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Impact of Biotic Stresses on the Alpine Scrub, Pasture Land and Forest Area of Branwar Forest Division, Kashmir Himalaya

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Abstract - The present study was carried out for assessing different type of biotic stresses in Branwar Forests of Kashmir Himalaya. The Present Study area i.e., Branwar Forest Range lies over and above famous tourist area of Yus Marg on one side and Neel Nag Forest Lake on the other side. The present investigation was carries out from April, 2010 to April, 2011. The cumulative effect of the biotic interferences was significantly seen in the reduction of vegetation cover. The present study revealed that the prominent factor for the exploitation of the vegetation cover of Branwar forest study area at herbaceous level is simply the overgrazing. The increasing disturbances not only disturb the plant species diversity, richness and evenness significantly but various plant species have got completely eliminated by different kinds of interferences like overgrazing, deforestation, hydal power production, forest fire, Stone extraction, road construction etc. The forests in the region are suffering from severe biotic stress. The forests are intimately linked with the agro-ecosystems in the mountainous areas of the Himalaya and the depletion has definite and obvious impacts on the overall socioeconomic and agricultural scenario of the entire region.

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Abstract - The present study was carried out for assessing different type of biotic stresses in Branwar Forests of Kashmir Himalaya. The Present Study area i.e., Branwar Forest Range lies over and above famous tourist area of Yus Marg on one side and Neel Nag Forest Lake on the other side. The present investigation was carries out from April, 2010 to April, 2011. The cumulative effect of the biotic interferences was significantly seen in the reduction of vegetation cover. The present study revealed that the prominent factor for the exploitation of the vegetation cover of Branwar forest study area at herbaceous level is simply the overgrazing. The increasing disturbances not only disturb the plant species diversity, richness and evenness significantly but various plant species have got completely eliminated by different kinds of interferences like overgrazing, deforestation, hydal power production, forest fire, Stone extraction, road construction etc. The forests in the region are suffering from severe biotic stress. The forests are intimately linked with the agro-ecosystems in the mountainous areas of the Himalaya and the depletion has definite and obvious impacts on the overall socioeconomic and agricultural scenario of the entire region. The productivity in agriculture has diminished over the years, rain fall has become erratic and lesser in amounts, water resources are fast drying up, land instability has increased, top soil erosion rate has increased, several species of plants and animals have become threatened, adverse climatic changes are in the offing, yield of milch cattle is on decline, pollution has become a problem to reckon with and all this with its attendant effects have resulted in a decline in the quality of life of the people. The future is becoming increasingly uncertain and this has given rise to allied social discontentment which is being reflected in various socio-political movements taking place.

Keywords : Forest, Importance Value Index, Grazing, Deforestation, Scrub, Biomass, Primary Productivity, Biotic Impact.

I. Introduction

From the past centuries human beings have influenced the forests, however, the impact has enormous in recent times. A comprehension assessment of the state of world's forests, recently released by the Food and Agricultural Organization of the United Nations (FAO, 2006), indicates that total forested area continues to decline significantly. Forests are defined as terrestrial ecosystems dominated by trees where the tree canopy covers at least 10 percent of the ground area (World Resource Institute, 2000). Forests, constituting a dominant and important ecosystem on Earth, provide a wealth of goods such as food, timber, fuel-wood, drinking and irrigation water, fodder, non-timber products, genetic resources and services, like remove air pollutants and release oxygen, cycle nutrients, provide human and wildlife habitat, maintain watershed functions and biodiversity, sequester atmospheric carbon, provide employment, moderate weather extremes and impacts, generate soil, provide recreation, and contribute to aesthetic beauty (Matthews *et al.*, 2000). Once distributed over half the planet, forests today cover only about 25 % of the world's total area, excluding Polar Regions. The World Resource Institute (WRI, 2000) has estimated that only about 22% of the world's original (old growth) forest cover is intact. Agenda 21 of the Earth Summit held in 1992 clearly stated that world over the forests are threatened by uncontrolled degradation and conservation to other types of land uses, under the influence of increasing human needs, agricultural expansion, and environmentally harmful mismanagement, including unsustainable commercial logging, overgrazing and unregulated browsing, etc. The degradation of forests is chiefly due to various anthropogenic pressures (Lone and Pandit, 2005). Overgrazing reduces plant leaf areas, which reduces interception of sunlight and plant growth. Plants become weakened and have reduced root length, and the pasture sod weakens. The reduced root length makes the plants more susceptible to death during dry weather. The weakened sod allows weed seeds to germinate and grow. If the weeds are unpalatable or poisonous, major problems can result.

II. Material and Methods

The plant community organization studies were conducted by stratified sampling technique using quadrats of different convinces as sampling units of different vegetational strata (trees, shrubs and herb strata). For tree canopy it was 10m×10m; for shrubs it was 5m×5m while for herb stratum it was 1m×1m. In

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the present study, trees in seedling or sapling stages at each quadrat were also counted as trees. The vegetation data were further computed for frequency, density and abundance following Curtis and McIntosh (1950). The relative values of frequency, density and dominance were determined as per Phillips (1959). These values were summed to represent IVI (Importance Value Index) of individual species in order to express the dominance and ecological success of the species (Curtis, 1959).The impact of deforestation was studied in terms of Importance Value Index (IVI) of trees at all the study sites. The relative values were summed up to determine the IVI of each tree species and thus the deforestation estimation. The estimation of primary productivity and intensity of grazing were estimated by biomass analyses using harvest method. For this purpose, the quadrats of definite size (40×40 cm2) were laid randomly at all the study sites during different seasons of the year. From each quadrat, the above ground parts (live as well as dead) of all the plants were clipped by using scissors and the material was dried to constant weight at 1050C. The difference in productivity values are explained on the grounds of effect of grazing (biotic factor) in the area under study.

$$Roduction\ Rate\ = W_2 - W_1$$

Where, W_2 = is the dry weight at time t_2 W_1 = is the dry weight at time t_1

III. Study Area and Study Sites

The present study is being carried out for assessing Edaphic Factors and Plant Community Organization in Branwar Forests of Kashmir Himalaya. The Present Study area i.e., Branwar Forest Range lies over and above famous tourist area of Yus Marg on one side and Neel Nag Forest Lake on the other side. It forms the main hydrologic catchment for the famous fresh water stream of Dudhganga in the Pir Panjal Forest Division. The stream is important for Trout fish. The Branwar Forest Area is an important area of Dudhganga Forest Division and is about 40 km away from Srinagar city encompassing an area of about 5148.50 ha which include a sizeable portion of alpine scrub and pasture land. Branwar forest region form a compact and linear strip like area, running from south east to north-west in length and from north-east to south-west in breadth. The main topographical feature of the tract is the Pirpanjal Mountain Range. Towards the foot of the mountains fan like projections with flat tops run at a very gentle angle towards the valley (karewas). The area is drained by a number of streams and nallas, e.g., Dudhganga, Shaliganga, etc. ultimately tributing to river Jhelum. All the area is open to grazing and grass cutting except those which are closed for the purpose by notification. There is no restriction as regarding to cattle grazing in these forests or the distance they come from, however browsing by goats in Deodar Forests is prohibited (Forest Plan, 1988-89). For the last two decades human activities have been on an increase in this part of the Dudhganga catchment. Besides being used as a heavily grazed range and pasture area it is being utilized for a dam construction and power generation. As such environmental monitoring of the area becomes imperative. For studying both plant community attributes and Edaphic factors of the study area the soil and plant samples are being gathered from four different sites Four sites were selected in the Branwar forest area in order to study the various edaphic factors (physico-chemical properties) and plant community organization. The study sites were selected in the forest area having same aspect, climate, topography, parent material, vegetation and were adjacent to each other so that the sites were comparable. General characteristics of the study sites are shown in Table1. Other main features for comparison of the study sites are as under:

Site I (Near Village Site) (NS): This site is located near the main entrance to the forest area and is the nearest to the village Branwar.

Site II (Riparian Site) (RS): This is located on the right side of Nalla Dudhganga deep in the forest. This site adjoins newly constructed and operative small scale hydal power project.

Site III (Dense forest Site and/or Dam forest site) (DS): This site is located in the Protected Dense forest near the newly constructed water storage dam for the operation of small scale mini power project.

Site IV (Protected Forest Site) (PS): This site is located in the protected forest area.

IV. Results

The floristic survey of the vegetation of Branwar forest showed that the natural growth was normal baring certain unprotected areas which were subjected to overgrazing, trampling, deforestation, stone quarrying, constructional activities and other anthropogenic activities

V. Deforestation

Overall the deforestation activities in the study area were quite apparent. As per the official records of the Forest Department (Divisional Forest Department Chadoora, J&K Govt.), the timber extraction was estimated to be 13869 cft for 2009-10 and 16135 cft for 2010-11 (Table 3). These estimates are certainly very low as compared to the actual ones as smuggling of timber is the routine practice in the area, being manifold. Similarly, firewood collection is again many times higher than the official quoted data (Table 3 and 4). The data on the impact of deforestation on tree species at the study sites based on Importance Value Index (IVI) of the tree species is presented in Table 2 and fig. 1. The forest vegetation community appeared to be in varied

stages of development in the area. Site-wise variation revealed that at near village (NS) site, the Importance Value Index (IVI) was maximum for *Pinus wallichiana* (126.7), followed by *Abies pindrow* (80.3), *Salix sp.* (43.0), *Robinia psedoacacia* (27.9) and *Ulmus villosa* (23.0) and at riparian forest (RS) site, the IVI was maximum for *Abies pindrow* (156.6), followed by *Pinus wallichiana* (118.6) and *Salix sp*. (24.7). The IVI for dam forest (DS) site and protected forest (PS) site was maximum 203.4 and 256.0 for *Pinus wallichiana* and least 94.54 and 43.94 was for *Abies pindrow* respectively. It is evident that the sites (I & II) are not protected and are subjected to more anthropogenic stress than dam forest (DS) site and protected forest (PS) site as is indicated from the IVI of tree vegetation being maximum at protected sites (III & IV).

a) Impact of grazing intensity on herbaceous vegetation

The area encompassing Branwar forest is sparsely populated by humans but is in close proximity with few villages having a fairly rich livestock population of 7110 animals comprising 3727 sheep, 610 goats and 2773 cattle (Table 37 and fig. 30), but the number may be much higher because the number of livestock owned by Gujars and Bakerwals living within the forest was not available. The data on productivity estimates at the study sites are depicted in Table 38 and fig. 31 & 32. An insight of the data showed that for near village (NS) site the aboveground biomass varied between a maximum of 270.00 g m-2 in autumn and a minimum of 162.20 g m-2 in spring. At riparian forest (RS) site the aboveground biomass varied between 280.00 g m-2 and 166.40 g m-2 similarly for dam forest (DS) site and protected forest (PS) site the above ground biomass varied between a maximum of 370.00 g m-2 and 398.00 g m-2 and a minimum of 245.00 g m-2 and 266 g m-2 respectively. The highest values of productivity of 159.60 g/m2/year was recorded for protected forest (PS) site, followed by 143.40 g/m2/year for dam forest (DS) site , 112.00 g/m2/year for near village (NS) site and 108.00 g/m2/year for riparian forest (RS) site.

b) Resource utilization

The people of the region, being dependent on biomass, have been living in close association with the flora of the forest from times immemorial. They use the plant resources not only for house building, timber, agriculture implements, food, fodder and other uses.

c) Other anthropogenic pressures

Other human pressures which are also destabilizing and degrading the forest soil and vegetation include stone extraction, construction of small water storing dam and power generating house for small scale hydro power generation operating within the forest area. The forest area of 143.18 hectares stands sanctioned to the power project and to other constructional activities by the Forest Department, J&K Govt. (Forest division, Chadoora). Besides a network of roads is also being constructed near and within the forest which will also brings habitat fragmentation.

VI. Discussion

The results of the present study indicate that a multitude of ecological stresses have disturbed the forest ecosystem as reflected by variability in soil characteristics and plant community organizational features. The mild disturbances increase the species diversity, richness and evenness while severe disturbance lead to a decrease in these variables for all types of vegetal zones. On the other hand, the reduction in vegetation cover due to various factors not only makes the soils prone to erosion but also lead to loss of major plant nutrients due to leaching. Thus, the growing biotic stresses are responsible for modifying the natural ecosystem in terms of its structural and functional attributes which not only modify that nature of soil both in terms of its composition and texture but also reduce the rich biodiversity of plants and their productivity. The Importance Value Index (IVI) of the tree species at the protected sites depicted higher values against the unprotected sites. The plant biomass varied considerably through different seasons in both the protected and unprotected sites. The highest values of biomass during summer and autumn are due to the presence of more number of species which could further be attributed to the fact that more hospitable situations were created facilitating their phenotypic development and thus increasing their population. The adverse effects of grazing were compounded by the fact that grazers were found to consume not only the leaves and stems but also the inflorescence of the plant species. The removal of organic matter in the form of herbage biomass and trampling by grazers has caused edaphic changes and consequently the vegetal changes at the grazed sites. The above findings are further corroborated by the work of other investigators while studying the effect of grazing on structure and productivity of vegetation (Lone and Pandit, 2007). Contrary to the present study, Chakravarti and Bhati (1971) observed no significant decrease in plant cover due to grazing in afforested dunes of Rajasthan although the author noted that some of the species decrease in their coverage against an increase in others.

VII. Conclusion

Low vegetation cover caused decrease in the species diversity of trees and increased that of shrubs, while intermediate values were observed for herbs. Lower values of richness and evenness at unprotected sites of near village (NS) sites and riparian forest (RS) site indicates that natural forests are degraded because of lower vegetation cover that may be due to cutting of

trees, firewood collection, cattle grazing, road construction and other anthropogenic stresses that can be restored by providing protection which ultimately help in regeneration process. The different vegetation types have been found to influence the soil to different extents. Trees and other plant species influence the physical and chemical properties of the soil by several mechanisms. Differences in litter quantity and nutrient status, root nutrient uptake and activity, interception of atmospheric deposition, canopy interaction, rock weathering and leaching can cause difference in the physical and chemical characteristics of top soils under various canopy cover. The results of the present study indicate that a multitude of ecological stresses have disturbed the forest ecosystem as reflected by variability in soil characteristics and plant community organizational features. On the other hand, the reduction in vegetation cover due to various factors not only makes the soils prone to erosion but also lead to loss of major plant nutrients due to leaching.

VIII. Acknowledgement

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Table 1 : Characteristics of selected study sites.

S.No.	Sites	Latitude	Longitude	Altitude (masl)	Tree density ($10m^2$)	Soil type	Dominant tree species
01.	NS (I)	$33^0$52′ 11.3″N	$74^0$39′ 22.2″E	2146	2.2	SiL	*Pinus wallichiana*
02.	RS (II)	$33^0$51′ 45.0″N	$74^0$39′ 20.6″E	2181	14.0	ScL	*Abies pindrow*
03.	DS (III)	$33^0$50′ 36.0″N	$74^0$38′ 52.3″E	2383	21.8	CL	*Pinus wallichiana*
04.	PS (IV)	$33^0$51′ 28.2″N	$74^0$38′ 54.6″E	2318	86.9	CL	*Pinus wallichiana*

Table 2 : Impact of deforestation on tree species at the study sites based on Importance Value Index (IVI) of the tree species.

S. No.	Name of the tree species	IVI		IVI	
		Protected areas		Unprotected areas	
		NS	RS	DS	PS
01.	*Abies pindrow*	80.3	156.6	96.54	43.94
02.	*Pinus wallichiana*	126.7	118.6	203.4	256.0

03.	*Robinia psedoacacia*	27.9			
04.	*Salix sp.*	43.0	24.7		
05.	*Ulmus villosa*	23.6			

Table 3 : Out-turn of timber in cubic feet during 2009-10 and 2010-11 at different study site of Branwar forest.

S.No.	Sites	2009-10	2010-11
01.	Site I & II	12509	15306
02.	Site III & IV	1360	829
03.	Total	13869	16135

Source : Divisional Forest Office, Chadoora

Table 4 : Out-turn of firewood (fuel) in quintals during 2009-10 and 2010-11 at different study sites of Branwar forest.

S.No.	Sites	2009-10	2010-11
01.	Site I & II	1018	1185
02.	Site III & IV	475	329
03.	Total	1493	1514

Source: Divisional Forest Office, Chadoora

Table 5 : Population estimates of livestock of different villages near Branwar forest during 2010-11.
Source: Sheep and Animal Husbandry Department, J&K Govt.

S. No.	Village	Sheep	Goat	Cattle	Total
01.	Branwar	968	346	936	2250
02.	Bonen	493	107	380	980
03.	Surasyar	842	98	560	1500
04.	Dadampora	1424	59	897	2380
06.	Total	3727	610	2773	7110

Source : Sheep and Animal Husbandry Department, J&K Govt.

Table 6 : Variation in the biomass production (g/m^2) of herbaceous vegetation at different study sites during different seasons of 2010.

S.No.	Seasons	Site I (NS)		Site II (RS)		Site III (DS)		Site IV (PS)	
		AGB (g/m^2)	ANP	AGB (g/m^2)	ANP	AGB (g/m^2)	ANP	AGB (g/m^2)	ANP
		108.00		112.00		186.60		196.80	
01.	Spring	162.20	54.20	166.40	54.40	245.00	58.40	266.00	69.20
02.	Summer	226.60	64.40	210.20	43.80	296.50	51.50	330.30	64.3
03.	Autumn	270.00	43.40	280.00	69.80	370.00	73.50	398.00	67.7
04.	Winter	210.00	-50.00	220.00	-60.00	330.00	-40.00	356.40	-41.6
05.	Total		112.00 $g/m^2/y$		108.00 $g/m^2/y$		143.4 $g/m^2/y$		159.6 $g/m^2/y$

AGB = Above ground Biomass & ANP = Above-ground Net Productivity.

Figure 1 : Importance Value Index of various tree species at the study sites.

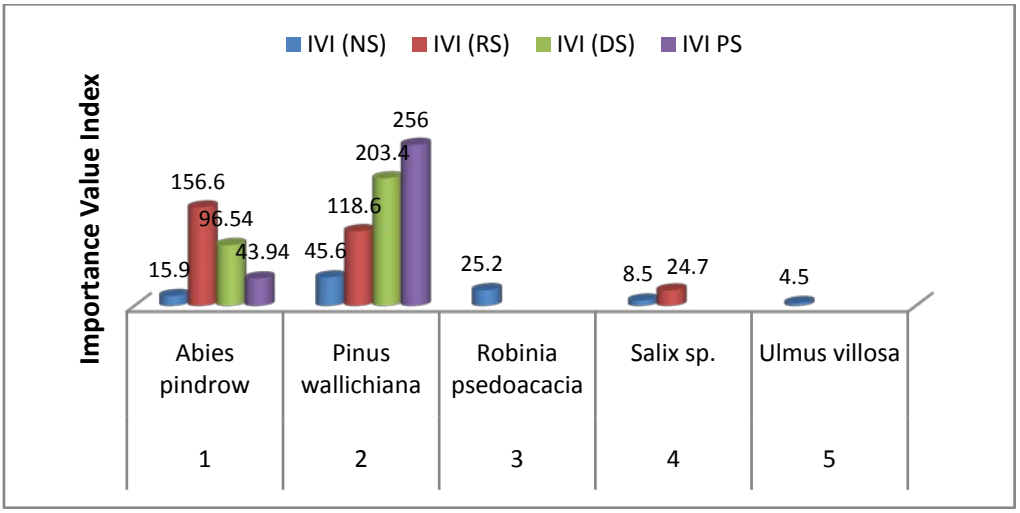

Figure 2 : Population estimates of livestock of different villages of Branwar forest during 2010-11.

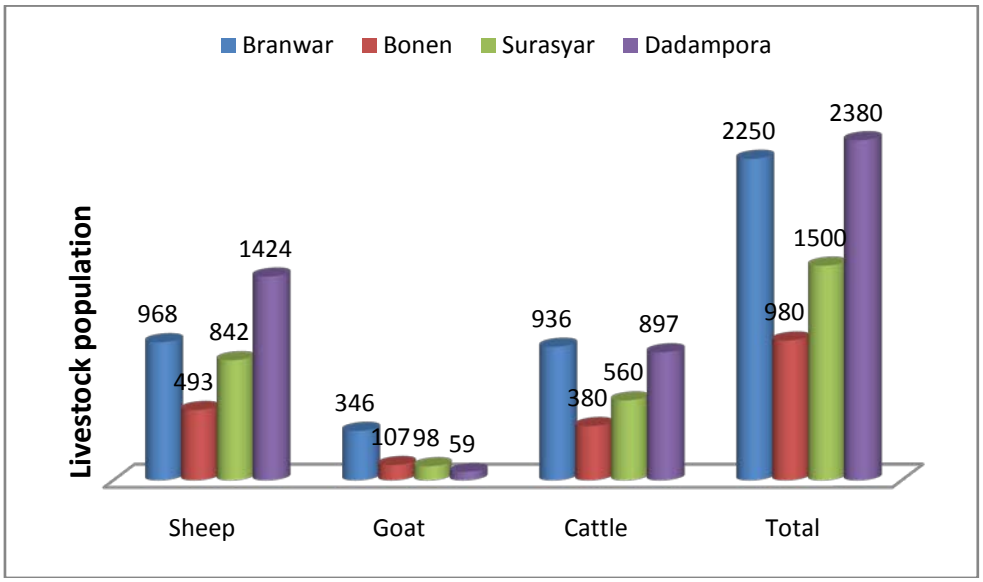

Figure 3 : Seasonal variation in the above ground biomass of herbaceous vegetation at various sites of Branwar forest during 2010-11.

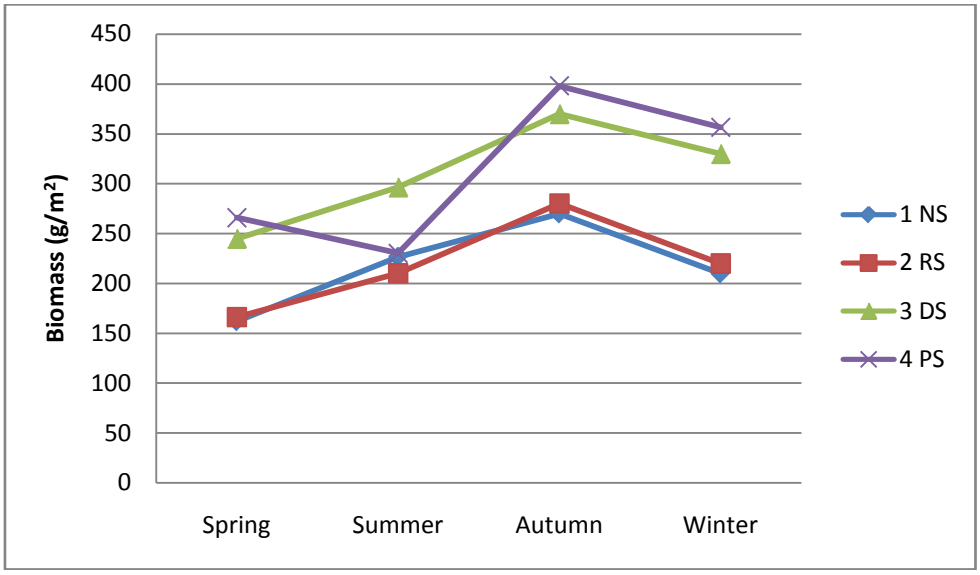

Figure 4 : Primary Productivity (g/m^2/year) of herbaceous vegetation at various sites of Branwar forest during 2010-11.