

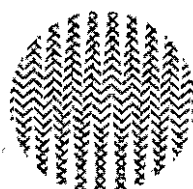
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Influence of deforestation and slope position on C and N stocks of the loess derived hillslopes of Golestan Province, Iran

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Abstract

C and N pools, populations of the microorganisms and the main soil physico-chemical properties were studied on different slope positions and land uses of the loess derived hill slopes of Golestan Province, north of Iran. The aim of this study was to determine the effect of deforestation and cultivation on the C and N pools in loess hillslopes. The results showed that the soils of the forest land use were mainly Alfisols while the adjacent deforested land use soils were mainly classified as Inceptisols indicating the lower landscape stability and loss of the previous topsoil following deforestation. Soil organic carbon (SOC), soil respiration, biomass C, population of fungi, biomass N, total N, and mineralized N were significantly higher in all the slope positions of the forest compared to the cultivated land use. Higher soil erosion, decrease in the stability of landscape, poor soil fertility, and finally natural disasters and loss of life are the consequences of deforestation in the study area.

Introduction

Depletion of the SOC pool has major adverse economic and ecological consequences, because the SOC pool serves numerous on-site and off-site functions of value to human society and well being (Lal, 2004). Much of the carbon pool is held in the topsoil, the layer which is most prone to changes upon land use conversion and deforestation. Young et al., (2005) stated that the continuous cultivation and cropping over ≥ 20 years significantly depleted SOC compared to grassy woodlands in the surface 0.2 m. Land clearing and cultivation lead to significant SOC loss due to increased organic matter mineralization (Wilson, 2002). The results of the study done by Ajami et al., (2006) revealed that cultivation has led to the deterioration of almost all studied soil quality attributes in loess hillslopes of Golestan province of Iran. Conversion of natural forests to agriculture in Golestan Province of Iran is of great concern and a main cause of annual destructive flooding. The aim of this study was to determine the effect of deforestation and cultivation on the C and N pools in loess hillslopes.

Materials and methods

The study area i.e Agh-Su is a part of the Gorganrood watershed located adjacent to Kalaleh city in eastern Golestan Province, northern Iran. The annual average soil temperature and the mean annual precipitation are 16 °C and 600 mm, respectively. The major parts of the study area are occupied by mountains and hills with the parent materials mainly composed of loess deposits. The history of deforestation goes back to almost 50 years ago. Ten pedons from different geomorphic units of a hillslope (summit, SU, shoulder, SH, backslope, BS, footslope, FS and toeslope, TS) of both forest land use and an adjacent deforested cultivated land were studied. The different horizons were sampled. Some physico-chemical analyses such as soil texture, bulk density, pH, EC, SP, CaCO₃, available P and K was carried out with standard techniques. Organic, inorganic and total carbon was measured by TOC analyzer. Total N was analyzed using TNS equipment of the soil chemistry lab. Inorganic N, soil respiration, microbial biomass C and N, net N mineralization, and population of bacteria, actinomycetes and fungi were determined in the ICRISAT, India.

Results and discussion

The soils of the forest land use were mainly classified as Alfisols in most of the slope positions. The adjacent deforested and cultivated land use however, lacked the requirement to be classified either as Alfisols or Mollisols which was mainly related to soil erosion. Figures 1 to 4 show the variation of some of the studied factors. As seen in Figure 1a, SOC is significantly higher in all the slope positions of the forest compared to the cultivated land use. The similar results were also found for the soil respiration (Fig. 1b), biomass C (Fig. 1c) population of fungi (Fig. 1d), biomass N, total N, and mineralized N. Inorganic C (IC) is

almost absent in all the different slope positions of forest indicating its favorable conditions for higher water infiltration and the downward leaching of carbonates.

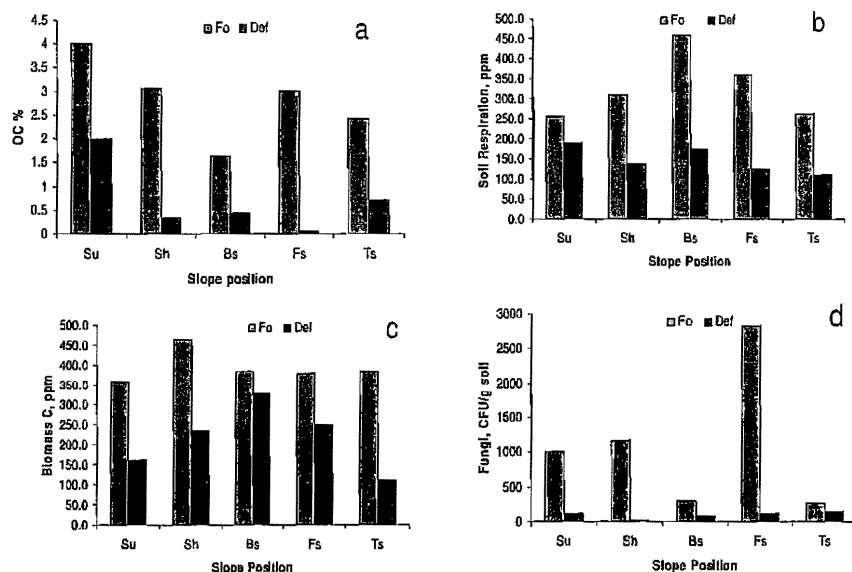


Fig. 1. OC, soil respiration, biomass C and population of fungi in the forest and deforested land uses on different slope positions

Table 1, shows the average values for the different studied parameters in the surface horizons of the forest and cultivated land uses. As seen SOC and N pools have been significantly depleted by deforestation which was largely due to the soil erosion of the highly susceptible loess derived soils. High amount of respiration in forest may be due to high new organic matter that is annually added to soil surface. Loss of organic matter in the cultivated area as a result of tillage practices and inappropriate management have caused low respiration.

Table 1. Average values for the different studied parameters in the surface horizons

Parameter	OC	IC	Bio- C	Respiration	TN	Bio-N	C:N	Fungi	Bacteria	Actinomycetes
	%		ppm					CFU/ g soil		
Forest	2.83	0.00	394	329	1797	31	13	1112	123533	273
Deforested	1.3	0.72	216	147	639	15	14.2	101	121673	264

Loss of organic matter in this sloping cultivated areas resulted in sheet and rill erosion, especially in shoulder and backslope positions. For each slope, in both surface and subsurface layers of cultivated land use, the amount of IC was significantly higher than the forest soil. Tillage is mainly responsible for uplifting of lime from underneath calcic horizons. Population of fungi was highly affected by deforestation which is mainly explained by the increase in soil pH as a result of clear cutting. In contrast, populations of bacteria and actinomycetes were not significantly affected by deforestation.

Conclusions

The present investigation showed that clear-cutting and subsequent cultivation, particularly on loess derived hillslopes could cause significant degradation of soil quality attributes. Higher soil erosion, decrease in the stability of landscape, poor soil fertility, and finally natural disasters e.g. flooding, land slide, soil creep and loss of life are the consequences of deforestation in the study area.

References

- Ajami M., F. Khormali, Sh. Ayoubi & R.A. Omrani. 2006. Changes in soil quality attributes by conversion of land use on a loess hillslope in Golestan Province, Iran. Accepted. *International Soil Meeting on "Soils Sustaining Life on Earth"*, May 22-26, Şanlıurfa-Turkey.
- Lal R., 2004. *Geoderma*, 123: 1-22.
- Wilson BR 2002. *Natural Resource Management*, 5: 7-15.
- Young R., Wilson BR, Mcleod M, Alston C. 2005. *Aust. J. Soil. Res.* 43, 21-31.