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ASSESSMENT OF EFFECT OF NATIONAL HIGHWAY (NH-22) EXPANSION ACTIVITIES ON SOIL CARBON STOCK IN MOUNTAINOUS ECOSYSTEM

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ABSTRACT

The study was conducted to analyse the impact of national highway (NH-22) bypass (Shoghi - Shimla - Dhali)expansion activities on soil carbon content. The study area was divided into four equal sites based on distances viz. Site 1, Site 2, Site3 and Site 4. The surface soil organic carbon in the study area lies in between range of 0.40 per cent to 1.29 %. The highest soil organic carbon of 0.79 % was registered in the post-monsoon season and lowest of 0.70 % was recorded in the pre-monsoon season. The soil organic carbon followed an increasing trend with the increasing distance from the highway. The highest soil carbon stock of 15.20 Mg C ha^{-1} was registered in the post-monsoon season and lowest of 14.70 Mg C ha^{-1} was recorded in the pre-monsoon season. The data further revealed that the soil carbon stock increased with the increase in distances from the highway at distances of 0-10 m, 10-20 m and > 20 m.

KEY WORDS : Soil, Organic carbon, Assessment, National, Monsoon, Site

INTRODUCTION

Soil is the basic element of plants and animal life, as it provides number of nutrients on which ecological productivity depends. Soil deterioration is the highly corrosive impact of road expansion activity which can bring out changes in the texture, structure and composition of soil lead to loss of organic and inorganic nutrient in the soil. In spite of these, road activities decrease the water holding capacity, percolation rate and ultimately cause soil erosion (Qing *et al.,* 2008). Road construction activities resulted in an increase of onsite soil erosion on hilly areas because of the exposure to bare soil material. Roads create new landscape elements and change soil properties, land form and geomorphological processes (Pereira *et al.,* 2015). The eroding of earth's surface for road construction leads to the removal of fertile and productive soils.

MATERIALS AND METHODS

In order to study the effect of highway expansion activity on soil quality, the National Highway 22 bypass Shoghi - Shimla - Dhali was divided into four uniform segments based on distance viz: Site 1, Site 2, Site 3, Site 4 and each site was considered as replication. The surface soil samples from each site were collected at three horizontal distances from the edge of the National Highway during pre-monsoon (April and May) and post-monsoon (October and November) seasons in the year 2018 and 2019. The horizontal distances considered were 0-10 meter, 10-20 meter and > 20 meter. In total there were 6 treatment combinations (2×3) which were replicated four times in randomized block design. The soil samples from surface (0-15 cm) layer were collected by using tube auger. The samples were dried in the shade and grounded using wooden pestle and mortar. The grounded soils were passed through a 2 mm sieve and stored in polythene bags for subsequent analysis of the following parameters:

Soil organic carbon

It was determined by Walkely and Black (1934) rapid titration method and expressed as per cent.

Soil carbon stock

The soil organic carbon stock (Mg C ha^{-1}) was computed by multiplying the soil carbon content (%) with bulk density (g) and depth(m) and expressed as Mg C ha^{-1} as per the following formula given by Nelson and Sommers (1996).

Soil carbon stock = (Soil bulk density × Soil depth× Organic carbon) × 100

RESULTS AND DISCUSSION

Soil Organic Carbon

The spatial and seasonal distribution of soil organic carbon along the highway showed significant effect (Table 1). The soil organic carbon distributed in the study area varied from 0.40 per cent to 1.29 per cent. The content of organic carbon showed an increasing pattern as the distance increased from the edge of road. The pooled effect of both the years showed significant spatial and seasonal variation among the distribution of organic carbon in the surface soil. The distribution of organic carbon content showed an increasing pattern with the increasing distance from the edge of the road. The mean values of organic carbon in the surface soil were recorded as 0.47 per cent, 0.51 per cent and 1.26 per cent at a distance of 0-10 m, 10-20 m and > 20 m, respectively. The decline in soil organic carbon at distance of 0-10m may be due to lower rate of decomposition of organic matter and higher organic carbon content at > 20 m may be due to higher amount of litter in the soil strata. The results are in line with the findings of Neher *et al.* (2013). The average highest (0.79 %) organic carbon content of the surface soil was noticed in the post- monsoon season while the lowest (0.70 %) content was reported in the pre-monsoon season. Decline in the organic carbon in pre-monsoon may be because of high temperature as organic carbon content decrease with increase in temperature and decomposition rates doubles with every 10°C increase in the temperature (Kirschbaum, 1995 and Hartel, 2005). The results are in line with Salim *et al.* (2015) who also reported higher amount of organic carbon in post-monsoon months and lowest in pre-monsoon months. The two way interaction in between season x distance showed significant variation as the highest (1.28 %) organic

Table 1. Seasonal and spatial variations in OC (%) of surface soil

Distances (m)	2018			2019			Pooled		
Seasons	Pre-monsoon	Post-monsoon	Mean	Pre-monsoon	Post-monsoon	Mean	Pre-monsoon	Post-monsoon	Mean
0-10	0.42	0.53	0.48	0.40	0.52	0.46	0.41	0.52	0.47
10-20	0.47	0.57	0.52	0.44	0.54	0.49	0.46	0.55	0.51
>20	1.23	1.28	1.25	1.24	1.29	1.26	1.23	1.28	1.26
Mean	0.71	0.79	0.75	0.69	0.78	0.74	0.70	0.79	0.74
$CD_{0.05}$									
	Distance	: 0.04		Distance	: 0.03		Distance	: 0.02	
	Season	: 0.03		Season	: 0.03		Season	: 0.02	
	Distance ´Season	: NS		Distance ´Season	: NS		Distance ´Season	: 0.03	
							Distance ´Season´ Year	: NS	

Table 2. Seasonal and spatial variations in soil carbon stock (Mg C ha^{-1}) of surface soil

Distances (m)	2018			2019			Pooled		
Seasons	Pre-monsoon	Post-monsoon	Mean	Pre-monsoon	Post-monsoon	Mean	Pre-monsoon	Post-monsoon	Mean
0-10	9.33	9.83	9.58	8.29	8.96	8.63	8.81	9.40	9.10
10-20	10.49	10.92	10.71	9.77	9.94	9.86	10.13	10.43	10.28
>20	24.72	25.65	25.18	25.61	25.90	25.75	25.16	25.77	25.47
Mean	14.85	15.47	15.16	14.56	14.93	14.74	14.70	15.20	14.95
$CD_{0.05}$									
	Distance	: 0.40		Distance	: 0.05		Distance	: 0.20	
	Season	: 0.33		Season	: 0.04		Season	: 0.16	
	Distance ´Season	: NS		Distance ´Season	: 0.08		Distance ´Season	: NS	
							Distance ´Season´ Year	: NS	

carbon was noticed in post-monsoon season in undisturbed area at a distance of > 20 m while the lowest (0.41 %) value of organic carbon was observed in pre-monsoon season at a distance of 0-10 m along the National Highway.

Soil carbon stock

The spatial and seasonal distribution of soil carbon along the highway showed significant effect (Table 2). The soil carbon distributed in the study area varied from 8.29

Mg C ha^{-1} to 25.90 Mg C ha^{-1}. The content of soil carbon showed an increasing pattern as the distance increased from the edge of road. The pooled effect of both the years showed significant spatial and seasonal variation among the distribution of soil carbon in the surface soil. The distribution of soil carbon content showed an increasing pattern with the increasing distance from the edge of the road. The mean values of soil carbon in the surface soil was recorded as of 9.10 Mg C ha^{-1}, 10.28 Mg C ha^{-1} and 25.47 Mg C ha^{-1} at a distance of 0-10 m, 10-20 m and > 20 m, respectively. The average highest (15.20 Mg C ha^{-1}) soil carbon content of the surface soil was noticed in the post- monsoon season while the lowest (14.70 Mg C ha^{-1}) content was reported in the pre-monsoon season. Higher SCS at > 20 m might be due to more tree and vegetation cover and higher organic matter. Trees are known to maintain soil organic matter and nutrient cycling through the addition of litter and root residues into the soil, the presence of trees affects carbon dynamics directly or indirectly (Singh and Singh, 1997 and Bhattacharyya *et al.,* 2008). Trees improves the soil productivity through ecological and physico-chemical changes that depends upon the quantity and quality of litter reaching soil surface and rate of litter decomposition and nutrient release (Meentemeyer and Berg, 1986). The two-way interaction in between season x distance was also found to be non- significant.

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Conflict of Interest

There is no conflict of interest for this manuscript.

CONCLUSION

Results of present research work found that the spatial and seasonal distribution of soil carbon along the highway had significant effect. Human activities such as road construction is a very important factors in soil destruction.Therefore, management programs must be considered to control and decrease destruction. So, according to the findings of this research it is necessary to consider effective methods to control and prevent forest soil destruction.

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