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Research Paper

Study aggregates stability and some physical and chemical properties of soil in Avard Watershed

Z. Jafari[a], H. Niknahad Gharmakher[b], M. Ghasemi[c], E. Jafari[d]

a.M.s students of Rangeland and watershed faculty of Gorgan University of Agricultural Sciences and Natural Resources, Gorgan, Iran.

b.Assistant professor of Rangeland management Department of Gorgan University of Agricultural Sciences and Natural Resources, Gorgan, Iran

c. students of Rangeland and watershed faculty of Gorgan University of Agricultural Sciences and Natural Resources, Gorgan, Iran.

d. M.s students of Rangeland and watershed faculty of Gorgan University of Agricultural Sciences and Natural Resources, Gorgan, Iran.

Corresponding Author: jafariz68@yahoo.com

Abstract: To preserve soil fertility and improve its performance, knowledge of the effects of land use changes on soil properties is necessary. In recent years, gardening on the low efficiency agricultural lands has been suggested. due to extensive land use change, this research was done to quantify the effects of gardening on some physical and chemical properties of soil in Avard Watershed**.** After the study area was identified by field survey and GPS, Three composite soil samples were taken from the depth of 0-30 cm of each land use (natural forest, Walnut Garden, Walnut – apple garden, cereal farm, and frijol farm). Some soil physical (Texture, Aggregate stability, Bulk density and Porosity) and chemical properties (Organic carbon, pH, and Electrical conductivity) were measured in laboratory. Data analysis was performed by $SPSS_{16.0}$ soft war. In order to compare the means of study parameters, tukey test at a significance level of 5% was used. The results demonstrated that only soil aggregate stability was significantly improved as a result of gardening on the low efficiency agricultural lands.

Keyword*:* Avard, Gardening, land use, physical and chemical properties**.**

Introduction

Soil is an important nonrenewable natural source. Todays, different studies show that the human affect soil that unfortunately is often associated with negative outcomes. Therefore, According to the importance of soil in relation to feeding the world's growing population, knowing all soil properties is essential (Khademi and et.al, 1383). Disturbances due deforestation, overgrazing, uncontrolled fires and conversion rangelands, forests to agricultural lands in Iran (Hajabbasi and et.al,1997), and in other parts of the world (Doran and Parkin, 1994) leading to degradation of physical, chemical and biological soil quality. Now, change the forests and rangelands into agricultural land convert a significant concern worldwide in the field of environmental degradation and global climate change (Wali and etal, 1999). Spaans and etal (1989) expressed land use change can make the soil susceptible to degradation. Research shows that changes after deforestation and farming operations, can reduce soil organic matter(Vagen and etal ,2006), reducing the amount of plant available elements(Lu and etal ,2002), special to severe losses of N(Likens and etal, 1970) and reducing the porosity, permeability and water holding capacity(Lu and etal, 2002). Annual percentage deforestation in the northern provinces of the country (Gilan, Mazandaran and Golestan), respectively, /02, 49/0 and 69/0 is estimated (Mirakhorlou and etal, 2006). Uninformed and unscientific land use cause acceleration decomposition of soil organic matter and affect other physical, chemical and biological features and land use change causes significant change in the amount of organic matter, total nitrogen and the ratio (C:N) (Sanchez-Maranon and etal, 2002. Yimer, 2007). Study soil characteristics changes in identifying the effects of different management in agriculture land and natural resources, including, rangelands and forests degradation and lands reclamation are important. If these studies reflect management effects on soil quality in the short term, are useful solution in order to know sustainable managements in each region to prevent from soil degradation, creation and stabilization of sustainable production and environment(Yousefifard and etal, 2007.Six and etal, 2000). In recent years, the construction of productive gardens in low- yielding agriculture lands improve the soil characterizes and reduce erosion has been introduced.

The purpose of this study, is studying the effects construction of productive gardens on some physical and chemical properties of low-yielding agricultural lands in the watershed Award Mazandaran. In the few last decades, these lands of natural forest use were converted to agricultural lands. Expected results of this study, provide useful information for sustainable land use of region lands case study will be helpful and in development of future management practices in this area.

Material and Methods

Description of the area study

Award watershed is located in the Mazandaran province and the coordinates 37" and 42' and 53° to 18" and east longitude 57' and 53° and 40" and 35' and 36° to 05" and 39' and 36° north latitude 's. These basin, with an area exceeding 9410/74 hectares, equivalent to 941074 square kilometers, is one of Neka river branches and is sub-basin the Neka River Basin, which is located in the east Mazandaran and South Glogah. Villages in the watershed: Award, Nyala, Yakhkesh, Sefid Chah, Pjym, Ramedan. According to the morphology and properties of altitude area, this watershed is of the mountainous watershed overlooking Neka river valley. Since these watershed is a non-hydrological basin and is composed of the independent and connected units, it has no unit main stream, but Neka river, that is the southern border basin can be considered as the main stream with 1400 meters in length and originate from the northern highlands and passing through the middle of the basin to exist of the southwest the basin output. Based on Amberzhe climate, Award basin is located in cold Mediterranean region and according to Domarton method, in the semi wet weather. According to the maps of rain and statistical periods of gauge rain, the rainfall average in the basin is about 459/10 millimeters in year that higher percentage is in the form of rain. The temperature average in the region is 11/46 °C in year, that is the lowest average temperature in month January and also the highest in the month July.

Field Operations and soil sampling

In this study, first by using Google Earth images, the initial boundaries was performed, and then through field visits and using the GPS device was controlled. After identifying the area, the three soil composite samples from a depth of 30-0 cm per treatment (natural forest, Walnut Garden, Walnut – apple garden, cereal farm, and frijol farm) were obtained and the total 15 composite sample in order to measure the chemical and physical soil parameter.

Laboratory Methods

After transferring the soil samples to a laboratory for experimental studies of soil, samples were dried in the air. Part of the samples with some aggregates determine the aggregates stability of the soil by Mean Weight Diameter (MWD) and also for measurement soil bulk density of the other samples were separated. Then, all soil samples after beating by sieve of 2 mm were sifting. To determine soil texture, after the decomposition of organic substances with Hydrogen peroxide and removal clays cohesion property with cologne salt, hydrometer method (Bouyoucos, 1962) was used. Bulk density by using the aggregate and paraffin method (Black and Hartge, 1986) and total porosity of the soil samples (F) in terms of percentage using soil bulk density was calculated:

$$F = 1 - \frac{(\text{soil bulkdensity})}{(\text{soil bulkdensity})} \times 100$$

In this equation, the soil bulk density is based on the measurements on the basis gram on cube centimeters and soil bulk density equal to 2/65 gram on cube centimeter. aggregate stability by wet sieving method (Kemper and Rosenau, 1986) was measured and the quantity as mean weight diameter (MWD) was calculated:

$$\text{MWD} = \sum_{i=1}^{n} \bar{x} w_i$$

In this equation, aggregates diameter mean remains on each sieve and wi aggregate weight ration remains on each sieve to the total weight of the sample and n is the number of sieve. Modified clay ratio (MCR) indicator was calculated from the formula:

$$\text{Modified clay ratio} == \frac{\%\,\text{clay} + \%\,\text{silt}}{\%\,\text{organic matter} + \%\,\text{clay}}$$

Soil acidity in saturated mud and by using a pH meter with glass electrode were measured (page and etal, 1987). Electrical conductivity using electric conductivity device in the saturation extract was determined (page and etal, 1987). Organic carbon oxidation by potassium dichromate in the presence of concentrated sulfuric acid was carried out and ammonium ferrous sulfate half-normal adjacent phenanthroline reagent by titration method, the amount of organic carbon was measured (Nelson, 1982).

Statistical analysis of the data

The statistical analysis over data was performed by using SPSS 16.0 software. At first, data based on absence of abnormalities such as outliers were controlled. After the homogeneity of variance test the null hypothesis of being equal parameters averages studied in various management, analysis of variance(ANOVA) was performed. Then in order to compare the means, Tukey test at 5% significance level was used and effects of gardening on some soil quality indicators were compared.

Results and Discussion

Soil texture: Soil texture show relative abundance of sand, clay and silt particles in the soil sample. soil texture especially with their impact on soil moisture conditions can determine plant growth, yields and even types of trees that grow in a region (Mahmoodi and Hakimian 1999). Results of soil constituents (Table1) indicate that due to land use changes, the sand particles percentage significantly were increased and the silt particles percentage significantly were decreased ($P<0.05$). Clay particles Percentage has decreased as a result of land use change, although this decrease is not significant ($P>0.05$). These changes lead to change in soil texture of sandy clay loam in natural forest to lighter texture sandy loam. Gardening in the studied area could not cause a change in soil texture. Bewket & Stroosnijder (2003) and Martinez-Mena and etal (2008) have observed in their studies that as the result of change in forest land use, clay and silt percentage in the soil texture reduced and the amount of sand is added. The explanation for this phenomenon could be argued that the change forest land use cause reduces soil organic matter and consequently, reduces the aggregate stability and increase rate of erosion. During the erosion selection process for the isolation soil particles, clay and silt particles isolated, transported to downstream areas, and in long-term it can lead to changes in soil texture (Bewket & Stroosnijder, 2003. Celik, 2005).

Aggregate stability: The resistance of aggregates against being torn is called aggregates stability by forces associated with water (NRCS, 1996). Mean weight diameter results in different land uses (Table 1) indicate that aggregate stability in cereal and frijol farm in comparison to natural forest land use significantly has been decreased($P<0.05$). But by gardening (walnuts and walnut - apple) significantly ($P<0.05$) has been increased. Celik (2005) Showed that the mean weight diameter and aggregates stability in the rangelands and forest soils were higher compared with agriculture soil. Carter (2002) the explains the reduction in aggregate stability is demonstrator unstable land use. The amount of aggregate stability more associated with soil organic matter than anything else is (Kavdir and etal, 2004). Coarse aggregates are broken by farm operations and also soil organic matter exposed to losses (Haynes, 1999. Shepher and etal, 2001). Bronik and lal (2005) showed that the soils with natural cover significantly have larger and more stable aggregates than soils that are cultivated. This could be due to greater microbial biotic biomass, residue and roots of plants, polysaccharides and humus substances in soil coarse aggregate.

Bulk density and total porosity: Changes in bulk density due to tillage operations are affected by temporary and permanent changes (Franzluebbers, 2000. Ferreras ,2000. Murti, 2002). The results (Table 1), indicates that there isn't the significant difference between the bulk density mean different land use (P>0.05). Also, the total porosity percentage in the soil different land use, has no significant differences with each other (P>0.05). In this study, the highest bulk density and lowest porosity can be observed in farm lands (Table 1) and gardening (walnuts and walnut-apple) has improved these parameters. Bulk density may vary by affected land management that impact on vegetation type and soil organic matter, soil structure and porosity. Forest land use change to cause degradation soil organic matter and natural stabilization aggregates through prone it to the loss caused by water and wind is decreased. When the eroded soil particles, soil pores are filled, porosity is decreased and bulk density is increased. In long-term increase in soil bulk density can lead to restrictions on the growth of plant roots (celik, 2005). Decrease in aggregate stability and increased soil bulk density in cultivated land (cereal farm and frijol farm), reflecting the increasing loses of soil adhesive material, reducing soil biological activity and the movement of air and water in the soil is poor and may lead to a decrease rooting depth of plants and weak growth (Jaiyeoba, 2003).

Table 1 – Comparison average some of physical parameters soil quality in different land use.

Land use	Clay (%)	Sand (%)	Silt (%)	Soil texture	MWD (mm)	Bulk density (g/cm^3)	Porosity (%)
Rangeland	a16	b77	b7	sandyloam	a8/49	a0/67	a74/66
Walnut-apple garden	a 17	b76	b7	sandyloam	a7/21	a0/68	a74/66
Walnut garden	a19	b74	b7	sandyloam	a8	a0/66	a75/33
Natural forest	a29	a61	a 10	Sandyclay loam	a9/87	a0/67	a73
Cereal farm	a17	b76	b 7	sandyloam	b 4/92	a0/72	a70/33
farm frijol	a19	b77	C 4	sandyloam	b4/58	a0/79	a70/66

* Similar letters indicate no significant difference at 5% level

pH: Soil reaction or pH, is represented soil acidity or alkalinity. Soil pH is influenced on factors such as availability of nutrients required by plants, heavy metal mobility and activity of soil microorganisms. Although, soil pH may change due to the different managements the lands (NRCS, 1996), according to the results obtained (Table 2), it did not show any significant difference among the mean values in different land use (P>0/05). The results obtained (Table 2) indicate that soil pH mean in the natural forest is less than cultivated land use and in the gardening lands, the soil reaction is intermediate state of the two users. Kiyani and etal (2004) Suggests that in forest soils, alkali ions were washed and therefore the soil acidity in forest areas is higher than other areas. In forest ecosystems soils, factors such as leaching alkali cautions, the processes of nitrate (Nitrification), Production of organic acids along with carbonic acid release from roots and soil microbial respiration are considered as the mechanisms controlling soil pH (NRSC, 1999). The more alkaline the soil caused by land use changes, may be the reflect differences in litter quality and its effects on soil microorganisms and application probable nitrate fertilizer. According to Figure1, the soil alkalinity in all the treatments case study based on providing available phosphorus plant roots is restriction.

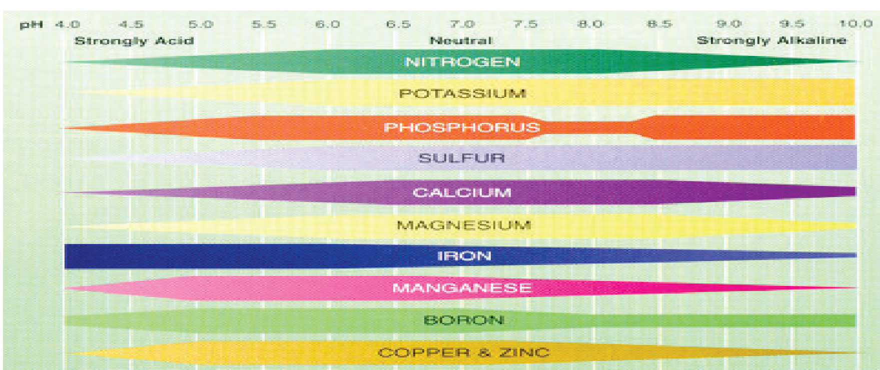

Figure 1 - Effect pH on microbial activity and provide elements (Niknahad & marmai, 1390).

Electrical conductivity (EC): soil EC is representative volumes of the soil conductive solution. Soil salinity is one of the factors that limits plant growth that emerge of the accumulation of salts in soil and with increasing concentrations of soluble salts will be high.

Although all treatments case study among soils are non-saline (Azarnivand and Zare ChahoUki, 1389), the results (Table 2) indicate that soil EC in cultivation soils has been increased and soil EC in the cultivated land use is significantly higher in comparison to natural forest land use (P<0.05). The soil EC in gardening lands (walnuts and walnut - apple) is reduced, so that there is no significant differences in any of the other land uses (P>0.05). In treatments cultivation the soil EC significantly increased could be due to reduced cover vegetation. Reduction of vegetation and litter lead to increased soil temperature and soil moisture is reduced. Reducing moisture lead to increase salt concentration in the soil and also electrical conductivity increases (Chaneton & Lavado, 1996).

Table 2 - Comparison average chemical parameters of soil quality in different land use.

C (%)	Ec (ds/m)	PH Log[H^+]-	Land use
[ab]4/67	[a]0/21	[a]7/84	Rangeland
[b]3/60	[ab]0/18	13/[a]8	Walnut-apple garden
[b]3/08	[ab]0/17	18/[a]8	Walnut garden
[b]3/54	[b]0/25	[a]8/21	Cereal farm
[b]4/22	[b]0/26	[a] 8/20	frijol farm
[a]8/57	[a] 0/16	[a]7/77	Forest

* For each land use, similar letters indicate no significant difference at the 5% level.

Organic carbon: Results obtained (Table 2) indicate that land use change had a significant negative effect on soil organic carbon and organic carbon content is decreased as a result of land use change (P<0.05). Gardening (walnuts and walnut - apple) couldn't have a positive effect on these parameters, also the amount of organic carbon in gardening lands soils significantly are lower than the rate of soil organic carbon in natural forests. Organic matter through the influence on soil physical and chemical properties and also control microbial activities, plays a important role in soil properties (Solomon and etal, 2002). Knowledge of quantitative and qualitative characteristics of soil organic carbon (SOC) to maintain the quality and productivity soils is essential (Velayutham ,2000). The most important factor in acceleration the decline soil organic matter is tillage operation that cause increasing the rate of decomposition of soil organic matter during plowing operations. Also, tillage causes the lower layers of the soil with organic matter mixed less with top soil contains more organic matter and topsoil organic carbon percentage decreases (Aguilar and etal, 1988).

Conclusions

According to the results of this study, especially the soil texture change, significant reduced aggregate stability, soil organic matter, and also significant reduce the conversion of forest land into agricultural lands (cereals and frijol), can be concluded that maintaining natural forest land is the most appropriate land use in the watershed Award, but according to the existing realities and also deforestation and replace it with tillage, virtually reclamation natural forest is impossible and insistence on it will be included socio - economic impacts. Therefore, according to the significant improvement in aggregate stability and other characteristics studied in this research in gardening lands than agricultural lands, convert and transform this lands into productive gardens can be recommended. Operation these recommendation is required to provide comprehensive project, systematic and integrated management and also, of the supply of credit. Prevention of land degradation, control soil erosion flow, creating jobs, preventing migration and land reclamation of the most important advantages convert and change agricultural lands use to productive gardens. Problems such as lack of funds, weak comprehensive programs, lack of support, poor information, unfamiliar with its benefits and water supply, the operation of these proposal would be difficult.

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