Bulletin of Environment, Pharmacology and Life Sciences
Bull. Env. Pharmacol. Life Sci., Vol 3 Spl Issue III 2014: 296-300

Online ISSN 2277-1808
Journal's URL:http://www.bepls.com
CODEN: BEPLAD
Global Impact Factor 0.533
Universal Impact Factor 0.9804

Full Length Article

Assessment the effects of land use changes on soil physicochemical properties in Jafarabad of Golestan province, Iran

Javad Rafi Sharif Abad*[1], Hassan Khosravi[2] and Esmaeil Haidari Alamdarlou[3]
[1] Combating Desertification, University of Hormozgan, Hormozgan, Iran
*corresponding author: Email: j.rafei@yahoo.com, P O. Box: 8951737664
[2] Faculty of Natural Resources, University of Tehran, Alborz, Iran
[3] Desert Regions Management, University of Tehran, Alborz, Iran

ABSTRACT

Land use changes from natural ecosystems into managed ecosystems resulted in negative effects on soil structure and quality. The main objective of this study was to determine the effects of different land-use types on physicochemical properties of soils in Jafarabad region, Northern Iran. Land use systems including natural forest, pastureland and agriculture were identified. Twenty seven of soil samples were collected from the 0-30 cm depth of three different adjacent land uses. The eleven soil physicochemical properties of soil were measured. Land use changes from forest to agriculture resulted in significant decreases in silt contents, aggregate stability, N, P, K and organic matter and with this change, bulk density, sand content and pH was increased significantly. There was no significant change in EC and clay among studied land use types. The results of study showed that forest clearing and subsequently cultivation and tillage practices resulted in the decline of the soil quality and these changes affects on soil sensitivity to degradation and erosion.

Key words: *Land use change, Forest, Cultivation, soil properties.*

Received 12.04.2014 Revised 21.05.2014 Accepted 11.06.2014

INTRODUCTION

Land use defined as the arrangements, activities and inputs people undertake in a certain land cover type to produce, change or maintain it [8]. Changes of forests to rangeland and agriculture lands are one of the most concerns in environmental degradation and world climate change [22]. Recently, due to population growth, forest lands are degraded and converted to agricultural lands. The anthropogenic changes in land use have altered the characteristics of the Earth's surface, leading to changes in soil physic-chemical properties, soil fertility, soil erosion sensitivity and content of soil moisture. Land use changes such as deforestation, conversion rangeland to cropland and cultivation are known to result in changes in soil physic-chemical and biological properties [10]. Impact of these change and their magnitude is according to land cover and land management [4],[18] Land use changes and agricultural practices, especially cultivation of deforested land may rapidly diminish soil quality. Severe deterioration in soil quality may lead to a permanent degradation of land productivity [13], [18], [11]. Transformation of one land use system into another system and different management practices can affect soil structure, soil organic carbon and other nutrients reserve [24]. Land use types affect on soil physic-chemicals and provide an opportunity to evaluate sustainability of land use systems and thus the basic process of soil degradation in relation to land use [23]. However, the information about the effect of land use changes on soil physic-chemical properties is essential in order to presentation of recommendations for optimal and sustainable utilizations of land resources. Due to an increasing demand for firewood, timber, pasture, food, and residential dwelling, the hardwood forests are being degraded or converted to cropland at an alarming rate in the hilly regions of Golestan Province, during the last few decades [3]. The forest coverage in this province has decreased by 32.2% (from 18 to 12.2 million ha) in the last 30 years [15]. Land degradation in the forms of soil erosion, declining fertility and destructive flooding are serious challenges induced by land use change over past decades in Golestan province, north of Iran. Despite the general recognition of the threat from land degradation on land productivity and ecosystem sustainability, few studies have been made to quantify the proper indicators for evaluating and monitoring soil quality. At present, approximately 60% of the study area is changed from forest to agriculture in recent years and subsequently has increased runoff and soil erosion. Realizing the seriousness of the problems and considering, the present investigation was initiated to evaluate the influence of different land use types on soil physicochemical properties in loess soils of Jafarabad region of Golestan province.

MATERIALS AND METHODS

Description of the Study Area

The study area is located between 36°47′′ and 36°52′′ northern latitudes, and 54°40′′ and 54°43 ′′ eastern longitudes, 25 km east of Gorgan City in Golestan province, northern Iran. The parent material is composed mainly of loess material highly sensitive to erosion. The mean annual precipitation (occurs mainly from October to April) and the mean annual temperature properties are 583 mm and 17.8° C, respectively. In recent years, people who live in the Jafarabad area, destroyed forests of area and cultivated agricultural crops in the clear felled forest land without using any soil conservation practices.

Soil sampling and analysis

Three soil profiles were selected for this study from three sites in each land use types including forest, pastureland and cultivated fields. Surface soil samples from 0-30 cm depth were collected using a hand auger in May 2014. A total of 27 soil samples were air-dried and passed through 2 mm sieve to remove stones, roots, and large organic residues. Soil bulk density was determined by the core method and Soil particle size analysis (soil texture) was done by the hydrometer method [11]. A wet sieving method was used to determine the percentage of aggregate stability (Water stable aggregates, WSA %) [14]. Soil pH and electrical conductivity (EC) were measured using pH meter and EC meter respectively. Organic Carbon (OC) content of the soil was determined using Walkley- Black method. Soil Total Nitrogen (TN) was analyzed by wet-oxidation procedure of the Kjeldahal method. The Available Phosphorus (P_{ava}) content was analyzed using the Olsen method, also extractable K was measured by flame Photometer.

Statistical Analysis

One-way analyses of variance (ANOVAs) procedures were used to compare the effects of different land use/land cover managements on chemical and physical properties of soil using SPSS Version 17. Separation of the means of the soil properties was performed using Duncan significance test ($p<0.05$). Additionally, Pearson's correlation coefficient was employed to evaluate the relations of various soil physicochemical characteristics.

RESULTS AND DISCUSSION

The soils of agriculture land had the highest bulk densities in comparison to other land use types that this difference was significant (Table 1). Similar finding were reported by Celik [6] that deforestation and subsequent tillage practices resulted in increase in bulk density for surface soil in southern highlands of Turkey. The results of this study are consistent with [12], [19], and [3] results. The percent of silt in agriculture land is lower than other land use types significantly but between forest and pastureland was observed no significant difference (Table 1). Subsequently, sand content is increased with changing forest to cultivated land, most likely as a result of preferential removal of silt and adding sand in soil surface by accelerated water erosion. Sand content is a physical parameter affected by soil erosion and, hence, can be measured and used as an indicator for evaluating soil degradation under different land use systems [3]. Soil texture in the land use types is silt loam. The conversion of forest into cropland is known to deteriorate soil physical properties and making the land more susceptible to erosion since macro-aggregates are disturbed [4]. Soil erosion can modify soil properties by reducing soil depth, changing soil texture, and by loss of nutrients and organic matter [17]. Clay content in this study had not significant difference among different land use types. When fine particles of soil are high, increasing in EC cause to instability of soil structure [21]. The cultivated soils were considerably lower in aggregate stability properties in comparison to other land use types (Table 1). Aggregate stability depends on interaction between primary particles and organic constituents to form stable aggregates, which are influenced by various factors related to soil environmental conditions and management practices [3]. Caravaca et al [22] indicated that aggregate stability of cultivated soils was significantly lower (mean 40%) than that of forested soils (mean 82%). The results of this study about aggregate stability are consistent with Celik [6], [9] and [12].

Soils under cultivation had higher pH than the soils under Forest and pastureland, but this rate had not significant difference between cultivated land and pastureland (Table 1). Probably the pre-weathered parent materials and the intense leaching of basic cations are the reasons for these acidic conditions. The results of Kizilkaya and Dengiz [16] research in Turkey showed a pH significant increasing from 6.03 in natural forest to 7.71 in cultivated land. The EC values of the natural forest, pastureland and agriculture soils varied from 0.57 in pastureland to 0.66 in agriculture land (Table 2). Kizilkaya and Dengiz [16] stated that changing forest to cultivated land have increased EC values in their studied area. EC content is presenting soil soluble salts components and probably the adding chemical fertilizer is a proper reason for increasing EC in cultivated lands. The results of this research showed a significant difference between different land use types for soil organic matter (SOM) and these values varied from 6.2 for natural forest to 3.45 for pastureland and 2.7 for agriculture land (Table 2). SOM has been reported as the most powerful indicator for assessing soil potential productivity in different land uses types and managements of the world [20], [1]. Significant reduction of SOM by changing forest or rangeland to agriculture land has been reported by [9], [7], [1], [3]. [17] reported that the organic matter content in soils decreased rapidly in the first few years from theirs cultivation. Cultivated soils generally have low organic matter content compared to native ecosystems, since cultivation increases aeration of soil, which enhances decomposition of SOM [16]. Considering to results, available phosphorus (AP) show not a significant difference among different land use types and pastureland slightly lower in AP than the soils under natural forest or agriculture (Table 2). The highest values of total nitrogen and absorbable potassium were observed for forest and significantly are differs from other land use types. Also lowest values were obtained for cultivated land (Table 2). [9] also suggested that cultivation decreased total soil porosity, soil respiration rate and nutrient-retention capacity. Results shown are consistent with those observed for surface soils after changing land uses [12], [3], [12].

There was a considerable degree of correlation between the physical properties and the various chemical properties measured (Table 3). The linear correlation analysis of the 11 soil physic chemical properties for the study area, showed a significant correlation among 29 of the 55 soil attribute pairs ($P < 0.05$) (Table 3). For both EC and available phosphorus properties was not showed significant difference versus other soil properties. The highest negative correlation was obtained for Potassium versus Nitrogen (r= -0.96). Results showed that there was a high correlation among physical properties such as bulk density and aggregate stability and among the various chemical properties such as soil organic matter, nitrogen and pH properties (Table 3). The findings by [12] and [3] showed similar trend in the correlation coefficients for similar studied soil properties.

Table1. Effects of land use types on soil physical properties in Jaffarabad, Iran

Soil properties / Land use	Bulk density (g cm^{-3})	Silt (%)	Clay (%)	Sand (%)	Aggregate stability (mm)
Forest	1.21^{a}	67^{a}	22^{a}	11^{a}	1.58^{a}
Pastureland	1.40^{b}	64^{a}	21^{a}	15^{a}	1.22^{b}
Agriculture	1.58^{c}	52^{b}	23^{a}	25^{b}	0.68^{c}

Table2. Effects of land use types on soil chemical properties in Jaffarabad, Iran

Soil properties / Land use	pH	EC (ds m^{-1})	Organic Matter (%)	Total Nitrogen (%)	Available Phosphorus (ppm)	Potassium (ppm)
Forest	7.1^{a}	0.60^{ab}	6.2^{a}	0.42^{a}	23^{a}	670^{a}
Pastureland	7.8^{b}	0.57^{a}	3.45^{b}	0.28^{b}	20^{a}	521^{b}
Agriculture	7.9^{b}	0.66^{b}	2.7^{c}	0.18^{c}	23^{a}	409^{c}

Table3. Pearson's correlation coefficients among measured soil properties in the 0-30 cm soil layer in studied land use types

	Bulk density	Silt	Clay	Sand	Aggregate stability	pH	EC	Organic Matter	Total Nitrogen	Available Phosphorus	Absorbable Potassium
Bulk density	1										
Silt	-0.68**	1									
Clay	0.18	-0.54**	1								
Sand	0.71**	0.91**	0.16	1							
Aggregate stability	0.80**	0.74**	-0.12	-0.81**	1						
pH	0.71**	-0.53**	0.02	0.61**	0.74**	1					
EC	0.20	-0.19	0.04	0.20	-0.35	0.22	1				
Organic Matter	-0.75**	0.58**	0.004	-0.69**	0.87**	-0.82**	-0.09	1			
Total Nitrogen	0.76**	0.67**	-0.12	-0.73**	0.93**	-0.79**	-0.32	0.92**	1		
Available Phosphorus	0.08	-0.19	0.35	0.06	-0.06	-0.12	0.15	0.12	0.003	1	
Absorbable Potassium	-0.80**	0.67**	-0.07	-0.76**	0.97**	-0.80**	-0.25	0.94**	-0.96**	0.01	1

CONCLUSION

The study of land use change and its impact will help greatly to the planning work and will show the future planning ways. The changes of natural forest and rangeland or pastureland to cultivation land have more negative effects on ecosystem, land and biosphere. The recognition of inner action and re-action of land ecosystems apposite of their changes is essential for achieving proper land management and sustainable development. Soil degradation in Gorgan is also exacerbated by soil nutrient depletion arising from land use changes together with continuous cropping, land incorrect management and absence of adequate soil nutrient saving. The results of this study showed that there are significant differences ($p<0.05$) among three land uses for all soil properties except clay and available phosphorus. Based on the results, soil nutrient in the natural forest and agriculture lands are highest and lowest respectively. Loss of organic matter is expected to have soil aggregates easily broken down, and consequently the finer particles are transported by erosion. Increased SOM improves aggregation, water holding capacity, nutrient-retention capacity and biodiversity in soil [3]. The low values of aggregate stability and high amount of bulk density in agriculture land is indicating weak and sensitive condition of cultivation land soil surfaces. The results showed that with changing forest or pasture land to cultivation land, physicochemical properties of soil are subjected to degradation and erosion. Degradation of natural forest and subsequent cultivation of soils had the negative effects on measured soil properties. Management practices that increase OC, TN, P_{ava} and potassium in the system should be included, when the land is continuously cultivated.

REFERENCES

1. Ajami M, Khormali F, Ayoubi S, Omrani RA. (2006). Changes in Soil Quality Attributes by Conversion of Land Use on a Loess Hillslope in Golestan Province. Iran. 18th International Soil Meeting (ISM) on Soil Sustaining Life on Earth, Maintaining Soil and Technology Proceedings, Soil Science Society of Turkey 501-504.
2. Ayele T, Beyene S, Esayas A. (2013). Changes in land use on soil physicochemical properties: the case of smallholders fruit-based land use systems in Arba Minch, southern Ethiopia. international journal of current research 5 (10), 3203-3210.
3. Ayoubi S, Khormali F, Sahrawat KL, Rodrigues de Lima AC. (2011). Assessing impacts of land use changes on soil quality indicators in a loessial soil in Golestan province, Iran. Journal of Agriculture Science Technology 13, 727-742.
4. Baskin M, Binkley D. (1998). Change in soil carbon following afforestation in Hawaii. Ecology 79, 823-833.
5. Bouyoucos GJ. (1951). A re-calibration of the hydrometer methods for making mechanical analysis of soils. Agronomy Journal 43, 434-438
6. Celik I. (2005). Land use effects on organic matter and physical properties of soil in a southern Mediterranean highland of Turkey. Soil and Tillage research 83, 270-277.
7. Chidumayo EN, Kwibisa L. (2003). Effect of Deforestation on Grass Biomass and Soil Nutrient Status in Miombo Woodland, Zambia. Agriculture, Ecosystem & Environ 96, 97-105.
8. Di Gregorio A, Jansen LJM. (1998). Land Cover Classification System (LCCS): Classification Concepts and User Manual. For software version 1.0. GCP/RAF/287/ITA Africover - East Africa Project in cooperation with AGLS and SDRN. Nairobi, Rome.
9. Evrendilek F, Çelik I, Kilic S. (2004). Changes in Soil Organic Carbon and other Physical Soil Properties along Adjacent Mediterranean Forest, Grassland, and Cropland Ecosystems in Turkey. Journal of Arid Environment 59, 743-752.
10. Houghton RA, Hacker JL, Lawrence KT. (1999). The U.S. carbon budget: contribution from land use changes. Science 285, 574-578.
11. Islam KR, Weil RR. (2000). Land use effects on soil quality in a tropical forest ecosystem of Bangladesh. Agriculture, Ecosystems & Environment 79, 9–16.
12. Islam KR, Kamaluddin M, Bhuiyan MK, Badruddin A. (1999). Comparative performance of exotic and indigenous forest species for tropical semi-evergreen degraded forest land reforestation in Bangladesh. Land Degradation & Development 10, 241–249
13. Kang BT, Juo, ASR. (1986). Effect of forest clearing on soil chemical properties and crop performance. In: Lal, R., Sanchez, P.A., Cummings, Jr., R.W. (Eds.), Land Clearing and Development in the Tropics. Belkema, Rotterdam pp, 383–394.
14. Kemper Wd, Rosenau RC. (1986). Aggregate stability and size distribution/ method of soil analysis, Part 1: Physical and mineralogical methods, Agronomy Monograph No 9, ASA-SSA- Madison USA, 425-442.
15. Kiani F, Jalalian A, Pashae A, Khademi H. (2003). Effects of Deforestation on selected Soil Quality attributes in Loess derived Land Forms of Golestan Province, Northern Iran. *Proceeding of the 4th International Iran and Russian Conference*, Shahrekord, 546-550.
16. Kizilkaya R, Dengiz O. (2010). Variation of land use and land cover effects on some soil physico-chemical characteristics and soil enzyme activity. Zemdirbyste-Agriculture 97(2), 15-24.
17. Lobe I, Amelung W, Du Preez CC. (2001). Losses of carbon and nitrogen with prolonged arable cropping from sandy soils of the South Africa Highveld. European Journal of Soil Science 52, p 93.

18. Nardi S, Cocheri G, Dell'Agnola G. (1996). Biological activity of humus. In: Piccolo, A. (Ed.), Humic Substances in Terrestrial Ecosystems. Elsevier Amsterdam, 361–406.
19. Paul KI, Polglase PJ, Nyakuengama JG, Khanna PK. (2002). Change in soil carbon following a forestation. Forest Ecology and Management 168, 241-257.
20. Shukla MK, Lal R, Ebinger M. (2006). Determining Soil Quality Indicators by Factor Analysis. Soil Tillage Research 87, 194-204.
21. Tayel MY, Abdel-Hady M, Eldardiry EI. (2010). Soil structure affected by some soil characteristics. American-Eurasian Journal of Agriculture & Environmental Science 7(6), 705-712.
22. Wali MK, Evrendilek F, West T, Watts S, Pant D, Gibbs H, McClead B. 1999. Assessing terrestrial ecosystem sustainability: usefulness of regional carbon and nitrogen models. Natural Resources 35, 20-33
23. Woldeamlak B, Stroosnijder L. (2003). Effect of agro ecological land watershed, Blue Nile basin, Ethiopia. Geoderma 111, 85-98.
24. Yeshanew A, Welfgang Z, Guggenbeyer G, Tekalign M. (2004). Soil aggregation and total and particulate organic matter as affected by conversion of native forests to 26 years continuous cultivation in Ethiopia. 203 pp.