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Research Paper

Effect of physiographic factors on Soil Carbon Sequestration in Kermanshah (Iran)

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Abstract: Some of the most important local factors on Carbon Sequestration in soil, is climate and topographic features (such as altitude, aspect and percent slope), In order to study the effect of slope aspect and elevation for Soil Carbon Sequestration took over in Kermanshah province .For this search 6 height class and 4 main slopes aspect was selected and sampling of the soil was done 0-30 cm randomly. Results showed that increasing the height increases the amount of Carbon Sequestration.Most Carbon Sequestration 52.73 tons, was at an altitude of 2100 meters in the north aspect, That is far from the grazing and human activity and vegetation growth is not limited .Results showed that the physiographic plays important role in land management order to access the Carbon Sequestration Soil Considering the physiographic and climatic conditions different management schedules including replanting species, grazing and soil protection should be considered.

Keywords: Physiographic, carbon sequestration, Kermanshah, Iran

Introduction

Physiographic properties (such as elevation, slope shape, slope degree and aspect) and climatic conditions (such as precipitation, temperature and radiation) are among the most important factors affecting soil carbon sequestration for each region. Landscape attributes including slope, aspect, elevation, and land use are the dominant factors influencing SOC in areas with the same parent material and climate regime(Dianwei et al,2006).On the other hand the in between soil properties, soil organic matter is an important component of terrestrial ecosystems. Changes in the abundance and composition of(soil) has the major effects on many processes that occur in any system (Batjes, 1996) .Soil carbon storage estimation in regional, national and global scale has most important in carbon cycle changes assessing (West etal, 1994) .Human beings are accelerating the rate of increase in atmospheric CO2 concentration through fossil fuels burning, land use, land-use changes and forestry activities, resulting in global warming and climate change during the recent times (Upadhyay et al. 2005). The average atmospheric CO2 concentration has increased from pre-industrial concentration of 280 µmol mol^{-1} to 364 µmol mol^{-1} in 1994, and is currently increasing at a rate of about 1.5 µmol mol^{-1} $year^{-1}$ (Kelling and Whorf 1998). A rise in global mean temperature by 0.74°C has already been recorded, and hence climate scientists are focusing on an urgent action to curb global warming (IPCC 2007; Kerr 2007). Vegetation play an important role in regional and global carbon (C) cycles because they store large quantities of C in vegetation and soil, exchange C with the atmosphere through photosynthesis and respiration, are sources of atmospheric C when they are disturbed by human or natural causes, become atmospheric C sinks during re-growth after disturbance, and can be managed to sequester or conserve significant quantities of C on the land (Brown et al. 1996). The elevation and slope aspect play a key role in determining the temperature regime of any sites. Within one elevation, cofactors like topography, aspect, inclination of slope and soil type affect the forest composition (Shank and Noorie 1950).The microenvironment of different aspects of hill slopes is influenced by the intensity and duration of available sunlight (Yadav and Gupta 2006). With the intense focus on the increasing levels of atmospheric CO2 and the potential for global climate change, there is an urgent need to assess the feasibility of managing ecosystems to sequester and store C (Johnson and Kern 2002). Many studies over the past, Naderi etal, 1386 the effect of height and slope on soil carbon storage concludes the only significant effect of altitude on soil carbon and Soil organic carbon was highest at the highest altitude. Heidari etal, 2010 investigated the effects of climate and physiographic properties on soil Carbon distribution and sequestration. The results show that except for the lowest elevation class organic carbon contents decrease with increasing elevation. In other words the Maximum organic carbon content belongs to elevation class no. 2 (2250- 2500 m), which corresponds to precipitation class no. 3. The highest carbon content was observed in middle precipitation class and elevation class no. 2. The SOC increased with increasing altitude, probably due to the quality of litter fall and lower rate of decomposition in the summit forest (Tsui etal, 2004). Study results of Han et al 2009 in investigation effect of topography and vegetation type on soil carbon storage in China showed that geographical aspect influence on Carbon Sequestration in the ecosystem. Evaluation of organic matter and mineral content in some soils by Brown et al 2004 showed, Sequestration of organic carbon in the northern slopes is greater than other aspects. Sharma et al 2011, Variation in carbon stocks on different slope aspects in seven major Forest types of temperate region of Garhwal Himalaya, India conclude that Soil organic carbon in the northern aspect is higher than South aspect Considering the importance of Soil Carbon Sequestration and region good position in the elevation range (1100-2100), also several slope aspects on each class to make good position to study the effects of slope and elevation for this research.

Materials and Methods

Characteristics of the region under study

The area of study is located on rangeland Kermanshah Province .This region is on a longitude of 46°, 27' and latitude of 34°, 48' (Figure 1). Minimum and maximum elevation is 1071 and 2083 meters above sea respectively. Average annual temperature is 10.22 °C that the averages of maximum and minimum are 18.22 °C, 5.51 °C, respectively. The average annual precipitation is approximately 626.8 mm.

Figure 1. Schematic location of the studied area.

Research method

Kermanshah province, an area of 3198 hectares of rangelands have been selected for this studyAccording to the position of region the fifth class 200 meters distance with respect to changes in dominant plant canopy cover (1100-2100 m) in 4 main aspects was chosen and overlay maps of elevation class and geography aspects was chosen equal region. Then the equal areas of soil samples were taken randomly from a depth of 0-30 cm. Gao et al (2007) argue that changes in soil organic carbon at depths greater than 30 cm is very small. The soil samples were dried in an oven at 105°C for 72 h and then weighed until two subsequent values were Constant (Brown,2004). The soil samples were sieved through a 2 mm sieve and then thoroughly mixed. Walkley and Black's rapid titration method (Walkley 1947) was used for organic C estimation, which is a widely used procedure (Brown 2004; Pearson et al. 2005) for organic C estimation because it is simple, rapid and has minimal equipment needs (Nelson and Sommers 1996). In order to calculate the percentage of the total carbon, bulk density was obtained by clod method (Macdicken, 1197.) Regarding the goal of study, the mineral layer thickness, carbon accumulation and bulk density of soil were specified as the variables. In order to determine the amount of the sequestrated carbon by the gram per meter square, the formula 1 was employed

Formula 1. (Brown, 2004) Cc = 1000C (%) Bde,

In this formula, **Cc** refers to the amount of the sequestrated carbon weight per meter square. **C** signifies the percentage of the accumulated carbon in the calculated depth of soil. **Bd** represents the bulk density of and **e** denotes the thickness of the soil depth by the centimeter. The gathered data were processed using Excel software 2003, and their analyses were performed on the SPSS Version 12. Variation analysis of one way was utilized to examine total compressions and Duncan Test was applied to compare the mean of carbon sequestration (Zar, 1196).

Result

Results of analysis of variance Physiographic factors on Soil Carbon Sequestration shows that between different geographical directions on each class there is a significant difference at 5% level (Table 1)

Table 1. Results of analysis of variance Physiographic factors on Soil Carbon Sequestration

Elevation class	Changes source	Sum of squares	df	Mean square	F	sig
1100-1300	Variance between groups	83.52	3	27.48	6.36	0.005*
	Variance within groups	70.03	16	4.37	-	-
	Total	153.55	19	-	-	-
1300-1500	Variance between groups	180.09	3	60.3	8.04	0.002*
	Variance within groups	119.35	16	7.46	-	-
	Total	299.45	19	-	-	-
1500-1700	Variance between groups	749.7	3	249.9	9.95	0.001*
	Variance within groups	401.73	16	٢٥	-	-
	Total	1151.43	19	-	-	-
1700-1900	Variance between groups	868.41	3	289.47	16.23	0.000*
	Variance within groups	285.36	16	17.83	-	-
	Total	1153.77	19	-	-	-
1900-2100	Variance between groups	746.86	3	248.95	10.62	0.00*
	Variance within groups	347.89	16	23.43	-	-
	Total	1121.75	19	-	-	-

*Different letters indicate significant differences in 5% level.

Results of Soil Carbon Sequestration mean Comparison shows that in the first elevation the highest and lowest Carbon Sequestration is in the north and south aspect. There are no significant different among South, west and east aspect (Figure 2). In the second elevation class between South and West aspect there is no significant different and the lowest Sequestration in the same aspect and while most Sequestration is seen in North aspect (Figure 3). In third, fourth and fifth elevation classes was the most carbon sequestration in north aspect and no significant different among south, west and east aspects (Figure 4, 5,6).

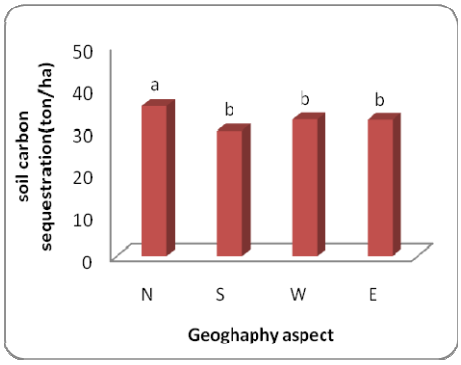

Figure 2. Comparison of mean the first elevation class on soil Carbon Sequestration

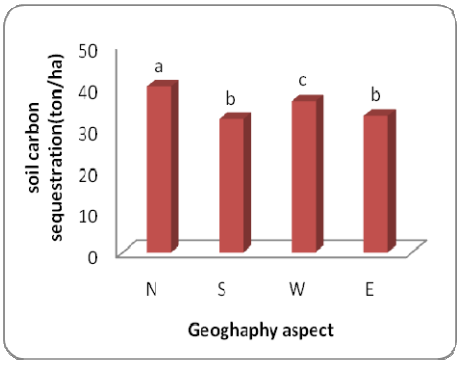

Figure 3. Comparison of mean the second elevation class on soil Carbon Sequestration

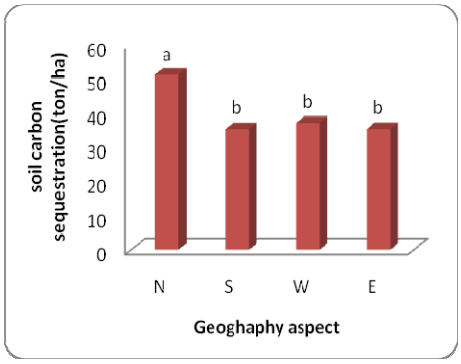

Figure 4. Comparison of mean the third elevation class on soil Carbon Sequestration

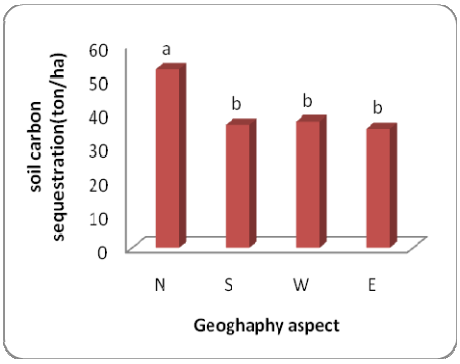

Figure 5. Comparison of mean the fourth elevation class on soil Carbon Sequestration

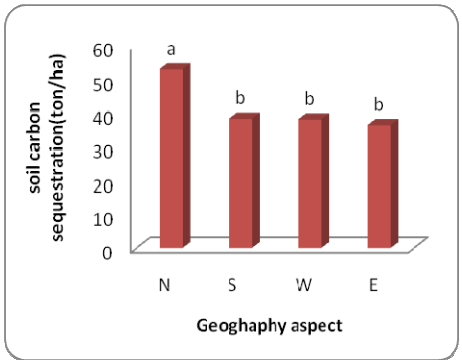

Figure 6. Comparison of mean the fifth elevation class on soil Carbon Sequestration Different letters indicate significant differences in 5% level.

Conclusion and Discussion

Elevation and aspect changes, would climate and environment change and this process with influence on the type and amount of chemical, physical and biological and plant composition type basically affects on deposition processes and characteristics of soil for example organic matter (Hutchins etal, 1976).Mean Comparison results show that the fourth and fifth elevation classes (1700-1900, 1900-2100) contains the highest amount of organic carbon.On the one hand due to increased plant biomass at high elevation and the change in temperature and precipitation at higher elevation increase the organic carbon accumulation in soil. At lower elevations due to low rainfall and severe grazing, soil and vegetation destroyed and soil organic carbon levels are low The Naderi et al 2006 and Heydari et al 2010 is consistent with the results. Also results show that the soil Carbon Sequestration is different in adverse aspects So that in all classes North and South, West has the most and lowest carbon Sequestration consequently. North aspect for having moisture and more favorable vegetation environmental conditions will be better growth and amount of Carbon Sequestration Soil also increased. North aspect to the relatively cooler and gets a little solar energy while the South West aspects are warmer and drier (higher energy) this leads to better growing conditions in the North than the South. Hence vegetation of south aspect has harder climate condition and prone various natural disturbances such as intense wind and firing leading to the loss of large amounts of plant biomass will be in this aspect. Besides the frequent occurrence of fires in these areas, particularly in West and South aspects due to the high flammability of inflammable because reduced soil moisture and high temperature environment lead to loss of soil and vegetation at the result of reduces the amount of soil carbon is consistent the results Sharma and Rikhari 1997 Banerjee and Chan 1981 .

Comparison of soil OC contents for different geographical aspects showed that the highest OC contents belong to the northern aspects in all elevation and precipitation class's .These results show that an overall conservation and management program must consider specific bio-eco-physical conditions of each site to be comprehensive. For a successful soil carbon sequestration program we should pay attention to all

environmental aspects involved in increasing biomass yield, site specific programming and soil carbon sequestration. The prevention of deforestation and promotion of afforestation have often been cited as strategies to slow down global warming (Bala et al. 2007).

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