IMPACT OF GRAZING ON SOIL ATTRIBUTES IN A PART OF NANDA DEVI BIOSPHERE RESERVE, UTTARAKHAND, INDIA

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Received-03.11.2017, Revised-22.11.2017

Abstract: Livestock is one of the main cause has different effects on different parts of range ecosystem. An effective factor is the number of livestock when it is beyond the capacity of the rangeland and it has different effects on soil and plants with different intensities of grazing. This studies measured short-term effects of grazing on soil attributes in sub-alpine rangelands in a part of Nanda Devi Biosphere Reserve (NDBR). To study the effect of grazing impact on soil attributes such as the P, K, organic carbon and pH in the three sites of NDBR; Toli Laga Chiae (Less Grazed), Salud Dugra (Medium Grazed) and the Tapovan (Heavy Grazed) systematic random soil sampling was conducted at 0-20 cm depth and nine samples were collected per site. The result was compared with the all sites. Result revealed that elements such as phosphorus and potassium in the heavy grazed site are more than the less grazed site. However, Organic carbon is more in less grazed site but it’s significantly differs from all the sites. One way Anova was used to analyze the variance.

Keyword: Ecosystem, Grazing, Biosphere reserve, Soil

INTRODUCTION

The Nanda Devi Biosphere Reserve (NDBR) is (30° 05'-31° 02'N Latitude, 79° 12'-80° 19'E Longitude), located in the northern part of India, falls in the biogeographically classified zone, 2B. The Nanda Devi, itself, is a mountain in India, which is a part of the Himalayan Mountain range. The NDBR with an area of 6020.43 km² is comprised of two core zones i.e. Nanda Devi National Park, 630 km²; Valley of Flowers National Park, 87.5 km²; surrounded by a buffer and a transition zones. Both the core zones have been recognized as World Heritage Site by UNESCO. Extensive systems of animal husbandry (e.g., meat and dairy cattle, sheep, goats, and so on) are mainly based on the direct grazing of forest (grasslands and pastures), fodder crops, and crop residues by livestock. Grazing effects on soil attributes of forage production systems follow direct and indirect pathways. Direct effects relate to animal trampling and excretion, while indirect effects are mediated by changes in vegetation structure and function. Subalpine pastures are available for a longer time of grazing and these are comparatively located at lower altitudes. These pastures are surrounded by forests and the grazing is a continuous process in both of these simultaneously or sequentially. So herds pass through the forest to reach the pasture areas and the herds stay and graze in these for quite some time beaching the pastures. The farmers are using sedentary system of livestock rearing between altitudes of 1000 to 2500 m, and between these altitudes all the cultivable land is utilized for agricultural crop production while the livestock is let loose in the forest and subalpine pastures for grazing.

The grazing continues throughout the year except during peak winter months of December and January, during this period crop residues and conserved tree leaf fodder are fed to the livestock. Soil, one of the most important elements of grassland ecosystems, is the source of food and moisture content for pasture plants. Excessive grazing is one of the most significant factors causing grassland degradation and typically, this degradation is effective on vegetation and soil. In general, the effect of grazing on pastures is considered to be in three processes: the loss of plants due to livestock foraging; soil and litter trampling; and deposition of feces and urine. The effects of these processes are hardly distinguishable from each other (Hiernaux et al., 1999).

Based on studies on grasslands, an important and obvious effect of grazing is the removal of above-ground biomass by livestock and subsequently, a significant impact on the rotation of the nutrients and their absorption (Shariff et al., 1994). In addition to general effects of grazing on plants, livestock have also other effects on grassland that subsequently effect on forage production. Generally, nutrients in livestock’s feces and urine are useful for forage growth, while trampling and selective grazing can be destructive. Livestock feces and urine are potential sources of nitrogen, phosphorus, potassium, sulfur, magnesium and calcium for plants (Nicol, 1987). Distribution of soil nutrients in a pasture is affected by different factors including parent material, vegetation communities, slope, aspect, kind of livestock, differences in grazing distribution patterns and watering points (Wedin et al., 1989). Therefore the present study was conducted to evaluate the impact of grazing on soil attributes in (NDBR).

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MATERIAL AND METHOD

Study area
Nanda Devi Biosphere Reserve is one of the great wilderness areas of the western Indian Himalaya. NDBR (30° 05'-31° 02’N Latitude, 79° 12'-80° 19'E Longitude), located in the state of Uttarakhand, India, falls in the biogeographically classified zone, 2B (Rodgers et al., 2000). The reserve is spread over Chamoli district in Garhwal region, Bageshwar and Pithoragarh districts in Kumaun region of the Uttarakhand State. The NDBR with an area of 6020.43 km² is comprised of two core zones i.e. Nanda Devi National Park (NDNP), 630 km²; Valley of Flowers National Park (VoF), 87.5 km²; surrounded by a buffer and a transition zones. Altitude varies within the range of 1800-7817 m asl. This wide geographical variation has added to the biological diversity of the Biosphere Reserve. The basin is dominated by Nanda Devi, a natural monument and India's second highest peak (7817 m) (Maikhuri et al., 2001).

The study was carried out in the three different parts of Nanda Devi Biosphere Reserve (NDBR), beats Urgam-IV (Toli Laga Chiae), Tapovan and Salud-Dungra of Joshimath Range. 1. Toli Laga Chiae (Less Grazed) village is located in Joshimath Tehsil of Chamoli district. It is situated 20km away from sub-district headquarter Joshimath and 87km away from district headquarter Gopeshwar. The total geographical area of village is 14.8 hectares. Toli Laga Chiae has a total population of 45 persons. There are about 11 houses in Toli Laga Chiae village. 2. Salud Dugra (Medium Grazed) village is located in Joshimath Tehsil of Chamoli district. It is situated 10km away from sub-district headquarter Joshimath and 77km away from district headquarter Gopeshwar. The total geographical area of village is 474.63 hectares. Salud Dugra has a total population of 1,583 persons. There are about 386 houses in Salud Dugra village. 3. Tapovan (Heavy Grazed) is located at a distance of 14 kilometers from Joshimath. Tapovan is a destination most famous for its hot springs. It is believed that these springs have medicinal properties and are believed to cure skin diseases. This destination also offers fabulous views of peaks such as Nanda Devi and Dronagiri Chaukumbha and is also a gateway to many other popular tourist destinations such as Badrinath and Valley of Flowers. The study areas were located in the Garhwal region of Greater Himalaya in Uttarakhand. The intensive study area is located towards western boundaries of the biosphere.

METHODOLOGY

In April 2017, the three study sites were selected less grazed (LG) Toli Laga Chiae, medium grazed (MG) Salud-Dungra and heavy grazed (HG) Tapovan based on the cattle population depends on directly or indirectly on the forest or pasture land. One km. transect were laid for the collection of soil samples at each site. Each transects nine quadrats 10x10 m. were laid and each quadrat having 100 m. consecutive distance from each others. Four random soil samples were taken from each quadrat using a soil augur to a depth of 20 cm. These samples were combined to get a composite sample for each sample plot (a total of 27 different soil samples, 9 from LG, 9 from MG and 9 from HG). To measure the organic carbon, Walkley-Black chromic acid wet oxidation method (Walkley and Black, 1934) was used and Olsen's method (Olsen et al., 1954) was for the available phosphorous. Soil potassium was
determined by normal ammonium acetate method. Soil pH was determined by using pH meter in saturated mud. One way Anova was used to analyze the variance. All the data analysis was run using SPSS 21 software.

RESULT AND DISCUSSION

Phosphorus: According to result found that level of phosphorus was higher in the heavy grazed site than the other sites but it’s having significant difference between the all sites (P < 0.026). It’s found that heavy grazing increasing the level of phosphorus in the soil which gives similar results (Javadi et al., 2006 and Kohandel et al., 2006). The higher amount of available phosphorus in soil its might be due to the higher grazing intensity which provides more excreta, litter deposition and more mobility of phosphorus on the surface of the soil due to livestock trampling (Zarekia et al., 2012). More than 65% of the phosphorus in the diet consumed by cows is returned as feces to pastures. Available soil phosphorus increase has been reported under manure (Haynes and Williams, 1993). However, Garcia et al., (2011) has reported that in an area with subtropical type climate ascertained that amount of phosphorus in ungrazed area was higher than the grazed area. This may be the effect due to the soil fertility and climatic conditions. The similar observations made by the El-Dewiny et al., (2006) that due to the degradation of organic matter, large amount of available phosphorus is released into the soil. Similarly, in the present study, due to the organic matter availability in soil was found that, animal excreta was the only factor which increasing the level of phosphorus in the soil in heavy grazed site.

![Available Phosphorus](image)

Potassium: According to data analysis found that there was no significantly difference between the all grazing sites. However, the amount of soil potassium was greater in heavy grazing site than the other sites. It may be the intensity of grazing in that area and availability of animals more than the other sites, the amount of soil potassium is higher (Zarekia et al., 2012). The availability of soil potassium in the heavy grazing site, it may be the amount of animals whichever feeding maximum over site, it shows the positive effects on accumulation of soil potassium through trampling and their excreta. This result supports by that the average content of potassium was higher in the areas with continuous grazing than in areas with other systems (control and rotational) Garcia et al., (2011). Tessema et al. (2011) findings were exactly opposite in his regards, they were found that the amount of soil nutrients were lower in heavy grazing site, it might be less availability of animal excreta in the site or used by the people for fuel or compost purpose in their agriculture fields. Potassium is consumed by the animals is returned to the soil maximum by animal urine than animal dung Haynes and Williams (1993).

![Available Potassium](image)
Soil organic carbon: Based on the statistical analysis found that soil organic carbon was significantly different from all the sites (p < 0.002). The maximum level of soil organic carbon was found in less grazed site than other sites. The conclusion is that less grazed site having very low disturbance on plant community and soil. Result showed that due to the fewer disturbances decomposition of the litter and plant material was more so that amount of soil organic carbon was higher than other sites. This is may be the exclusion of plant material in large amount from the heavy grazed and medium grazed sites. Similarly, Frank et al. (1995) compared an eighty year old enclosure with heavy and medium grazed treatments and found that half the mass of decomposed litter in the grazed treatments. Many studies showed the reverse relationship between grazing intensity and organic matter (Bagheri et al., 2009 and Kumbasi et al., 2010). It might be due to the grazing on vegetation by livestock and decrease in plant cover and consequently, the decrease of soil organic matter. However, the effect of grazing on decomposition of soil organic matter is not identical in different rangeland ecosystems. Grazing may be increase or decrease the soil organic matter, or have no effect on it (Zarekia et al., 2012).

Soil pH: Based on the statistical analysis, no significant difference in soil pH it was observed that due to the influence of grazing treatments. Result revealed that grazing has no effect on soil pH. Similarly, in the grassland steppes of Northern China, Xie and Wittig (2004) was found that no correlation between soil pH and moderate and intensive grazing intensities. Similar results were also reported by, Shan et al., (2011) that no significant difference in pH values in controlled region and region under different grazing conditions. Other than this also found that pH-value increases with increasing the intensity of grazing (Javadi et al., 2006 and Hosseinzadeh et al., 2010). The soil pH affects by the climatic conditions, altitude, rainfall, plant community and grazing intensity in the area. Based on the result of the present study, the content of organic matter varied in different sites. It shows the organic matter may not be affects the soil pH, therefore, no significant difference in pH values in the study sites.
CONCLUSION

Continuous heavy grazing throughout the year tended to increase the amount of phosphorus and potassium in the soil because of the animal feces. The highest amount of soil organic carbon was observed in Toli Laga Chiae with less grazing intensity but the difference was significant from all the sites. For better understanding of effect of grazing on soil nutrient availability due to the grazing intensity needs more time, soil and water management requires longer duration in the temperate region, as compared to the tropical region due to the fact that in tropical region litter decomposition and mineralization is faster.

ACKNOWLEDGEMENT

I thank to Mr. C.S. Joshi, Director Nanda Devi Biosphere Reserve, Joshimath and all the forest officials of Forest Department who had supported during the field work. I also thank full to Dr. Manoj Sharma, Assistant Professor, C. H. & F., Jhalaripatan, Jhalawar (Raj.) for their valuable comments to improve this manuscript.

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