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ASSESSSMENT OF HUMAN IMPACT ON THE STRUCTURE AND COMPOSITION OF LASDANA FOREST DISTRICT BAGH, AZAD JAMMU AND KASHMIR, PAKISTAN

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Abstract

Natural forest resources of moist temperate forests of Himalayas are severely threatened due to over exploitation by rural population for their domestic usage. Six forest sites were selected to examine the anthropogenic impacts on natural forests in which 3 sites were disturbed and 3 were control sites with natural vegetation without any disturbance. Total 102 species were recorded belonging to 42 families and the most dominant family was Lamiaceae followed by Poaceae. Dominant tree species of the area were *Abies pindrow* having IVI 90.94 and *Pinus wallichiana* has 69.51 IVI respectively. The shrub layer was dominated by *Viburnum grandiflorum* having IVI (29.2) followed by *Berberis lycium* (16.91) while herb layer was dominated by *Fragaria nubicola* (14.93), *Bupleurum falcatum* (12.69) and *Impatiens bicolor* (12.20). Average Simpson's diversity was 0.962; average Shannon diversity was 3.63; average species richness was 1.48; average species evenness was 0.91 whereas average maturity index was 42.18. Average tree density was 410/ha; average stump density was 360/ha; average stem to stump value was 2.08 whereas average regeneration rate was found to be 263.33/ha. The quantified structural forest attributes reveal a severe intensity of human pressure on the local forests. There is a serious threat to the ecosystem services provided by the local forest reserves and reflect the need of immediate merasures for the conservation and sustainable use of the forest resources.

Key Words: Human Imapct, Vegetation Composition, Diversity, Subtropical Forest, Anthropogenic Impact.

Introduction

Himalayan forests are characterized by unique physiographic factors and diverse structure and composition. The composition of the forest varies according to the topography such as foothills, upper mountains and plains (Singh, 2006). The rural population of Himalayas totally depends on forest resources to fulfill their energy requirements. The Himalayan forest have experienced severe degradation over past few decades due to immense anthropogenic pressure like rapidly increasing population, over extraction of the fuel and timber wood; and agriculture expansion (Ahmedulla & Nayar, 1999; Cochard & Dar, 2014 and Dar, 2003). Diversity components impel the traits expression including the number of species, species richness, species evenness, species composition and interactions among species. Each factor has an impact on functioning of ecosystems and on species diversity that impede ecosystems to environmental variations (Chapin *et al.*, 2000). Geographic factors including topography, aspect, soil type and degree of slope inclination influenced the forest composition. Different altitudinal variations and slopes affect the species richness and distribution of tree species (Eilu & Obua, 2005). Changes in altitude and climatic fluctuation like temperature and rainfall instigate the species richness (Kharkwal *et al.*, 2005). The distribution and species richness are determined by microclimatic factors (Sharma *et al.*, 2009). The microclimatic factors are in turn influenced by the intensity and extent of accessible sunlight to the area (Yadav & Gupta, 2006). The continuous harvesting of trees leads to deforestation and has deteriorating effects on forest structure and composition (Rüger *et al.*, 2007). Deforestation cause climatic change, soil erosion and flooding and also causes global warming (Lobell *et al.*, 2011). The main objective is to investigate the structure and composition of local forests stands and to analyze the correlation between environmental variables including altitude, aspect and slope and the forest structure and composition.

Materials and Methods

District Bagh is located in Western Himalayas having sub-tropical to sub alpine vegetation. The investigated forest area lies in Lasdana forest range, District Bagh Azad Kashmir at $73^0$44'54.22" East longitude and $34^0$04'34.92" North latitude (Fig. 1). The area has an altitudinal range of 2000 to 2900 meters. The entire population of the area is 143399 including 6841 male and 7559 females and the annual growth rate is 2 percent (Anon., 2014). The climate of the area is moist temperate. During summers average temperatures is 10 to 15^{o}C whereas winters facade always severe and freezing temperature ranging from 0 below to -10^{o}C (Pak-met, 2015). From November to March the studied area remains under the snow cover. Nomads and locals use the area as summer pastures from April –August (Shaheen *et al.*, 2011a).

Study was carried out during May 2015 to September 2015. A total of 6 localities were selected including 3 disturbed sites that were near to the settlement; whereas 3 control sites were away from the settlement. Control sites with minimum disturbances were selected to compare with the sites which were severely disturbed. Quadrat method was used for vegetation sampling. At each site 10 quadrats were laid for trees, 20 for shrubs and 40 for herbs. The Quadrat size for trees, shrubs and herbs was 10 m x 10 m, 5 m x 5 m and 1 m x 1 m respectively (Cox, 1985). Altitude, latitude and longitude of each selected site were recorded by using a Garmin 2000 global positioning system (GPS).

Diameter at Breast Height (DBH) of each individual tree was recorded. Following parameters including density, frequency, cover, relative density, relative frequency, relative cover and importance value index were studied. Regeneration status, deforestation intensity, soil erosion, grazing intensity, slope variations and aspect were also measured following Ahmad & Shaukat (2012).

Study area showed an average tree density was 660/ha at control site 3 and minimum of 160/ha at disturbed site 1. An average of stump density was 600/ha at disturbed site 1 while minimum of 120/ha was at control site 1. Average deforestation rate was represented by a stem to stump value of 5.16 at control site 1 whereas it was minimum of 0.3 at disturbed site 1 (Table 2). The average regeneration rate was 740/ha at control site 2 whereas minimum of 0 was at disturbed site 3 where seedlings were totally absent.

The statistical analysis was used to find the correlation and the dominance of the species within a community (Tables 2 and 3). PCA biplot separated the indicator species i.e. *Pinus wallichiana* and *Abies pindrow* from the rest of species (Fig. 2). *Viburnum grandiflorum*, *Sarcococca saligna* and *Onychium japonicum* showed significant correlation with the disturbed sites. Remaining species were clumped in the center without having any significant correlation with any of the control or disturbed categories.

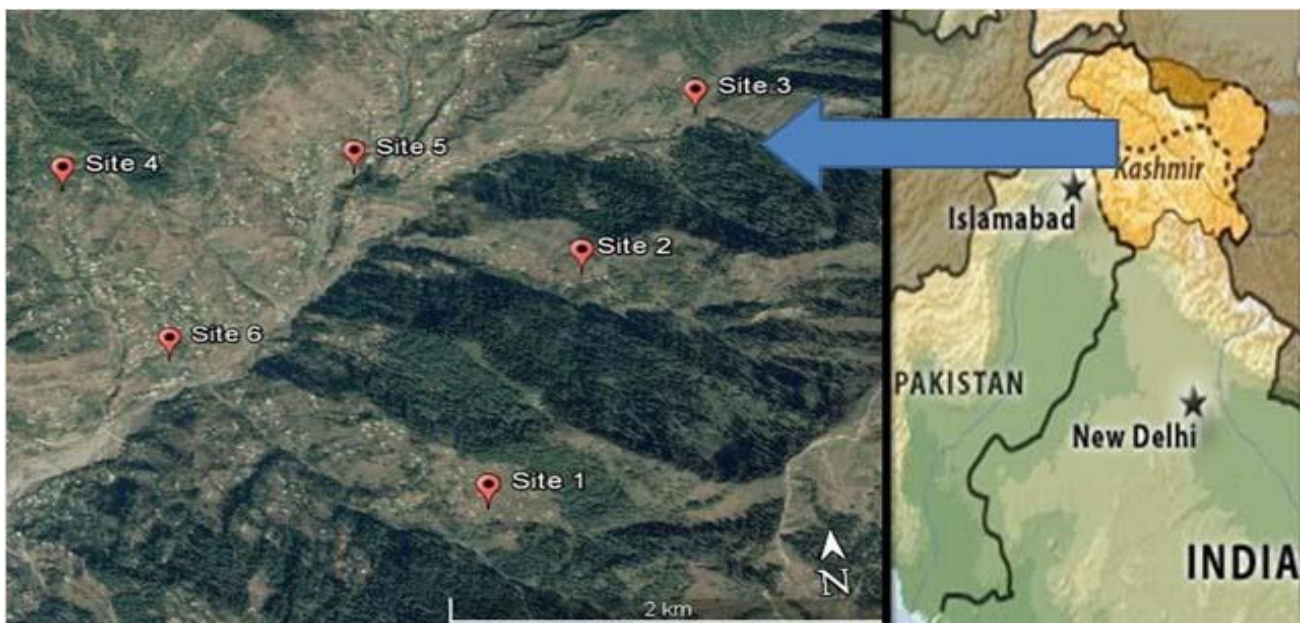

Fig. 1. Map of the study area.

Table 1. Indices data of vegetation of Lasdana Forest Bagh.

Communities	No of species	Simpson's diversity	Shannon diversity	Species richness	Species evenness	Maturity
Disturbed site 1	36	0.96	3.66	1.34	0.92	35.27
Disturbed site 2	44	0.99	3.50	1.76	0.93	34.31
Disturbed site 3	32	0.989	3.30	1.55	0.95	40.93
Average	37.33	0.97	3.48	1.55	0.93	36.83
Control site 1	49	0.91	3.66	1.14	0.89	60.20
Control site 2	63	0.95	3.79	1.50	0.92	43.41
Control site 3	71	0.97	3.88	1.61	0.90	39.01
Average	61	0.94	3.77	1.41	0.90	47.54
Total average	**49.16**	**0.96**	**3.63**	**1.48**	**0.92**	**47.54**

Table 2. Parameter data of the vegetation of the Lasdana Forest.

Community	Tree density/ha	Stump density/ha	Stem/ Stumps	Regeneration/ ha	Erosion class	Grazing class
Disturbed1	180	600	0.3	140	2	3
Disturbed2	240	580	0.41	80	2	3
Disturbed3	160	460	0.34	0	2	2
Average	193.3	546.6	0.35	73.33		
Control1	620	120	5.16	400	1	1
Control2	600	180	3.3	740	1	1
Control3	660	220	3.0	220	1	1
Average	626.6	173.3	3.82	453		
Total average	**410**	**360**	**2.08**	**263.33**		

Table 3. Importance value index of communities.

Sr. No.	Species name	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6	Average
1.	*Abies pindrow*	90.94	84.29	59.44	11.8	0	0	41.08
2.	*Acacia nilotica*	0	0	0	0	2.03	0	0.34
3.	*Achillea millefolium*	4.8	2.81	4.98	0	0	0	2.10
4.	*Adiantum venustum*	2.51	0	2.68	0	3.18	9.05	2.90
5.	*Aesculus indica*	0	1.95	0	0	1.96	2.4	1.05
6.	*Allium humile*	2.46	1.42	0	0	0	0	0.65
7.	*Ajuga bracteosa*	3.48	1.81	0	0	0	0	0.88
8.	*Ajuga parviflora*	0	0	2.83	0	0	0	0.47
9.	*Arisaema flavum*	4.62	3.29	5.4	0	0	0	2.22
10.	*Arisaema jacquemontii*	0	0	0	8.2	9.99	4.1	3.72
11.	*Artemisia dubia*	0	3.52	3.24	0	0	0	1.13
12.	*Arthraxon prionodes*	1.08	2.21	2.64	3	7.79	7.61	4.06
13.	*Aster himalaicus*	3.06	2.06	2.49	0	0	0	1.27
14.	*Avena sativa*	0	3.68	0	0	0	0	0.61
15.	*Berberis lycium*	2.92	2.72	2.28	0	16.91	0	4.14
16.	*Bergenia ciliata*	0	2.02	0	0	0	0	0.34
17.	*Bistorta amplexicaulis*	0	0	4.2	0	0	7.16	1.89
18.	*Bupleurum falcatum*	5.41	12.69	4.83	0	2.22	0	4.19
19.	*Calamintha umbrosa*	0	2.35	0	0	0	0	0.39
20.	*Caltha alba*	4.27	1.42	1.9	0	0	0	1.27
21.	*Cirsium vulgare*	3.26	2.58	2.15	0	4.15	5.24	2.90
22.	*Clematis montana*	0	0	1.1	0	0	0	0.18
23.	*Cotoneaster racemiflorus*	0	1.17	0	0	0	0	0.20
24.	*Cynodon dactylon*	0	4.61	0	0	0	0	0.77
25.	*Cynoglossum glochidiatum*	5	1.66	3.65	1.8	0	0	2.02
26.	*Dactylis glomerata*	0	3.63	0	0	5.43	0	1.51
27.	*Digitaria sanguinalis*	0	3.09	0	0	0	0	0.52
28.	*Dryopteris juxtaposita*	0	0	0	4.7	4.84	0	1.59
29.	*Dryopteris stewartii*	9.48	3.39	1.49	6.7	0	0	3.51
30.	*Duchesnea indica*	3.71	2.76	4.05	5.2	8.07	0	3.97
31.	*Elaeagnus umbellate*	0	0.79	0	0	0	0	0.13
32.	*Equisetum arvense*	0	3.52	0	0	0	0	0.59
33.	*Fragaria nubicola*	6.62	6.56	2.56	0	13.95	14.93	7.44
34.	*Galium aparine*	5.22	4.43	5.86	4.7	2.65	3.98	4.47
35.	*Gentiana kurroo*	0	0	3.36	0	0	0	0.56
36.	*Geranium rotundifolium*	0	0	0.63	0	3.73	0	0.73
37.	*Geranium wallichianum*	4.48	4.48	0.98	0	0	6.67	2.77
38.	*Hedera helix*	1.92	0	2.61	2.6	2.63	0	1.63
39.	*Impatiens bicolor*	0	5.71	0	12.2	0	0	2.99
40.	*Impatiens edgeworthii*	3.7	0	3.78	0	11.67	10.93	5.01
41.	*Indigofera heterantha*	5.04	3.01	1.42	0	3.91	2.68	2.68
42.	*Isodon rugosus*	3.43	2.61	0	8.2	1.38	0	2.60
43.	*Jasminum humile*	3.57	1.07	1.83	4.1	2.25	0	2.14
44.	*Lindelofia longiflora*	0	0	6.13	0	0	0	1.02
45.	*Lonicera quinquelocularis*	0	1.27	0	1.3	5.87	0	1.41
46.	*Machilus odoratissima*	0	0	0	2	0	0	0.33
47.	*Micromeria biflora*	0	0	1.03	0	0	0	0.17
48.	*Nepeta erecta*	1.23	1.81	2.76	0	5.95	6.22	3.00
49.	*Oenothera rosea*	4.67	2.6	2.13	0	5.25	5.55	3.37
50.	*Onychium japonicum*	8.38	5.95	1.03	11.9	4.84	11.3	7.23
51.	*Origanum vulgare*	0	3.86	0	0	0	0	0.64
52.	*Oxalis corniculata*	0	6.29	0	6.2	6.24	11.45	5.03
53.	*Phalaris paradoxa*	0	2.3	10.55	2.9	2.49	0	3.04
54.	*Phlomis bracteosa*	0	2.23	6.42	0	3.75	0	2.07
55.	*Picea smithana*	0	0	0.89	1.8	0	0	0.45
56.	*Pinus wallichiana*	5.84	15.47	34.48	46.8	47.24	69.51	36.56
57.	*Plantago lanceolata*	4.85	2.99	3.32	4.4	0	6.84	3.73
58.	*Plantago major*	3.38	3.22	2.67	5.6	1.25	4.26	3.40
59.	*Poa pratensis*	4.68	3.87	0	0	8	4.47	3.50

Table 3. (Cont'd.).

Sr. No.	Species name	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6	Average
60.	*Poa alpina*	0	0	4.85	5.7	0	0	1.76
61.	*Poa stewartii*	0	0	1.98	0	0	0	0.33
62.	*Polygonum aviculare*	1.06	1.03	2.63	4.5	8.31	7.61	4.19
63.	*Persicaria nepalense*	0	0	1.98	0	8.47	7.95	3.07
64.	*Populus alba*	0	0	0	0	2.03	0	0.34
65.	*Potentilla anserina*	2.51	1.96	1.45	3.9	0	0	1.64
66.	*Primula denticulata*	0	0	1.08	0	0	0	0.18
67.	*Primula macrophylla*	0	0	3.1	0	0	0	0.52
68.	*Prunella vulgaris*	3.42	3.31	2.04	3.5	5	6.36	3.94
69.	*Prunus padus*	0	0	0.88	1.9	0	0	0.46
70.	*Pteris cretica*	3.42	0	0	6.3	3.04	0	2.13
71.	*Pteris vittata*	0	3.19	3.81	0	0	4.3	1.88
72.	*Pteris nepalensis*	0	0	2.85	0	4.98	0	1.31
73.	*Quercus floribunda*	0	2.27	0	0	0	0	0.38
74.	*Quercus incana*	0	0	0	2.8	7.22	4.78	2.47
75.	*Ranunculus muricatus*	4.3	2.92	2.23	3.6	0	0	2.18
76.	*Rosa macrophylla*	4.81	1.36	0	0	1.11	0	1.21
77.	*Rubus fruticosus*	7.13	0	1.58	0	0	0	1.45
78.	*Rumex nepalensis*	4.61	3.33	2.99	4.5	0	7.18	3.77
79.	*Rumex hastatus*	0	0	2.25	0	0	0	0.38
80.	*Salix alba*	0	0	3.07	0	0	0	0.51
81.	*Salvia lanata*	0	0	2.35	0	0	0	0.39
82.	*Sarcococca pruniformis*	4.83	2.61	0	6.7	12.03	9.61	5.96
83.	*Saussurea albescence*	0	0	4.1	0	0	0	0.68
84.	*Saussurea fastuosa*	0	0	2.38	0	0	0	0.40
85.	*Senecio chrysanthemoides*	0	3.99	3.68	0	0	0	1.28
86.	*Sibbaldia cuneata*	4.17	0	1.54	0	0	0	0.95
87.	*Silene vulgaris*	3.28	0	0	0	0	0	0.55
88.	*Sisymbrium irio*	0	0	2.16	0	0	0	0.36
89.	*Skimmia laureola*	3.03	0	0	0	0	0	0.51
90.	*Solanum nigrum*	0	3.54	1.05	0	0	0	0.77
91.	*Stellaria media*	1.89	2.25	4.44	0	4.29	0	2.15
92.	*Taraxacum* sp.	2.24	2.19	1.13	4.1	7.24	0	2.82
93.	*Thymus linearis*	3.17	5.24	0.94	0	0	4.12	2.25
94.	*Trifolium pretense*	0	0	1.31	0	0	0	0.22
95.	*Trifolium repens*	7.05	3.45	7	4.7	5.82	9.33	6.23
96.	*Tussilago farfara*	0	0	2.48	0	0	0	0.41
97.	*Urtica dioica*	6.77	0	3.8	8.4	0	6.67	4.27
98.	*Verbascum thapsus*	0	1.76	1.41	0	4.15	4.87	2.03
99.	*Viburnum grandiflorum*	10.8	12.89	11.11	79.9	19.76	25.37	26.64
100.	*Viola canescens*	7.43	0	1.93	0	0	7.46	2.80
101.	*Viola odorata*	0	4.57	4.57	3.2	6.64	0	3.16
102.	*Vulpia myuros*	0	2.88	0	0	0	0	0.48

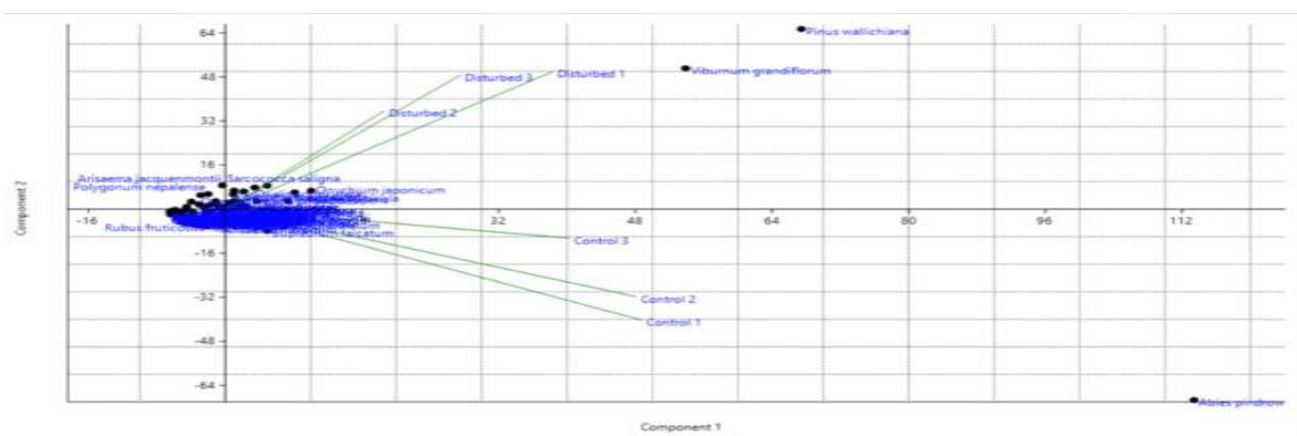

Fig. 2. Principal component analysis biplot of species.

Discussion

The present study reveals that the investigated area is severely threatened due to the anthropogenic disturbances such as excessive fuel wood collection, timber collection, grazing, trampling, and lopping. Present study area showed an average of Shannon-Wiener diversity index was 3.63. Our core findings were less than 3.66 in Dachigam, Kashmir (Shameem & Kangroo, 2011); 3.81 in Northeast India (Sarkar & Devi, 2015). Lower diversity values recorded from the area showed that area was under high anthropogenic influences including grazing, cutting as trampling (Shameem & Kangroo, 2011). The average Simpson's index value was 0.96; similar results were recorded as 0.96 in Langakawi Island, Malaysia (Hayat *et al.*, 2010). However our values are greater than that of 0.05 in Northeast India (Sarkar & Devi, 2015); 0.90 in Nakyal valley, district Kotli (Amjad *et al.*, 2014) and 0.91 in alpine pasture Himalaya Kashmir (Shaheen *et al.*, 2011b). Lower diversity values show that area is under high anthropogenic influences and increase in disturbances causes changes in micro climate of the sites and it provides opportunities to species to migrate from the disturbed site (Whittaker, 1970).

Average species richness calculated from the investigated area was 1.48. Reported values were less than 7.92 in Kashmir Himalaya, India (Shameem & Kangroo, 2011); 1.8 in little Andaman Island, India (Rasingam & Parathasarathy, 2009); 7.3 in Northeast India (Sarkar & Devi, 2015). The decrease in species richness is because of the climatic variations and altitudinal variations, slope and difference of aspects (Sharma *et al.*, 2009). The Average species evenness calculated from the investigated site was 0.92 and the calculated results were higher than 0.17 in moist temperate forest of Garhwal Himalaya, India (Sharma *et al.*, 2009); 0.90 in alpine pasture of Kashmir, Pakistan ((Shaheen *et al.*, 2011c). Higher evenness values exhibit when number of species is less. Average maturity index was 42.18 in comparison value were less than 44.1 in Kashmir, Pakistan (Shaheen *et al.*, 2011b); 44 in Nakyal valley, District Kotli (Amjad *et al.*, 2014); 54.81 in woodland alpine association Ganga Choti, District Bagh (Hussain & Malik, 2012). Both communities exhibit a very low maturity because cutting of preferred tree species for fuel and for timber prevent the forest to reach the maturity stage (Saxena & Singh, 1984).

The average tree density was 410 ha^{-1} in the investigated area. Calculated results was less than 600 ha^{-1} in Sangla valley Northwest Himalayas (Sharma *et al.*, 2014); 767 ha^{-1} in Oak dominated forests of Nainital India (Joshi and Yadava, 2015); 1158 ha^{-1} in western Himalayas India (Sharma *et al.*, 2008). Our findings showed that the number of trees was less because of high rate of deforestation and illegal overcutting of the forest for fuel wood and timber (Sagar *et al.*, 2003).

The average stem/stump value recorded from the investigated area was 2.08. Our findings were greater than 1.9 in subtropical forest of District Bagh, Pakistan (Shaheen *et al.*, 2011a); 0.630 in semi-arid region of Zimbabwe (Gotosa *et al.*, 2013). Our core findings revealed that the forest of the area has lesser number of trees and is severely influenced by anthropogenic pressure, putting the local forests at risk (Borah *et al.*, 2014). Average rate of seedlings recorded from the investigated area was 930/ ha. Calculated results were less than 2681/ha^{-1} recorded in Garhwal Himalaya (Tiwari *et al.*, 2010); 3414/ha^{-1} in Langkawi Island, Malaysia (Hayat *et al.*, 2010). Our findings revealed that the natural regeneration in the area was less because of low seed production due to cutting of the mature trees for fuel wood and timber. Intense browsing by the animals is also responsible for the poor seedling counts in the area (Dhar *et al.*, 1997). The study area was dominated by *Abies pindrow* and *Pinus wallichiana. Abies pindrow* was present at higher altitudes whereas *Pinus wallichiana* was present at lower altitudes in the moist temperate zones. The comparative Analysis of the disturbed and undisturbed sites revealed different trends of threat intensities on the key stone forest species. It was observed that at disturbed sites, *Pinus wallichiana* showed lower IVI vales indicating high pressure. This may be attributed to the high preference of *Pinus wallichiana* as Timber specie. The rapid urbanization and household construction has led to high levels of *Pinus wallichiana* extraction from the local stands. On the other hand, *Abies pindrow* showed lower IVI values at the *control* sites. *Abies pindrow* is structurally less tolerant to the climatic pressures including snow fall and land slide, as compared to the *Pinus wallichiana*. The control sites receive more snowfall and experience land slide during the Monsoon season.

The pressure is developing on the most favorite and preferred fuel wood tree species which include *Quercus incana, Quercus dilatata, Abies pindrow, Pinus wallichiana* and *Pinus roxburghii. Although A. pindrow, P. wallichiana* and *P. roxburghii* are most significant timber wood species, but due to ignorance and acute shortage of alternate fuel sources, these species are preferred for fuel (Shaheen *et al.*, 2011b).

Conclusion

Natural forest resources are severely threatened due to over exploitation by rural population for their domestic purposes such as fuel wood and timber consumption, and livestock fodder. Substantial increase in population size and poverty are also the major factors affecting the forest status in the area. The rate of deforestation is increasing with the increase in population which may turn the Kashmir Mountains barren; and vulnerable to climatic changes and biodiversity loss. A comprehensive and conservative forest policy should be formulated and implemented in letter and spirit, with the coordination and supervision of local communities and Government machineries.

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