



Study of the Effects of Land Use Change on Organic Soil Characteristics Case Study: Shenroud of Siahkal, Guilan Province

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ABSTRACT: In order to study the effect of land use change of forest into pasture and garden on soil characteristics, Shenroud of Siahkal Region located of Iranian north forests was selected. Soil samples were taken using random systematic method from depth of 0 to 30 centimeters. Totally 60 soil samples (20 samples for each region) were delivered to the soil lab. The data analysis was implemented using SPSS 18 Software and in order to study and compare the data average, the one way variance analysis test (ANOVA) and Duncan's multivariate test were used. The research results showed that the percentage of organic carbon, nitrogen and phosphorus in the forests is higher than the tea garden and pasture which implies a decline in soil quality due to forest land use change into pasture and tea garden. Average carbon to nitrogen ratio was highest in tea garden and the lowest in pasture and forest. Therefore, it can be said that land use change can affect the soil characteristics and lead to soil destruction and decline in soil nutrients.

Key Terms: Land Use Change, Soil, Shenroud of Siahkal

INTRODUCTION

The soil quality is one of the most important studied factors in assessment of soil management and biological realm stability (Hemmati, 2012). The soil characteristics are extremely affected by soil management and land use systems. The soil is a very important factor in growth and distribution of vegetation. The land use change affects ecosystem processes specifically mineralization rate of carbon and nitrogen. The effect of different usages through adding their leaf litters to the soil surface in natural forests, tea gardens and pastures can have positive or negative effects on physical, biological and chemical characteristics of the soil. Land use change and agricultural operations in untapped lands reduce entrance of the fresh plant debris to the soil. Reduction of carbon stocks in soil, cause decrease of microbial biomass and activity of microorganisms in the soil. This important part of the soil has a crucial role in decomposition of organic materials and returning the essential nutrient elements.

Considering the importance of land use change for soil characteristics, present research studies forest use change into pasture and tea garden in region of Guilan province.

MATERIALS AND METHODS

A. The Study Area

This region is located between 49° 47' 50" geographical longitude and 36° 36' 55' 30" geographical latitude. Its minimum and maximum height from sea level is 700 to 2100 meters and its general slope is toward the north. The samples were taken from soil of 3 regions by random systematic method. After designing the 50 x 50 network, 30 points were selected for each region and in each region from depth of 0 to 30 centimeters. The soil samples (totally 60 samples) were transferred to the soil lab and the organic carbon was calculated using Walky-black's Method, soil nitrogen by Kjeldahl Method. The results from physical and chemical soil parameters were organized using Excel and SPSS Software and they were normalized using Kolmogorov-smirnov Method.

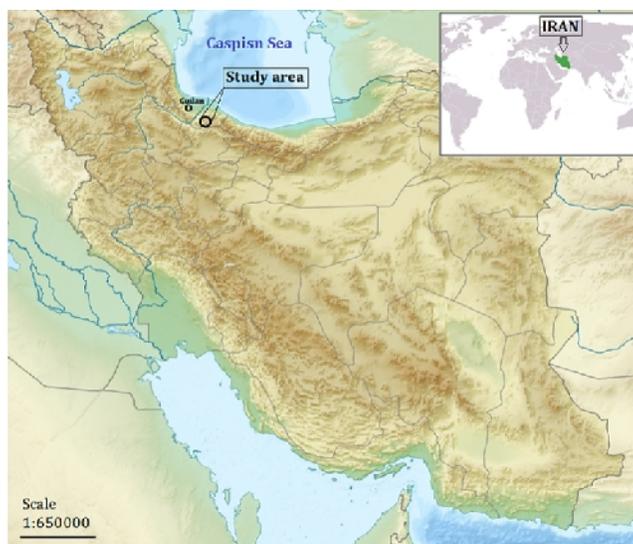


Fig. 1. Geographical Location of the Study Area in Guilan Province.

RESULTS

A. Soil Organic Carbon

The results from variance analysis and comparison of data averages, using Duncan's test implies that the percentage of organic carbon in forest and tea garden

field shows a significant difference in 95 percents probability level with pasture field and the average of this amount in forest mass (control) and tea garden has been more than the pasture (Table1 and Fig. 2).

Table 1: Results of Soil Organic Carbon Variance Analysis in 3 Fields of Forest (Control), Pasture and Tea garden.

| Change Source | Sum of Squares | Freedom Degree | Mean-square | F | Significance |
|---------------|----------------|----------------|-------------|--------|--------------|
| Treatments | 35.655 | 2 | 16.32 | 30.754 | 0.000** |
| Errors | 19.912 | 57 | 0.503 | | |
| Total | 55.567 | 59 | | | |

**Significance in 99 percents confidence level.

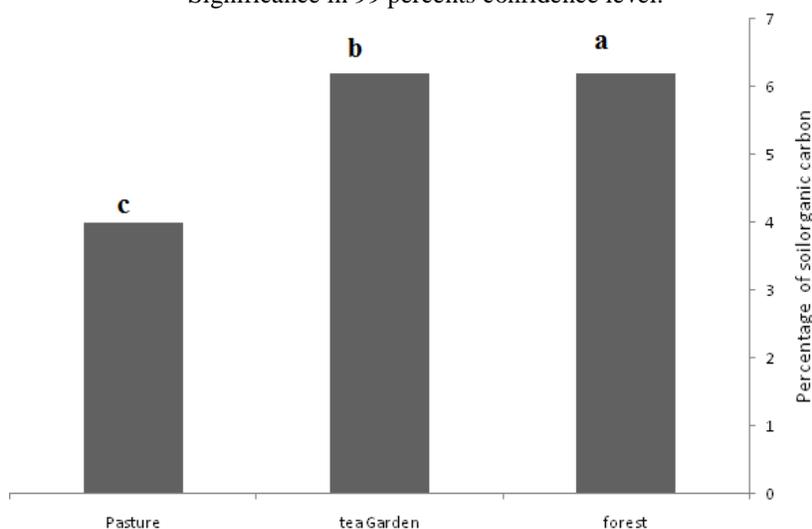


Fig. 2. Percentage of Soil Organic Carbon in 3 Fields of Forest (control), Pasture and Tea Garden.

B. Soil Nitrogen

The results of variance analysis and comparison of the average data, using Duncan's test proved that soil nitrogen percentage in 3 fields of forest (control), pasture and tea garden shows a significant difference in 95 percents probability level and average of this amount in forest mass (control) was the highest and in pasture it was the lowest (Table 2 and Fig. 3).

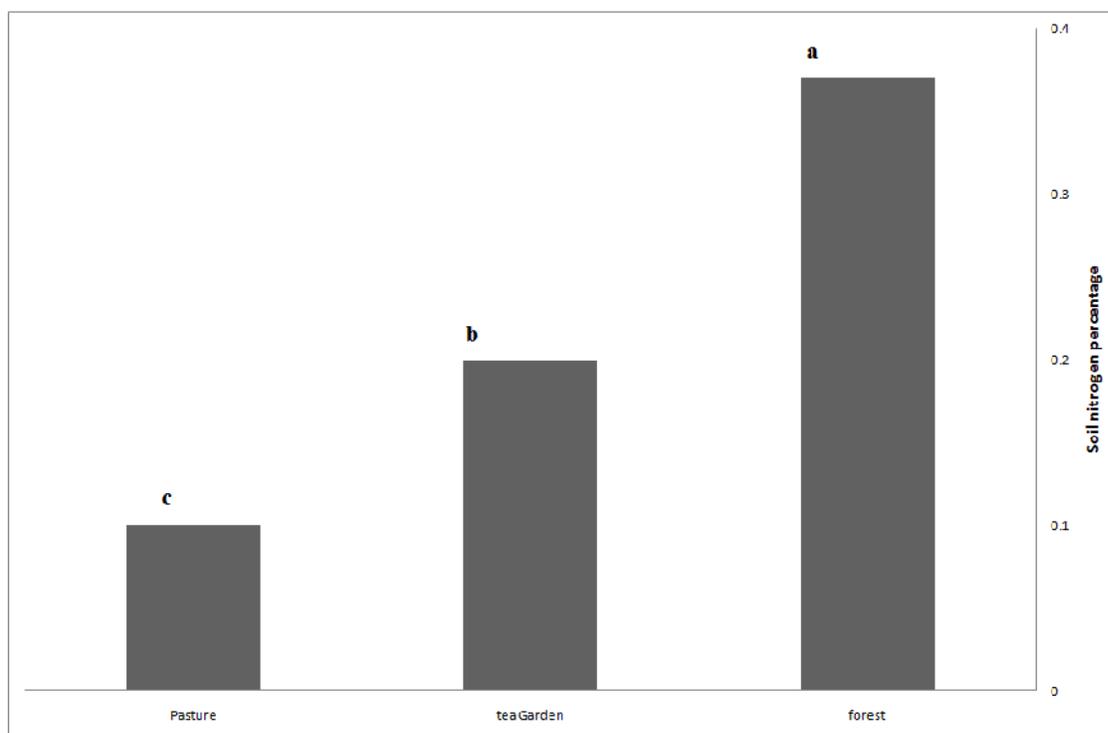
C. Carbon to Nitrogen Ratio of the Soil

The results from variance analysis and comparison of data averages using Duncan's test showed that carbon to nitrogen ratio of tea garden field has a significant difference in 95 percents confidence level with two fields of forest (control) and pasture. Average of this amount was the highest in tea garden and it was the lowest in forest (Table 3 and Fig. 4).

Table 2: Results of Soil Nitrogen Variance Analysis in 3 fields of Forest (Control), Pasture and Tea Garden.

| Change Source | Sum of Squares | Freedom Degree | Mean-square | F | Significance |
|---------------|----------------|----------------|-------------|--------|--------------|
| Treatments | 0.232 | 2 | 0.156 | 29.402 | 0.000** |
| Errors | 0.18 | 57 | 0.015 | | |
| Total | 0.412 | 59 | | | |

**Significance in 99 Percents Confidence Level

**Fig. 3.** Soil Nitrogen Percentage in 3 Fields of Forest (Control), Pasture and Tea Garden.**Table 3: Variance Analysis of Soil Carbon to Nitrogen Ratio in 3 Field of Forest (control), Pasture and Tea garden.**

| Change Source | Sum of Squares | Freedom Degree | Mean-square | F | Significance |
|---------------|----------------|----------------|-------------|-------|--------------|
| Treatments | 1399.38 | 2 | 689.69 | 8.991 | 0.011* |
| Errors | 2468.10 | 57 | 75.818 | | |
| Total | 3867.48 | 59 | | | |

*Significance in 95 Percents Confidence Level

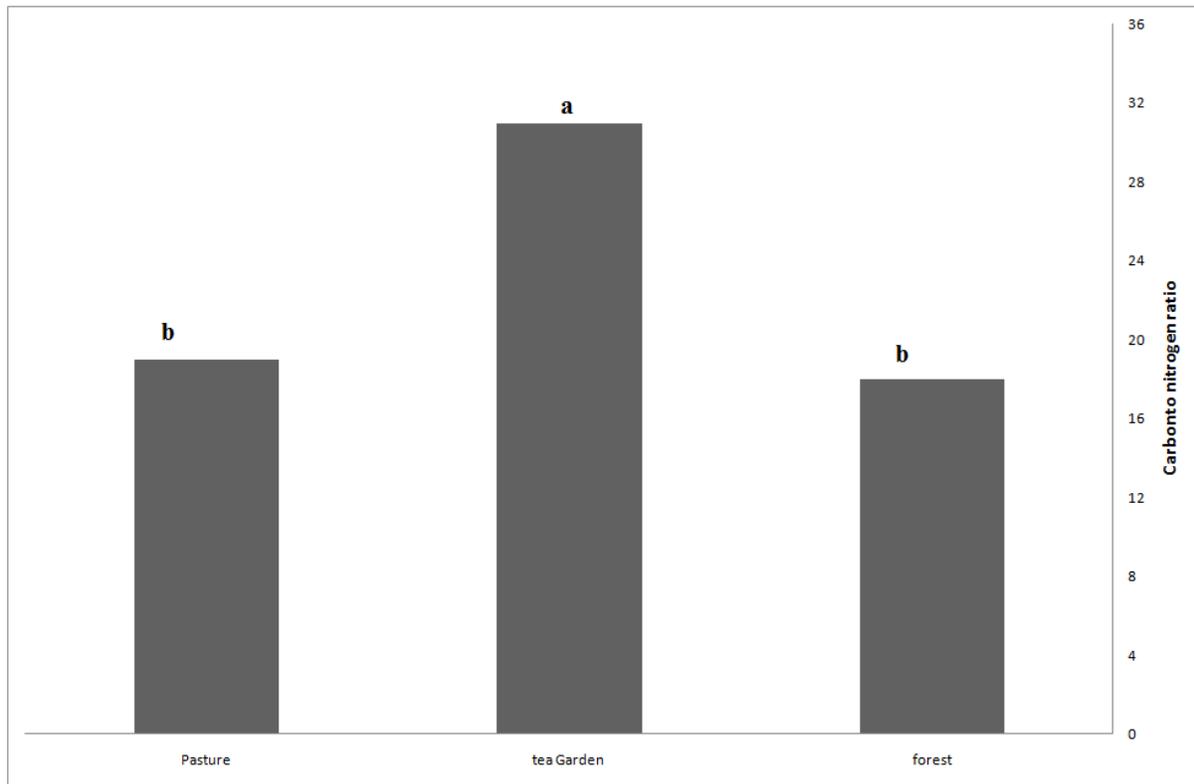


Fig. 4. Carbon to Nitrogen Ratio of the Soil in 3 Fields of Forest (Control), Pasture and Tea Garden.

DISCUSSION

Amount of soil nitrogen in the first place, closely depends on humus amount and vegetative growth which changes depending on humus type and the related plant. Also, in different horizons of a soil, the amount of total nitrogen is quite different so that, horizon A inside different types of soil has the highest and horizon c has the lowest nitrogen amount. In the lower depths that soil biological activity is totally stopped, the nitrogen level may fall to zero (August, Ranger 2001). In present research, the total nitrogen level in 3 studied areas, in forest field has been more than two others and it has a significant difference in 95 percents probability level. This may be due to existence of more leaf litters and humus layers in forest areas compared to two other areas, also because of no cultivation and abundant leaf litters there is a balance between fast decomposition of soil organic material and fast accumulation of leaf litters but this balance is not observed in agricultural lands and gardens. Lemeih and Itanna (2004), in their research mentioned reduction of organic carbon and soil nitrogen in agricultural fields compared to forest field. Average soil organic carbon was obtained 6.3 percents in forest field, 2.7 in pasture field and 6.3 in tea garden.

The results of statistical test related to organic carbon proved that pasture field shows a significant difference in 95 percents probability level with fields of forest and tea garden in terms of soil organic carbon. Increase of plant debris and plant leaves in two fields of forest and tea garden compared to pasture has caused this difference. The researches have shown that amount of soil carbon and organic materials depend on type of the existing species (August and Ranger, 2001). Results of a research studying the effect of 11 tree species on the soil showed that most of the species have increased major action concentrations in soil but only 3 species have raised the organic carbon in soil. Increase or decrease of organic carbon amount can be attributed to plant debris's and plant leaves which cause adjustment and improvement of soil physical and biological properties (Fisher, Binkli, 1999).

Carbon to nitrogen ratio in field of tea garden showed a significant difference in 95 percents probability level with pasture and forest fields. In present research, despite that the amount of organic material in forest and tea garden were almost in the same range but considering that nitrogen percentage in forest was higher and it is placed in denominator of this ratio, it causes the ratio of the forest to be lower than tea garden.

The higher the amount of organic carbon and carbon to nitrogen ratio is, implies more organic materials in that region (Zarrin Kafsh, 1376) that confirms the research findings. Another study concluded that the more the nitrogen amount in plant leaf is, the C/N relation is minimized and mineralization and decomposition of plant debris's happen faster. Carbon to nitrogen ratio has an opposite relation with soil cultivation rate (Zarrin Kafsh, 1380).

CONCLUSION

The results of this research show a significant difference in amount of nitrogen, organic carbon, carbon to nitrogen ratio, acidity and phosphorus during the forest use change into pasture and garden. According to the results, forest use change caused reduction in percentage of organic carbon, nitrogen in forest and carbon to nitrogen ratio in garden. Therefore, considering the ecological importance of Iranian northern forests, results of this research require more attention to studying the modification and land use change in this area.

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