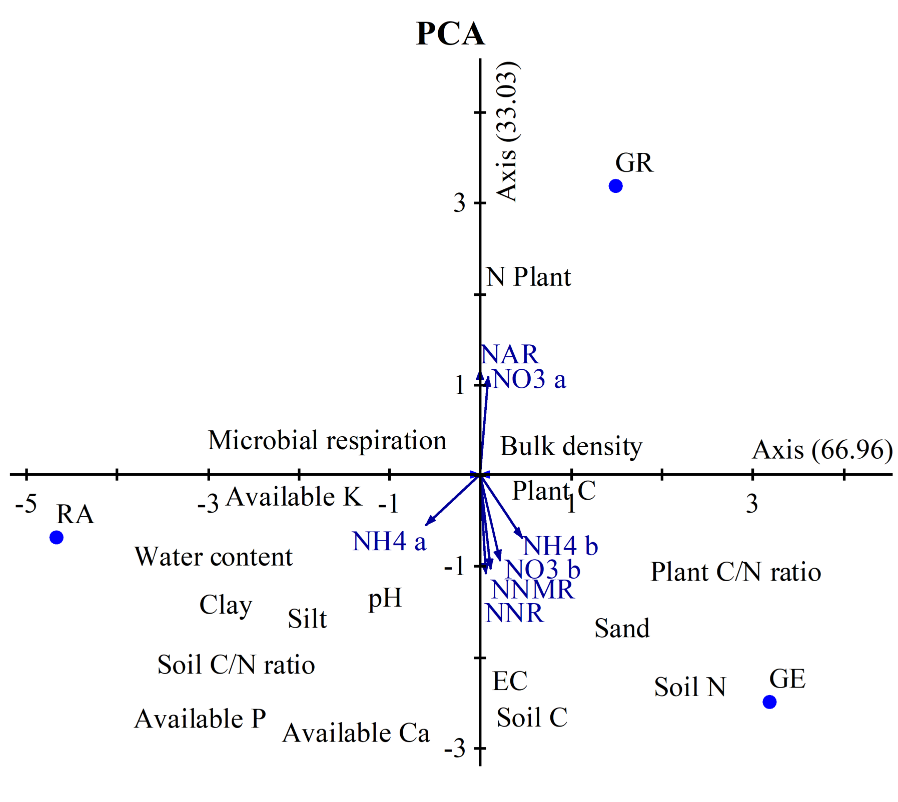

Figure 5. PCA based on the correlation matrix of the, land covers, soil physico-chemical and biochemical features. NH_4^+a=ammonium (sampling in June), NH_4^+b=ammonium (sampling in July) ,NO_3^-a=nitrate (sampling in June), NO_3^-b=nitrate (sampling in July), NAR=net ammonification rate, NNR=net nitrification rate, NNMR=net N mineralization rate from the Grazed Rangeland (GR), Grazing Exclusion (GE), Rainfed Agriculture (RA).

2017). The elimination photosynthetic tissue and fallowing respiration of assimilated C by the grazing animals lead to a very few quantity of soil organic C in GR since potential C inputs to soil organic matter have decreased (Wang et al., 2014; Bagchi et al., 2017).

The accumulation of nitrous oxide in the enclosed lands can be instantly linked to the enhancement of surface and underground biomass, the aggregation of organic matter as litter on the surface of the earth, and the increase in the entry of nitrogen into the soil by litter and roots (Ley et al., 2018). The rise of above and below ground biomass, the collection of remaining grass as litter on the ground, and the increased input of N into soils by litter and roots have straightly resulted in the accumulation of total N in GE grassland (Qiu et al., 2013; Yusuf et al., 2015) which confirms our findings of soil under GE compared with the other land covers. It has been proved that the reduction of the rate of N mineralization and N supply in RA lead to increasing the C/N ratio in the area (Pringle et al., 2014; Noghreh, 2019). The organic manure applications under RA can be contributory to increase available P and Ca in this land cover. Moreover, existence of more silt and clay fractions due to their greater capacity for holding cations is another reason to increase these elements in the RA (Lu et al., 2015). Soil microbial respiration is primarily controlled by climatic factors while plant coverings have a secondary effect on it. Thus, the rate of soil microbial respiration is controlled primarily by climatic factors and substrate factors while vegetation has a secondary effect on it (Raich and Tufekcioglu, 2000); in our study areas, there were no significant differences in soil microbial respiration. It might be related to the carbon of plants in three land covers.

4.2 Soil nitrogen transformation

In general, the accumulation of $NH_4^+$was lower in July than in June while NO_3^- concentrations were mainly lower in June than in July. According to the report by (Vymazal, 2007)V, NH_4^+ can be reduced by processes such as adsorption, plant uptake and volatilization. Higher NH_4^+ contents from RA may occur as a result of a lack of rainfall in that period and lower volatilization due to more clay fractions in the land cover. In contrast, most NH_4^+ contents from GE may occur as a result of increases in plant biomass because NH_4^+ leaching under GR and RA is high due to the rainfall. Whereas animal grazing leads to decrease total nitrogen content, the accumulation of annual nitrification would decline (Shan et al., 2011). It is said that enhancing the nitrification resulted from increasing NH_4^+-N concentration, since the nitrification is independent of organic matter, plant and litter quality, and there is no competition between them and ammonification (Jalali et al., 2014). Wang et al. (2022) indicated that grazing horse induced significant increases in soil moisture and NO_3^- in desert grassland. According to the dataset of this study, the RA had a higher C/N ratio in comparison to both GR and GE. When soil C/N ratios are high, microbes have C; however, N is limited as a multiplier factor in the C/N ratio and consequently, decreases the N mineralization rate and N supply to the rangeland (Magdoff and Weil, 2004), thereby decreasing rangeland productivity. Many studies have suggested that the quantity of soil organic matter may be an important determinant of N mineralization (Cai et al., 2016); however, our data do not show this. The reason is seasonal variation in allelopathic potential and antimicrobial activity of toxic plants such as *Artemisia genus* (Mahboobi and B., 2009; Kegode et al., 2012) indicating that the mineralization of nitrogen in soil was influenced by the quality of plants. Seasonal variation in allelopathic potential has been reported for *Artemisia aucheri* and *Artemisia genus*; so, GR showed lower soil microbial activities. Based on principal component analyses (PCA), the outcomes of this study detected that there is a positive correlation between the amount of soil N mineralization and N, ammonium and nitrate concentration that agreed with previous findings (Magdoff and Weil, 2004; Dong et al., 2021). Animal grazing could have induced shifts in plant and soil microbial community composition, resulting in dissimilarities in net N mineralization contents, with the peak value of net N immobilization appearing (Zheng et al., 2011; Leptin et al., 2021). Extremely grazing may decrease the root exudates generation due to over-defoliation, and hence, result in a reduced N mineralization (Xu et al., 2007; Sun et al., 2017). (Schrama et al., 2013) hypothesize that soil compaction by herbivores reduces oxygen availability in wet soils such as those in the present study, resulting in a reduction in N mineralization. (Zhao et al., 2010) found since various plant species show different growth rates, root functioning capable have a diverse effect on microbial processes such as nitrogen mineralization and nitrification.

5. Conclusion

Based on finding of this study, land covers have diverse influence on plant quality and also, the topsoil physical, chemical and biochemical features. Grazing exclusion plays a positive role in adjusting soil N content and increasing N mineralization. This research recommends a temporal grazing exclusion with the presence of annual and perennial grasses abundance that can help better performance than other land covers techniques in betterment soil quality, particularly the N content and the net N mineralization rate.

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Ethical Approval
This manuscript does not report on or involve the use of any animal or human data or tissue. So the ethical approval does not applicable.

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Authors Contributions
All authors have contributed equally to prepare the paper.

Availability of Data and Materials
The data that support the findings of this study are available from the corresponding author upon reasonable request.

Conflict of Interests
The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

References

Accoe F., Boeckx P., Busschaert J., Hofman G., Cleemput O. van (2004) Gross N transformation rates and net N mineralization rates related to the C and N contents of soil organic matter fractions in grassland soils of different age. *Soil Biology and Biochemistry* **36** (12): 2075–2087.

Aghajantabar Ali H., Mohseni Saravi M., Chaichi M.R., Heidari GH. (2015) Grazing Pressure effect on soil physical and chemical characteristics and vegetation cover in Vaz watershed, Mazandaran province. *Journal of Watershed Management Research.* **6** (11): 111–123.

Alef K. (1995) Estimating of soil respiration. In: Alef, K., Nannipieri, P. (Eds.), methods in soil microbiology and biochemistry. *Academic Press, New York.,* 464–470 pp.

Allison L.E. (1975) Organic carbon. In: black CA. (Ed.), methods of soil analysis, part 2. *American Society of Agronomy,* 1367pp.

Arzani H., Basiri M., Khatibi F., Ghorbani G (2006) Nutritive value of some Zagros Mountain rangeland species. *Small Ruminant Research.* **65** (1-2): 128–135.

Asadiyan M., Hojjati S.M., Pourmajidian M.R., Fallah A (2013) Impact of land-use management on nitrogen transformation in a mountain forest ecosystem in the north of Iran. *Journal of Forestry Research.* **24** (1): 115–119.

Bagchi S., Roy S., Maitra S., Sran S. (2017) Herbivores suppress soil microbes to influence carbon sequestration in the grazing ecosystem of the Trans-Himalaya. *Agriculture Ecosystems Environment.* **239**:199–206.

Blanchet G., Gavazov K., Bragazza L., Sinaj S. (2016) Responses of soil properties and crop yields to different inorganic and organic amendments in a Swiss conventional farming system. *Agriculture, Ecosystems and Environment.* **230**:116–126.

Bouyoucos G. J. (1962) Hydrometer method improved for making particle size analysis of soils. *Agronomy Journal* **54** (5): 464–465.

Bower R.F. Co.A.and Reitemeier, Fireman M. (1952) Exchangeable cation analysis of saline and alkali soils. *Soil Science* **73** (4): 251–262.

Bremner J.M (1960) Determination of nitrogen in soil by the Kjeldahl method. *The Journal of Agricultural Science.* **55** (1): 11–33.

Cai H. A.and Xu, Shao X., Zhu P., Zhang M. W.and Xu, Murphy D.V. (2016) Carbon and nitrogen mineralization in relation to soil particle-size fractions after 32 years of chemical and manure application in a continuous maize cropping system. *PloS one.* **11** (3): e0152521.

Conant R.T., Cerri B.B. C.and Osborne, Paustian.K. (2017) Grassland management impacts on soil carbon stocks: A new synthesis *Ecological Applications.* **27** (2): 662–668.

De Araujo Pereira A.P., Lima L.A.L., Bezerra W.M., Pereira M.L., Normando L.R.O., Mendes L.W., Melo V.M.M. (2021) Grazing exclusion regulates bacterial community in highly degraded semiarid soils from the Brazilian Caatinga biome. *Land Degradation and Development.* **32** (6): 2210–2225.

De Deyn G.B., Quirk H., Bardgett R.D. (2011) Plant species richness, identity and productivity differentially influence key groups of microbes in grassland soils of contrasting fertility. *Biology Letters.* **7** (1): 75–78.

Deng L., Shangguan Z.P., Sweeney S. (2013) Changes in soil carbon and nitrogen following land abandonment of farmland on the loss plateau, china. *PLoS One.* **8** (8): e71923.

Dong V. L.and Martinsen, Wu Y., Zheng Y., Liang C., Liu Z., J. Mulder. (2021) Effect of grazing exclusion and rotational grazing on labile soil organic carbon in north China. *Europian Journal of Soil Sciences.* **72** (1): 372–384.

Duran J., Rodriguez A., Palacios J.M., Gallardo A. (2009) Changes in net N mineralization rates and soil N and P pools in pine forest wildfire chronosequence. *Biology and Fertility of Soils.* **45** (7): 781–788.

Fahey C., Koyama A., Antunes P.M., Dunfield K., Flory S.L. (2020) Plant communities mediate the interactive effects of invasion and drought on soil microbial communities. *The ISME journal.* **14** (6): 1396–1409.

FAO. (2011) Soil Health, Technologies that Save and Grow. *FAO, Rome*

Feng J., Han X., He N., Zhang Y., Zhou L., Han X. (2015) Sheep grazing stimulated plant available soil nitrate accumulation in a temperate grassland. Pakistan. *Journal of Botany.* **47** (5): 1865–1874.

Gao Y., Schumann M., Chen H., Wu N., Luo P. (2009) Impacts of grazing intensity on soil carbon and nitrogen in an alpine meadow on the eastern Tibetan Plateau. *Journal of Food, Agriculture and Environment.* **7** (2): 749 –754.

Ghelichnia H. (2006) Research report rangeland evaluation in different climates. *Research instatute of forest and rangelands.* **3**:110pp.

Hao Y., He Z. (2019) Effects of grazing patterns on grassland biomass and soil environments in China: A meta-analysis. *PLoS One.* **14** (4): e0215223.

Homer P. F. C. D.and Pratt (1961) Methods of analysis for soils, plants and waters, University of California. *Agricultural Sciences Publications, Berkeley, CA, Berkeley, California.,* 309pp.

Jalali M., Mahdavi S., Ranjbar F. (2014) Nitrogen, phosphorus and sulfur mineralization as affected by soil depth in rangeland ecosystems. *Environmental Earth Sciences,* **72** (6): 1775–1788.

Kahmen A., Wanek W., Buchmann N. (2008) Foliar δ15N values characterize soil N cycling and reflect nitrate or ammonium preference of plants along a temperate grassland gradient. *Oecologia.* **156** (4): 861–870.

Kegode G. O., Ciernia M.G., Vlieger D.B. (2012) Allelopathic potential of Artemisia biennis (biennial wormwood). *Ecol. Econ* **3** (4): 582.

Khajehzadeh M.H., Zare M.H., Ghanati F., M. Sharifi. (2014) Changes of enzymes activity and production of secondary metabolites of Artemisia aucheri in different altitudes and its relation to adaptation. *Journal of Chemical Health Risks.* **4**:57–66.

Kooch Y. (2012) Response of Earthworms Ecological groups to decay degree of dead trees (Case study: Sardabrood forest of Chalous, Iran). *Journal of Environmental Management.* **2**:112–144.

Leptin A., Whitehead D., Anderson R.C., Cameron C.K., Lehto J.N. (2021) Increased soil nitrogen supply enhances root-derived available soil carbon leading to reduced potential nitrification activity. *Apllied Soil Ecology* **159**:1–11.

Ley M., Lehmann M.F., Nikaus P.A., Luster J. (2018) Alteration of nitrous oxide emissions from floodplain soils by aggregate size, litter accumulation and plant–soil interactions. *Biogeosciences* **15** (22): 7043–7047.

Li M., Zhaou X., Zhang Q., Cheng X. (2014) Consequences of afforestation for soil nitrogen dynamics in Central China. Agriculture. *Ecosystems and Environment.* **183**:40–46.

Liang D.F., Niu S.T. K.C.and Zhang (2018) Interacting effects of yak dung deposition and litter quality on litter mass loss and nitrogen dynamics in Tibetan alpine grassland. *Grass and Forage Science.* **73** (1): 123–131.

Lu X., Yan Y., Sun J., Zhang X., Chen Y., Wang X., Cheng G. (2015) Carbon, nitrogen, and phosphorus storage in alpine grassland ecosystems of Tibet, effects of grazing exclusion. *Ecology and Evolution.* **5** (19): 4492–4504.

Magdoff F., Weil R.R. (Eds.) (2004) Soil organic matter in sustainable agriculture. *CRC press, Boca Raton, Florida USA.* **73** (1): 123–131.

Mahboobi M., B. Ghazian (2009) Chemical composition and antimicrobial activity of Artemisia aucheri Bioss. Essential oil. *Iranian Journal of Medicinal and Aromatic Plants.* **25** (3): 429–440.

Mc Cune B., Mefford M. (1999) Multivariate analysis of ecological data version 4.17. MJM software. *Gleneden Beach, 233 pp, Oregon, USA.*

Mehrani A., Riazi B., Hamedani KH.H. (2014) Evaluation the effects of land use in the Gomishan plains. *Science and Technology Environmental.* **6** (1): 295–307.

Mikhailova E.A., Bryant R.B., Vassenev I.I., Schwager S.J., Post C.J. (2000) Cultivation effects on soil organic carbon and total nitrogen at depth in the Russian Chernozem. *Soil Science Society of America Journal.* **64**:738–745.

Mofidi M., Rashtbari M., Abbaspour H., Ebadi A., Sheidai E., J. Motamedi. (2012) Impact of grazing on chemical, physical and biological properties of soils in the mountain rangelands of Sahand, Iran. *The Rangeland Journal.* **34**:297–303.

Mohebbi S., Dianati Tilaki G.A., Abedi M. (2016) Applying landscape function analysis method in order to assess the ecological function of plant patches in rangeland management treatments (Pilot: Kojour Noshahr Rangelands). *Journal of Range and Watershed Management.* **69** (1): 187–199.

Noghreh Y. N.and Kooch (2019) Effect of vegetation type on soil microbial activities and nitrogen mineralization dynamic in shrublands and non-wooded rangelands of central Alborz. *Journal of Rangeland.* **13** (4): 691–702.

Oduor C.O., Karanja N., Onwong A.R., Muretthi S., Pelster D., Nyberg G. (2018) Pasture enclosures increase soil carbon dioxide flux rate in Semiarid Rangeland, Kenya. *Carbon balance and management.* **13** (1): 1–12.

Orwin K.H., Buckland S.M., Johnson D., Turner B.L., Smart S., Oakley S., Bardgett R.D. (2010) Linkages of plant traits to soil properties and the functioning of temperate grassland. *Journal of Ecology.* **98** (5): 1074–1083.

Pei H. S.and Fu, Wan C. (2008) Changes in soil properties and vegetation following exclosure and grazing in degraded Alxa desert steppe of Inner Mongolia, China. *Agriculture, Ecosystems and Environment.* **124** (1-2): 33–39.

Pineiro G., Paruelo J.M., Oesterheld M., Jobbágy E.G. (2010) Pathways of grazing effects on soil organic carbon and nitrogen. *Rangeland Ecology and Management.* **63** (1): 109–119.

Pringle M.J., Allen D.E., Phelps D.G., Bray S.G., Orton T.G., Dalal R.C. (2014) The effect of pasture utilization rate on stocks of soil organic carbon and total nitrogen in a semi-arid tropical grassland. *Agriculture, Ecosystem and Environment.* **195**

Qasim Sh., Shamim Gul Sh., Hussain Shah M., Hussain F., Ahmad S., Islam M., Rehman G., Yaqoob M., Shah S.Q. (2017) Influence of grazing exclosure on vegetation biomass and soil quality. *International Soil and Water Conservation Research.* **5** (1): 62–68.

Qiu L., Wei X., Zhang X., Zhang X., Cheng J. (2013) Ecosystem carbon and nitrogen accumulation after grazing exclusion in semiarid grassland. *PLoS One.* **8** (1): e55433.

Raich J.W., Tufekcioglu A. (2000) Vegetation and soil respiration: correlations and controls. *Biogeochemistry.* **48** (1): 71–90.

Raiesi F. (2017) A minimum data set and soil quality index to quantify the effect of land use conversion on soil quality and degradation in native rangelands of upland arid and semiarid regions. *Ecological Indicators.* **75**:307–320.

Rumpel C., Creme A., Ngo P.T., Velasquez G., M.L. Mora, Chabbi A. (2015) The impact of grassland management on biogeochemical cycles involving carbon, nitrogen and phosphorus. *Journal of Soil Science and Plant Nutrition.* **48** (1): 353–371.

Ruwanza S., Shackleton C. (2016) Effect of the invasive shrub, Lantana camara, on soil properties in the Eastern Cape, South Africa. *Weed Biology and Management.* **16** (2): 67–79.

Schrama M., Veen G.C., Bakker E.L., Ruifrok J.L., Bakker J.P., Olff H. (2013) An integrated perspective to explain nitrogen mineralization in grazed ecosystems. *Perspectives in Plant. Ecology, Evolution and Systematics.* **15** (2): 32–44.

Shan Y.M., Chen D.M., Guan X.X., Zheng S.X., Chen H.J., Wang M.J., Bai Y. F. (2011) Seasonally dependent impacts of grazing on soil nitrogen mineralization and linkages to ecosystem functioning in Inner Mongolia grassland. *Soil Biology and Biochemistry.* **43** (9): 1943–1954.

Sheydai Karkaj S., Sepehri A., Barani H., Motamedi J. (2017) Correlation of organic carbon storage with some soil characteristics in East Azarbaijan rangelands. *Journal of Rangeland.* **11** (2): 125–138.

Sitters J., Wubs E.J., Bakker E.S., Crowther T.W., Adler P.B., Bagchi S., Veen G.F. (2020) Nutrient availability controls the impact of mammalian herbivores on soil carbon and nitrogen pools in grasslands. *Global change biology.* **26** (4): 2060–2071.

Sun G., Zhu-Barker X., Chen D., Liu L., Zhang N., Shi C., He L., Lei Y. (2017) Responses of root exudation and nutrient cycling to grazing intensities and recovery practices in an alpine meadow: An implication for pasture management. *Plant and Soil.* **416** (1): 515–525.

Turmel M.S., Speratti A., Baudron F., Verhulst N., Govaerts B. (2015) Crop residue management and soil health: A systems analysis. *Agricultural Systems.* **134**:6–16.

Vymazal J. (2007) Removal of nutrients in various types of constructed wetlands. *Science of the Total Environment.* **380** (1-3): 48–65.

Wang D., Wu G.L., Zhu Y.J., Z.H. Shi. (2014) Grazing exclusion effects on above-and below-ground C and N pools of typical grassland on the Loess Plateau (China). *Catena.* **123**:113–120.

Wang X., Wang C., Zhou C., Zuo S., Lamao Q., Huang D. (2022) Grazing horse effects on desert grassland soil gross nitrification and denitrification rates in northern China. *Agriculture.* **12** (7): 1036.

Wang X. Ch.and Han, Xing X. (2010) Effects of grazing exclusion on soil net nitrogen mineralization and nitrogenavailability in a temperate steppe in northern China. *Journal of Arid Environments.* **74** (10): 1287–1293.

Wang Y., Wesche K. (2016) Vegetation and soil responses to livestock grazing in Central Asian grasslands, a review of Chinese literature. *Biodivers Conserv.* **25** (12): 2401–2420.

Wei L., Hai-Zhou H., Zhi-Nan Z., Gao-Lin W. (2011) Effects of grazing on the soil properties and C and N storage in relation to biomass allocation in an alpine meadow. *Journal of soil science and plant nutrition.* **11** (4): 27–39.

Wright A.L., Hons F.M., Rouquette F.M. (2004) Long-term management impacts on soil carbon and nitrogen dynamics of grazed bermuda grass pastures. *Soil Biology and Biochemistry.* **36** (11): 1809–1816.

Xu Y., Li L., Wang Q., Chen Q., Cheng W. (2007) The pattern between nitrogen mineralization and grazing intensities in an Inner Mongolian typical steppe. *Plant and Soil.* **300** (1): 289–300.

Yusuf H.M., Treydte A.C., Sauerborn J. (2015) Managing semi-arid rangelands for carbon storage: grazing and woody encroachment effects on soil carbon and nitrogen. *PloS one.* **10** (10): e0109063.

Zhang L.H., Xie Z.K., Zhao R.F., Wang Y.J. (2012) The impact of land use change on soil organic carbon and labile organic carbon stocks in the Longzhong region of Loess Plateau. *Journal of Arid Land.* **4** (3): 241–250.

Zhao X. H.and Zhang, Xu S., Zhao X., Xie Z., Wang Q. (2010) Effect of freezing on soil nitrogen mineralization under different plant communities in a semi-arid area during a non-growing season. *Applied Soil Ecology.* **45** (3): 187–192.

Zheng S.X., Lan Z.C., Li W.H., Shao R.X., Shan Y.M., Wan H.W., Taube F., Bai Y.F. (2011) Differential responses of plant functional trait to grazing between two contrasting dominant C3 and C4 species in a typical steppe of Inner Mongolia, China. *Plant and Soil.* **340** (1): 141–155.

Zhong L., Du R., Ding K., Kang X., Li F.Y., Bowatte S., Hoogendoorn C.J., et al. (2014) Effects of grazing on N2O production potential and abundance of nitrifying and denitrifying microbial communities in meadow-steppe grassland in northern China. *Soil Biology and Biochemistry.* **69**:1–10.

Zhou G., Zhou X., HE Y., Shao J., HU ZH., Liu R., Zhou H., Hosseinibai SH. (2017) Grazing intensity significantly affects belowground carbon and nitrogen cycling in grassland ecosystems, a meta-analysis. *Global Change Biology.* **23** (3): 1167–1179.

Zhu G.Y., Deng L., Zhang X.B., Shangguan Z.P. (2016) Effects of grazing exclusion on plant community and soil physicochemical properties in a desert steppe on the Loess Plateau, China. *Ecological Engineering.* **90**:372–381.