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Effect of silting yield index on biomass and carbon sequestration potential along an altitudinal gradient of subtropical Chir pine forests and grasslands in north western Himalaya, India

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Introduction

Biomass is an important characteristic of vegetation and is regarded as an important indicator of ecological and management processes in the vegetation. Measures of standing crop also reflect the amount of energy stored in the vegetation, which can indicate the potential productivity at the site. Forests are important for carbon sequestration besides playing very important role in the global carbon cycle. They store about 80% of all aboveground and 40% of all belowground terrestrial organic carbon. This study comprises to estimate the biomass and carbon stock of chirpine forests at different altitudinal gradients.

Materials and Methods

The present study was carried out in Giri catchment in Himachal Pradesh located between 30^{o} 33′ 48″ and 31^{o} 16′ 08″ N latitude and 77^{o} 02′ 32″ to 77^{o} 38′ 22″ E longitude. It has an area of about 2389 km^2 (Rao *et al*., 1989). The present investigation focused on chirpine forests which are primarily located in Solan and Sirmaur districts in this catchment, thus the study was restricted to these districts only. The different sub-watersheds selected in SYI (Silting yield index) classes are depicted in: a) very high SYI (C_1), b) high SYI ($C_{2)}$, c) medium SYI (C_3), and d) low SYI (C_4). Each sub-watershed was divided into three elevation classes *viz*., E_1 (900-1300m), E_2 (1300-1700m) and E_3 (1700-2100m) through GIS. The Giri catchment has 135 sub-watersheds. Keeping proportional random sampling, 5, 3, 3 and 1 sub-watersheds were selected for the study from above cited SYI classes, respectively.

Results and Discussion

Aboveground biomass (AGB) of herbage vegetation (q/ha) in grasslands of different sub-watersheds varied from 28.44 (SW_6) to 46.13 (SW_4), 21.37 (SW_6) to 43.23 (SW_3) and 14.75 (SW_6) to 41.80 (SW_4) at elevation E_1, E_2 and E_3, respectively. It decreased with increase in elevation from E_1 to E_3 in all SYI classes except in C_3, where the AGB was more at elevation E_2. In the understory vegetation of chirpine forests, total ABG of herbage vegetation in different sub-watersheds varied from 23.35 (SW_7) to 44.07 (SW_4), 18.58 (SW_6) to 42.14 (SW_5) and 18.02 (SW_6) to 37.75 (SW_3) at elevation E_1, E_2 and E_3, respectively. The comparison in mean ABG of herbage at different elevation levels and SYI revealed that mean ABG decreased along the elevation in all the SYI classes except in SYI class C_3, where the AGB at elevation E_2 was lower in comparison to E_3. It was also observed that the mean AGB of herbage decreased with increase in elevation in both the plant communities. It was also noticed that at SYI class C_2, AGB of herbage was less in comparison to other SYI classes in both the plant communities.

In grasslands, total BGB (Belowground biomass) of herbage vegetation (q/ha) in different sub-watersheds varied from 15.61 (SW_6) to 27.93 (SW_9), 11.11 (SW_6) to 27.87 (SW_9) and 7.39 (SW_6) to 27.53 (SW_{10}) at elevation E_1, E_2 and E_3, respectively. In grasslands of different sub-watersheds, mean BGB of herbage decreased with increase in elevation except in SYI class C_3 where BGB was more at elevation E_2 than E_1. In the understory vegetation of chirpine forests, total BGB of herbage vegetation in different sub-watersheds varied from 11.96 (SW_7) to 22.01 (SW_4), 9.15 (SW_6) to 19.57 (SW_9) and 7.95 (SW_7) to 17.70 (SW_{13}) at elevation E_1, E_2 and E_3, respectively. The total biomass of chirpine trees (ABG and BGB) in different sub-watersheds at different elevations and SYI classes revealed that biomass production in chirpine trees was highest (1546.94) in SW_4 and lowest (1083.22) in SW_{11} at elevation E_1. Similarly, at elevation E_2 the maximum biomass of trees was 1563.74 in SW_4 and minimum was 1244.02 in SW_5. At elevation E_3 highest biomass of trees occurred in SW_4 as 1315.92 and lowest 692.64 in SW_7. The variation in total average biomass of trees relative to elevations showed that it was higher (1399.04) at elevation E_2 followed by E_1 (1244.92) and E_3 (1000.43).The total carbon stock (t/ha) in different sub-watersheds explicates that in grasslands, at elevation E_1, total carbon stock in different sub-watersheds varied from 308.69 (SW_7) to 520.16 (SW_1). Whereas, at elevation E_2, it ranged from 380.70 (SW_6) to 539.17 (SW_{10}) and at elevation E_3 from 429.75 (SW_6) to 550.27 (SW_{13}). In chirpine forests at elevation E_1, total carbon stock in sub-watersheds varied from 964.80 (SW_{11}) to 1263.58 (SW_4), from 1138.69 (SW_6) to 1305.66 (SW_{10}) at E_2 and from 828.27 (SW_7) to 1170.01 (SW_4) at E_3.

Keeping in view the trend of herbage growth along the season its sampling in the present investigation was done at the time of its peak growth in September. The AGB and BGB of herbage were higher in grassland in comparison to chirpine forests. In the present study 8-16% reduction in AGB in herbage vegetation was recorded under chirpine forests at different elevations. Total biomass (AGB + BGB) of vegetation in chirpine forests was highest at elevation E_2 *i.e.* 1300-1700m.

Conclusion

Average total biomass of herbage in sub-watersheds decreased with increase in elevations in both the plant communities. The effect of elevation on herbage total biomass in grasslands and chirpine forests compared by Duncan multiple range test, revealed that in SYI C_2 herbage total biomass, at elevations E_1, was significantly higher than E_3. Total carbon stock (t/ha) in grassland decreased in the order $E_3 > E_2 > E_1$ and in chirpine forests it was higher at elevation E_2 and was followed by E_1 and E_3.

References

Rao C. S., C. V. Shyamala and T. V. S. Rao. 1989. *Evaluation of integrated watershed management programme: flood prone river-upper Yamuna-UP and HP*. Sponsored by National land Use and Conservation Board, Ministry of Agriculture and Rural Development Area, 1-157.

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