

Variation in Biomass and Soil Carbon Stock in Alpine Pastures of District Shimla, Himachal Pradesh

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Abstract A study was conducted to estimate the biomass and soil carbon stock in various sites of alpine pastures during the year 2014–2015. In Chansal site, the value of above ground and below ground biomass was 1.92 t/ha and 4.01 t/ha respectively. The values of these components at Kavar site was 1.80 t/ha and 2.01 t/ha respectively. Whereas, the values of these components at Talra site was 3.01 t/ha and 7.40 t/ha respectively. The amount of carbon stock in Chansal site for above ground and below ground was 0.83 tC/ha and 1.72 tC/ha respectively. The values of these components at Kavar site was 0.77 tC/ha and 0.86 tC/ha respectively. Whereas, amount of carbon stock in above and below ground at Talra site was 1.30 tC/ha and 3.19 tC/ha respectively. The biomass as well as the carbon stock was higher at Talra followed by Chansal and Kavar. The soil organic carbon stock (tC/ha) at 10–15 cm, 15–30 cm and 30–45 cm was 58.30, 54.09 and 50.87 respectively at Chansal site. In Kavar site, values of soil organic carbon stock for these depths were 49.84 tC/ha, 45.88 tC/ha and 38.50 tC/ha respectively. Whereas, these values for different depths were 58.61 tC/ha,

41.16 tC/ha and 28.57 tC/ha respectively at Talra site. The value of total soil carbon stock was little more (163.26 tC/ha) at Chansal site than Talra site (128.34 tC/ha).

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

Introduction

It is well known that global climate is changing day by day as a result of anthropogenic causes and natural variability. This includes the change in the atmospheric composition, hydrological cycle changes in solar inputs and finally taking place in the land surface. Changes are taking place in our environment and across the face of this planet. Life on earth has existed for billions of year and hope that that it will continue into future too. But in future many ecosystems will experience extremely rapid environment changes owing to human activities including climate change and habitat destruction [1]. Consider these changes, which have accelerated since the early 1950s : human population increase, conversion of the lands into cultivation, fertilizer, production, at-

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mospheric green house gases and species extinctions. However, all these changes can be seen by analyzing long term meteorological observations when correlated with the changing pattern of vegetation structure and function.

The pastures in the alpine zone 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. As far as Himachal Pradesh is concerned, alpine pastures cover around 10,052sq 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 Shimla forest circle of Himachal Pradesh.

Materials and Methods

The detail field study was carried out in the selected/identified sites of alpine pastures in Shimla Forest Circle. The study site of Chansal was located at latitude 31°12'55.5" N, longitude 77°58'36.8" E and altitude 3550 m and at Kavar having latitude 31°11'14.5" N, longitude 78°05'08.1" E and altitude 2970m. Whereas, site of Talra was located at latitude 31°01'42.3" N, longitude 77°45'58.5" E and al-

titude 3280 m. The biomass of herbs was determined by destructive method following standard techniques with 1 m × 1 m quadrat size. The samples were oven dried to a constant weight and then used to analysed carbon content by employing CHNS analyser (Elementar Vario Micro Q 2013). Soil samples from the selected sites of different forest types were collected by digging the profile for three depth intervals (0-15 cm, 15-30 cm, 30-45 cm). Dried and processed soil samples were used for estimation of organic carbon (%) by employing Walkley & Black's rapid titration method [2]. The bulk density (g cm^{-3}) of the soil samples was analysed by laboratory method [3]. 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 [4].

Results and Discussion

The different forest types 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 Shimla forest circle have been described as below.

Biomass and carbon stock

The study was conducted in Alpine Pasture at Chansal and Kavar in Rohru forest division and Talra in Chopal Forest division. Table 1 shows the variation in above ground and below ground biomass and carbon stock of alpine pastures at different sites. In Chansal site, the values of above ground and below ground biomass were 1.92 t/ha and 4.01 t/ha respectively. The values of these components at Kavar site were 1.80 t/ha and 2.01 t/ha respectively. Whereas, the values of these components at Talra site were 3.01 t/ha and 7.40 t/ha respectively. The amount of

Table 1. Biomass and carbon stock in alpine pasture of Shimla Forest Circle, Himachal Pradesh.

Sl. No	Component	Biomass (t/ha)			Carbon stock (tC/ha)		
		Chansal	Kavar	Talra	Chansal	Kavar	Talra
1	Above Ground	1.92	1.80	3.01	0.827	0.778	1.294
2	Below Ground	4.01	2.01	7.40	1.721	0.867	3.193
	Total	5.93	3.81	10.41	2.548	1.645	4.487

Table 2. Soil organic carbon, bulk density and soil carbon stock under alpine pastures of Shimla Forest Circle, Himachal Pradesh.

Soil Depth (cm)	Organic carbon (%)			Bulk density (g/cc)			Organic carbon stock (tC/ha)		
	Chansal	Kawar	Talra	Chansal	Kawar	Talra	Chansal	Kawar	Talra
0-15	5.62	4.20	5.40	0.786	0.860	0.804	58.30	49.84	58.61
15-30	4.70	3.50	3.30	0.872	0.950	0.924	54.09	45.88	41.16
30-45	4.40	3.00	2.30	0.876	0.930	0.920	50.87	38.50	28.57
Total							163.26	134.22	128.34

carbon stock in Chansal site for above ground and below ground was 0.83 tC/ha and 1.72 tC/ha respectively. The values of these components at Kawar site were 0.77 tC/ha and 0.86 tC/ha respectively. Whereas amount of carbon stock in above and below ground at Talra site was 1.30 tC/ha and 3.19 tC/ha respectively. The biomass as well as the carbon stock was higher at talra followed by Chansal and Kawar. This may be due to reason that grazing pressure in Talra site is less as compared to Chansal and Kawar site.

Soil organic carbon stock

Soil organic carbon (%) at different depths i.e. 10-15 cm, 15-30 cm and 30-45 cm was 5.62, 4.70 and 4.40 respectively at Chansal site. The values of these components for different depths at Kawar site were 4.20, 3.50 and 3.00 respectively. Whereas, values of organic carbon (%) at these three depths for Talra site were 5.40, 3.30 and 2.30 respectively Table 2. The values of bulk density (g/cc) at 10-15 cm, 15-30 cm and 30-45 cm were 0.79, 0.87 and 0.88 respectively for Chansal site. In Kawar site, values of bulk density for these depths were 0.86, 0.95 and 0.93 respectively. Whereas, at Talra site values of bulk density for these depths were 0.80, 0.93 and 0.92 respectively. 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 the earlier finding [5—7].

The soil organic carbon stock (tC/ha) at 10-15 cm, 15-30 cm and 30-45 cm was 58.30, 54.09 and 50.87 respectively at Chansal site. In Kawar site, values of soil organic carbon stock for these depths

were 49.84 tC/ha, 45.88 tC/ha and 38.50 tC/ha respectively. Whereas, these values for different depths were 58.61 tC/ha, 41.16 tC/ha and 28.57 tC/ha respectively at Talra site. The value of total soil carbon stock was more (163.26 tC/ha) at Chansal site than Kawar site (134.22 tC/ha) and Talra site (128.34 tC/ha). This may be due to more organic carbon content at Chansal site than other two sites. The soil organic carbon stock decreased with increasing 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 [8] who reported soil carbon stock of 162.87 t/ha in alpine pastures of Chamoli district in Uttarakhand.

Conclusion

In alpine pasture, the biomass as well as the carbon stock was higher at Talra followed by Chansal and Kawar. The value of total soil carbon stock was little more (163.26 tC/ha) at Chansal site than Kawar site (134.22 tC/ha) and Talra site (128.34 tC/ha). This may be due to more organic carbon content at Chansal site than other two sites.

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