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Estimation of Biomass and Soil Carbon Stock in Alpine Pastures of Lahaul Valley of District Lahaul and Spiti, Himachal Pradesh

R. K. Verma, Ranjeet Kumar

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ABSTRACT

A study was conducted to estimate the biomass and soil carbon stock in various sites of alpine pastures of Lahaul valley of district Lahaul and Spiti, Himachal Pradesh. In Urgos site, the values of above ground and below ground were 1.57 t/ha and 3.46 t/ha respectively. The values of these components at Trilokinath site were 1.37 t/ha and 3.38 t/ha respectively. Whereas, in Tandi site, values of above ground and below ground biomass were 1.73 t/ha and 2.72 t/ha respectively. The amount of biomass carbon stock at Urgos site for above ground and below ground was 0.80tC/ha and 1.66tC/ha respectively. The values in Trilokinath site these components were 0.726tC/ha and 1.656tC/ha respectively. Whereas, at Tandi site values for above ground and below ground biomass carbon stock were 0.88tC/ha and 1.13tC/ha respectively. The biomass as well as the carbon stock was higher at Urgos site than Trilokinath and Tandi site. The soil organic carbon stock (tC/ha) at 0-15 cm and 15-30 cm was 37.93 and 28.46 respectively at Urgos site. The soil organic carbon stock (tC/ha) at these depths was 32.34 and 26.77 respectively at Trilokinath site. Whereas, values of soil organic carbon stock (tC/ha) at 0-15 cm and 15-30 cm was 30.28 and 24.80 respectively at Tandi site. The value of total soil carbon stock was more (66.39 tC/ha) at Urgos site than Trilokinath site (59.11 tC/ha) and Tandi site (55.08 tC/ha) respectively.

Keywords Biomass, Soil carbon stock, Above ground, Below ground.

INTRODUCTION

The climate is changing day by day due to anthropogenic causes and natural variability. The changes taking place in the atmospheric composition, hydrological cycle, solar inputs and finally in the land surface. The changes are also taking place in our environment and across the face of this planet. The life on earth has existed for billions of year and it will continue into future too. However, in future many ecosystems will experience extremely rapid environment changes owing to human activities including climate change

R. K. Verma [1]*, Ranjeet Kumar [2]
[1, 2] Scientist
[1] G, Forest Ecology and Climate Change Division, [2] E and Head, Forest Ecology and Climate Change Division
Himalayan Forest Research Institute
Conifer Campus, Panthaghati 171013, Shimla (HP), India

Email: rkverma89326@gmail.com
*Corresponding author

and habitat destruction (Lenski 2001). The changes, which have accelerated since the early 1950s are human population increase, conversion of the lands into cultivation, fertilizer production, atmospheric green house gases and species extinctions. All these changes can be seen by analyzing long term meteorological observations when correlated with the changing pattern of vegetation structure and function.

The alpine pastures occupy about 1.52% of the total land area in the country and are mainly concentrated in the Himalayan states of Arunachal Pradesh, Sikkim, Uttar Pradesh, Himachal Pradesh and Jammu and Kashmir. The alpine pastures are supposed to be the only true grasslands in India and where the grazing density is too high. In Himachal Pradesh, alpine pastures cover around 10,052 sq km which otherwise constitute 17% of the total geographical area of the state. In India, grasslands range from village grazing grounds and extensive low-pastures of dry regions to rolling grassy downs of alpine Himalayas and are the most important renewal natural resources. Now, realizing the crucial role of ecological balance for our survival and sustained development with rapidly advancing technologies, the preservation of natural resources, viz., grasslands and their management on the scientific basis so as to maintain them in the highest state of production. In this paper an attempt has been made to estimate biomass and soil carbon stock of alpine pastures falling in Lahaul Valley of Lahaul and Spiti district of Himachal Pradesh.

MATERIALS AND METHODS

The detail field study was carried out in the selected/identified sites of alpine pastures in Lahaul Valley of Lahaul and Spiti district, Himachal Pradesh. The study site of Urgos was located at latitude N 32°51’30.6”, longitude E 76°47’40.2” and altitude 3299m and at Trilokinath having latitude N 32°41’06.8”, longitude E 76°41’20.7” and altitude 2895 m. Whereas, site of Tandi was located at latitude N 32036’58.6”, longitude E 76059’35.13”and altitude 3085m. The biomass of herbs was determined by destructive method following standard techniques with 1mx1m quadrate size. The samples were oven dried to a constant weight and then used to analyzed carbon content by employing CHNS analyzer (Elementar Vario Micro Q 2013). Soil samples from the selected sites of alpine pastures were collected by digging the profile for two depth intervals (0-15cm, 15-30cm). Dried and processed soil samples were used for estimation of organic carbon (%) by employing Walkley and Black’s rapid titration method (Walkley and Black 1934). The bulk density (g cm^{-3}) of the soil samples was analyzed by laboratory method (Gupta 2000). The soil organic carbon pool for a specific depth was computed by multiplying the soil organic carbon with bulk density, fraction of coarse elements and depth (Bates 1996).

RESULTS AND DISCUSSION

The different vegetation due to their structure, function and species reflects wide variability both in biomass and carbon storage. The biomass production levels obtain and carbon stored in biomass and soil through alpine pastures of Lahaul Valley of Lahaul and Spiti district have been described as below.

Biomass and carbon stock

The study was conducted in alpine pastures at Urgos, Trilokinath and Tandi in Lahaul Valley. The data in Table 1 shows the variation in above ground, below ground and litter biomass and carbon stock of alpine pasture at different sites. In Urgos site, the values of above ground, below ground biomass and litter were 1.57 t/ha, 3.46 t/ha and 0.53t/ha respectively. The values of above ground, below ground biomass and litter was at Trilokinath site were 1.37 t/ha, 3.38 t/ha and 0.51t/ha respectively. Whereas, at Tandi site, the values of above ground, below ground and litter were 1.73 t/ha, 2.35 t/ha and 0.49t/ha respectively. The amount of carbon stock at Urgos site for above ground, below ground biomass and litter was 0.80t/ha, 1.66t/ha and 0.265tC/ha respectively. The values in Trilokinath site for above ground, below ground biomass and litter was 0.726t/ha, 1.656t/ha and 0.252tC/ha respectively. Whereas, at Tandi site for above ground, below ground biomass and litter these values were 0.88t/ha, 1.13t/ha and 0.249 tC/ha respectively. The biomass as well as the carbon stock was higher at Urgos site than Trilokinath and Tandi site. The finding are in line with the result of (Verma 2017) who reported biomass and biomass

Table 1. Biomass and carbon stock in alpine pasture of Urgos, Trilokinath and Tandi site in Lahaul Valley of Lahaul and Spiti district, Himachal Pradesh.

Sl. No.	Component	Biomass (t/ha)			Carbon stock (tC/ha)		
		Urgos	Trilokinath	Tandi	Urgos	Trilokinath	Tandi
1	Above ground	1.57	1.37	1.73	0.80	0.726	0.88
2	Below ground	3.46	3.38	2.35	1.66	1.656	1.13
3	Litter	0.53	0.51	0.49	0.265	0.252	0.249
	Total	5.56	5.26	4.57	2.725	2.634	2.259

carbon stock ranged from 3.81 to 10.41 t/ha and 1.645 to 4.487 t/ha in alpine pastures of district Shimla, Himachal Pradesh.

Soil organic carbon stock

Soil organic carbon (%) at different depths i.e. 0-15 cm and 15-30 cm was 2.32 and 1.65 respectively at Urgos site. In Trilokinath site, soil organic carbon (%) at different depths i.e. 0-15 cm and 15-30 cm was 2.2 and 1.75 respectively. Whereas, values of organic carbon (%) at these two depths for Tandi site were 1.96 and 1.56 respectively (Table 2). The values of bulk density (g/cc) at 0-15 cm and 15-30 cm were 1.09 and 1.15 respectively for Urgos site. In Trilokinath site, values of bulk density for these depths were 0.98 and 1.02 respectively. Whereas, the values of bulk density (g/cc) at 0-15 cm and 15-30 cm were 1.02 and 1.06 respectively for Tandi site. The values of organic carbon were decreased and values of bulk density increased with increasing the soil depth. Thus, the higher value of bulk density in soil can also be ascribed to low soil organic content. These finding are in line with earlier findings (Karan *et al.* 1991, Sharma *et al.* 1995, Cihacek and Ulmer 1997). The soil organic carbon stock (tC/ha) at 0-15 cm and 15-30 cm was 37.93 and 28.46 respectively at Urgos site. The soil organic carbon stock (tC/ha) at 0-15 cm and 15-30 cm was 32.34 and 26.77 respectively at Trilokinath site. Whereas, soil organic carbon stock (tC/ha) at 0-15 cm and 15-30 cm was 30.28 and 24.80 respectively at Tandi site. The value of total soil carbon stock was more (66.39 t/ha) at Urgos site than Trilokinath site (59.11 tC/ha) and Tandi site (55.08 tC/ha) respectively.

The soil organic carbon stock decreased with increasing the soil depth at all the sites. Higher grass lands i.e. alpine pastures have normally higher soil organic carbon store because of higher accumulation of soil organic matter as a result of low temperature. The findings of the present study are in conformity with the findings of (Negi and Gupta 2012) who reported soil carbon stock of 162.87 t/ha in alpine pastures of Chamoli district in Uttarankhand. Verma (2017) also reported soil carbon stock upto 30cm depth ranging from 95.72 to 112.39tC/ha for alpine pastures of Shimla district, Himachal Pradesh.

CONCLUSION

In alpine pasture, the biomass as well as biomass carbon stock was higher at Urgos followed by Trilokinath and Tandi. The value of total soil carbon stock was little more (66.39 tC/ha) at Urgos site than Trilokinath site (59.11 tC/ha) and Tandi site (55.08 tC/ha). This may be due to more organic carbon content at Urgos site than other two sites.

Table 2. Soil organic carbon, bulk density and soil organic carbon stock under alpine pasture of Urgos, Trilokinath and Tandi in Lahaul valley of Lahaul and Spiti district, Himachal Pradesh.

Soil depth (cm)	Organic carbon (%)			Bulk density (g/cc)			Organic carbon stock (tC/ha)		
	Urgos	Trilokinath	Tandi	Urgos	Trilokinath	Tandi	Urgos	Trilokinath	Tandi
0-15	2.32	2.20	1.96	1.09	0.98	1.02	37.93	32.34	30.28
15-30	1.65	1.75	1.56	1.15	1.02	1.06	28.46	26.77	24.80
							66.39	59.11	55.08

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