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ECOSYSTEM SERVICES AND STRUCTURE OF WESTERN HIMALAYAN TEMPERATE FORESTS STANDS IN NEELUM VALLEY, PAKISTAN

HAMAYUN SHAHEEN*, SHAMSHAD AZIZ AND MUHAMMAD EJAZ UL ISLAM DAR

Department of Botany, University of Azad Jammu & Kashmir, Muzaffarabad, Pakistan.
**Corresponding author's email: hamayunmaldial@yahoo.com*

Abstract

Forest ecosystem provide valuable services and livelihood support to the rural mountain communities of the Himalayas. Present research was conducted to assess the forest ecosystem services and vegetation structure of Neelum valley in Kashmir, Pakistan. A total of 56 plants species belonging to 32 familes were recorded from the studied forest stands. The dominant species were *Pinus wallichiana, Abies pindrow, Cedrus deodara, Vibrunum grandiflorum, Indigofera haterantha,* and *Agrostris gigantica.* The recorded value of species diversity was found to be 2.35; richness as 1.61; species evenness as 0.75; and maturity index as 49.34%. Thirty two plants speices were reported having ethnomedicinal usage. Fourty two percent respondents were using wild vegetables whereas 23% were involved in mushroom collection. Population showed an average family size of 8.80; herd size of 5.26; land holding as 1.59 acres; and grazing area of 0.302 acre/grazing unit. Annual fuel wood consumption of 3.11 kg/ capita/ day was recorded. Forest stands showed an average tree density of 344/ha. An average stem/stump value of 2.01 indicated high tree felling intensity. Regeneration pattern was represented with an average of 85 seedlings/ha. A continuous grazing pressure along with moderate erosion effects was observed. Vegetation structure showed significant disturbance due to deforestation, overgrazing, trampling and environmental changes. Conservation policy should be applied at local and regional levels by authorities for conservation and maintenance of forest services.

Key words: Forest Ecosystem Services, Fuelwood, Wild vegetables, Himalayas, Kashmir.

Introduction

Ecosystem services are the outcome of ecosystem functions and transformations of natural assets into products that benefits to the communities (Anon., 2005). Forest ecosystem is the primary aid to the sustainable livelihood of Himalayan mountain populations. Forest ecosystem services are classified into four main categories including regulating (Boyd & Banzhaf, 2007); provisioning (Kremen, 2005); supporting and cultural categories (Naidoo *et al*., 2008). Forest ecosystem provides valuable services including air quality regulation, waste treatment, water purification, regulation of water flows (Hein *et al*., 2006); soil erosion prevention, climate regulation, maintenance of soil fertility (Klein *et al*., 2007); pollination, seed dispersal, pest and disease regulation (Gallai *et al*., 2009); maintenances of life cycles of migratory species, nutrient recycling, spiritual, religious and esthetic values, cultural diversity, recreation, ecotourism and educational values and carbon sequestration (De Groot *et al*., 2002). About 10% of the world's population depends directly whereas an estimated 40% depends indirectly on mountain forest resources for their livelihood (Schild, 2016).

Sustainable management of forest structure is of most important for the survival of local inhabitants as well as existing climatic conditions (Cronin & Pandya, 2009). More than 60% of the Himalayan forests Ecosystem has been distructed during last century (Pokhriyal *et al*., 2010). Poor economic conditions, population explosion and lack of awareness in local inhabitants of forest surrounding areas are the main threats for the depletion of forest diversity (Gairola *et al*., 2008). Local forests of are facing severe biotic pressure including deforestation, over grazing, trampling, soil erosion, over exploitation, overuse, unscientific collection having deteriorating impacts on forest structure and services (Costanza *et al*., 1997). Current study was designed for the assessment of forest services; analyzing the impacts of anthropogenic pressure on forest reserves; and prioritization of forest services based on people perspective and market values.

Materials and Methods

Study area: The investagted area is situatied in District Neelum, Azad Jammu & Kashmir, Pakistan within 32º 23″ to 32º 87″ North latitude and 74º 10″ to 74º 81″ east longitude at an altitudinal range of 1400m in south to 5200m in north (Fig. 1). The highest temperature is 38.33ºC and lowest is -2.58ºC, recorded in June and January respectively. Maximum humidity is recorded as 85 percent whereas lowest is 31.44 percent recorded in December and May respectively. Maximum rain fall is 288.03mm in of July and lowest 36.21mm in October (Pak-Met, 2012; Shaheen *et al*., 2012).

Forest ecosystem services assessment: Five different sites including Ashkot, Salkhalah, Athamaquam Town area, Athai Lalla and Nagder were selected for the assessment of forest ecosystem services. A total of 400 Questionnaires were distributed at each site (80/site) to record the data about forst ecosystem services. The survey focused on parameters including Occupation, Family size, Income, Current status, benefits, threats and conservation management of forests Ecosystem (Raymond *et al*., 2009); Quantity of fuel wood consumed, Preferred fuel wood, edible and palatable and medicinal species (Acharya *et al*., 2011); herd size, grazing area, wild vegetables, mushroom and timber wood extraction (Butt, 2006). Quantity of fuel wood consumption was measured over a period of 24 hrs, using a weight survey method (Bhatt *et al*., 1994).

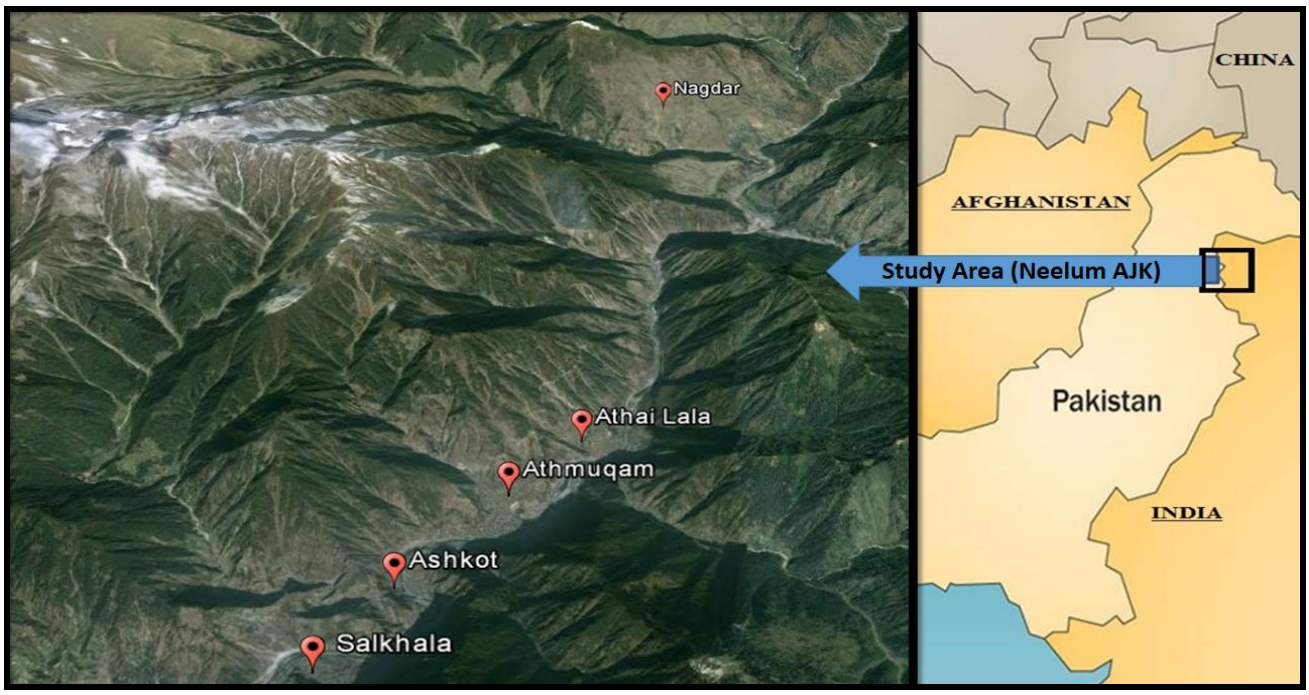

Fig. 1. Location of the study area and satellite imagery of study sites.

Phytosociological analysis: Density, frequency, canopy cover, relative values, and important value index were measured by using standard phytosociological methods (Ahmed & Shaukat, 2012). Quadrats of 20m X 20m for trees, 5m X 5m for shrubs, 1m X 1m for herbs were used. Indices of Diversity were calculated after Simpson, (1949); and Shannon and Weaver, (1959). Species richness was calculated after Menhinick, (1964) whereas evenness was calculated after Pielou, (1975). Community maturity was calculated after Pichi-Sermolli, (1948). Regeneration capacity was determined by counting the number of seedlings in the sampled plots. Stem to stump value was calculated to indicate the deforestation intensity (Shaheen *et al*., 2015). Erosion and grazing intensity were assessed at the sites by using visual parameters like trampling, browsed vegetation and hoof marks (Khan *et al.,* 2013).

Results

Local forest flora comprised of 56 plant species belonging to 32 families including 13 trees, 9 shrubs and 34 herbaceous species (Table 3). Dominant plant species included *Cedrus deodara* with an IVI %age of 29.8 followed by *Pinus wallichiana* (26.12), *Agrostris gigantica* (19.82), *Abies pindrow* (14.74), *Chrysopogon echinulatus* (13.26), *Viburnum grandiflorum* (12.5), and *Dryopteris stewartii* (12.09). Vegetation was dominated by Therophytes comprising 32% followed by Magaphanerophytes (27.42%), Hemicryptophytes and Nanophanerophytes (16% each); and Geophytes (8%). Mesophylls (41%) were the dominant leaf spectrum followed by Microphylls (30.35%), Nanophylls (17.85 %) and Leptophylls (10.71 %) (Table 3).

Four forest communities were identified at the selected sites including *Abies-Lonicera-Viburnum, Pinus-Cedrus-Indigofera, Agorostis-Cedrus-Dryopteris* and *Cedrus-Agrostis-Pinus* community. The identified plant communities showed an average species diversity (Shannon's) of 2.35. Highest diversity value of 2.53 was recorded in *Cedrus-Agrostis-Pinus* community where as *Abies-Lonicera-Viburnum* community showed least value of 2.2 (Table 1). The recorded average value of species richness was 1.62 whereas evenness value was 0.76. Communities showed an immature succession stage represented by low maturity index values in the range of 43-54. The average number of species per site was 22.25 with a Beta diversity value of 03. Forest stands showed an average tree density of 344/ha. Highest tree density of 422/ha was recorded in Ashkot forest followed by 366/ha in Athai Lalla, and 349/ha in Nagdar. Salkhala site showed lowest tree density value of 258/ha (Table 3).

Fifty seven percent of the respondents were found to use the local medicinal herbs in the area. Old age group (>40 years) showed higher association with the use of ethnomedicine as compared to younger age group. Fifty four percent of recorded species, including 38 plants belonging to 23 families exhibited medicinal properties. Different plant parts used due to cure diseases included Roots/rhizome (60.62%), leaves (26.31%), whole plant (21.05%), Arial parts (10.52%), stem (7.89%), bark (7.89%) and seeds (5.26%) (Table 4). Major diseases treated by using Medicinal herbs included asthma, stomachache, toothache, hepatitis, piles, dysentery, diabetes, joint pain, cough backache, constipation, fever, cold, and fracture. Forty two percent respondents were found using wild edible vegetables from the local forest. Recorded vegetables used by the locals included species of *Dryopteris*, *Taraxacum*, *Polygonum*, *Epilobium*, *Mentha*, *Allium*, *Osmunda*, *Plantago* and *Phytolacca*. These vegetables were used fresh as well as dried and stored for winter use. Twenty three percent respondents were found involved in mushroom collection for food and market sale. The preferred mushroom collected for market sale was *Morchella esculenta*.

Table 1. Phytosociological attributes of the identified plant communities.

Sr. no.	Forest communities	Species number	Altitude (m)	Simpson diversity	Shannon diversity	Species richness	Evenness	Maturity index %
1.	*Abies-Lonicera-Viburnum*	21	3000-3280	0.12	2.22	1.3	0.73	47.61
2.	*Pinus-Cidrus-Indigofera*	22	2020-2280	0.06	2.42	1.72	0.78	54.54
3.	*Agorostis-Cedrus-Dryopteris*	20	1680-1920	0.08	2.24	1.53	0.74	51.66
4.	*Cidrus-Agrostis-Pinus*	26	1620-1920	0.06	2.53	1.92	0.77	43.58

Table 2. Fuel wood consumption level, grazing area and herd size at investgated sites.

No.	Site name	Altitude (m)	Family size	No. of respondents	Fuel wood consumption kg/day/capita			Grazing area (Acres)	Herd size
					Summer	Winter	Annual		
1.	Nagder	1700-2500	9	360	1.38	7.96	4.10	0.15	8.67
2.	Athi lalla	1600-1780	9.77	391	1.14	5.30	2.54	0.00	6.62
3.	Athmuqam	1600-1650	7.45	298	1.01	6.06	2.67	0.22	2.25
4.	Salkhalla	1500	8.85	354	1.36	6.20	2.95	0.12	4.12
5.	Ashkot	1420-1900	8.95	358	1.49	7.03	3.31	0.25	4.65
	Average		**8.80**	**352.2**	**1.27**	**6.51**	**3.11**	0.15	**5.26**

The average annual fuel wood consumption in the area was calculated as 10.045 tons. Daily per capita fuelwood consumption was found to be 3.11 kg with a maximum of 4.1 Kg at Nagdar and 2.54 Kg at Athai Lalla (Table 2). The preferred fuel wood species in the area included *Pinus wallichiana, Cedrus deodara, Abies pindrow, Aesculus indica, Picea smithiana, Taxus baccata, Quercus dilatata,* and *Acer caesium.* Results revealed that study area exhibited an average herd size of 5.26 cattle per family. The local populations had an average land holding of 1.59 acres whereas available grazing area per unit was calculated to be 0.302 acres (Table 2).

The total variance explained by PCA was more than 90 percent with 1st component explaining 45% verifying the vegetation pattern. The community B lying on southern aspect exhibited differences in vegetation structure from the other sites was separated and shown on Y-axis (Fig. 2). The rest of three sites located in moderate elevation exhibited similar vegetation structure were shown along X-axis closely spaced from each other. Paired group agglomerative clustering validated the vegetation structure determined by field data. The very first cluster was formed of dominant conifers including *Abies pindrow, Pinus wallichiana, Picea smithiana, Cedrus deodara* having maximum IVI values in data matrix (Fig. 3). The second cluster comprised of forest understory species including *Thymus linearis, Poa attenuatta, Daphnae oleides* and *Isodon rogusus*. *Sarcococca saligna, Osmunda regalis, Dichanthium* and *Quercus dilatata* having strong affiliation with North facing slopes constituted next cluster. The last cluster comprised of *Picea smithiana, Lonicera govaniana, Vibernum grandiflorum* and *Sambucus wightiana* indicating disturbed forest stands due to absence of dominant conifers.

Discussion

Local forest stands represented immature community structure due to prevailing disturbances caused by immense pressure on forest ecosystem. The present study revealed a daily per capita fuelwood consumption of 3.11 kg, which is considerably higher than reported values of 2.9 kg for Kashmir Himalayas (Shaheen *et al*., 2011); 1.5 kg for the tribal communities of the Indian Himalayas (Bhatt *et al*., 1994); 1.7-2.5 kg for South-East Asian countries (Donovan, 1981); 1.9-2.2 kg for Southern India (Hegde, 1984); and 1.23 kg for Himalayan range of Nepal (Mahat *et al*., 1987). An increasing trend in fuelwood consumption levels was revealed with increasing altitude. Higher altitudes characterized by harsh climatic conditions, unavailability of alternate fuels, easy access to the forest stands, absence of forest monitoring and low living standards are basic reason for high fuelwood consumption (Osei, 1993). High fuelwood extraction has resulted in deteriorated forest structure having tree density values in the range of 200-300/ha. These values are lower than the recorded values for 540/ha in Indian Himalayas (Saxena & Singh, 1984); 490/ha in coniferous forests of Romania (Bindiu, 1973); and 545/ha in Canadian coniferous forests (Kimmins & Krumlik, 1973).

Grazing is among the prominent disturbances having deteriorating impacts on forest flora (Kremen, 2005). Investigated area exhibits an available grazing area of 0.302 acres/grazing unit which is extremely low for the average herd size of 5.26; almost 28 times less than the recommended value of 8.5 acres/grazing unit for western Himalayan pastures (Singh *et al*., 1984). Due to low available grazing area, pressure is shifting towards the surrounding forest lands (Negi, 2009). Seedlings and saplings are most vulnerable segment of forest structure to grazing which is adding in the anthropogenic pressure on conifers in the form of tree felling and lumbering (Foley *et al*., 2007). This fact is evident from a low seedling count of 85/ha in the study area.

Table 3. Species composition, IVI %age, and biological spectrum of local forest flora.

Botanical name	Family	Habit	Life form	Leaf spectra	IVI % age
Abies pindrow (Royle ex. D.Don) Royle	Pinaceae	Tree	Mp	L	14.74
Agrostris gigantica Roth	Poaceae	Herb	Th	N	19.82
Ailanthus altissima (Mill.) Swingle	Simarubaceae	Tree	Mp	Me	1.93
Ajuga brateosa (Wall. Ex Benth)	Lamiaceae	Herb	Th	Mi	1.03
Angelica glauca (Sichold & Zucc.) Kitag	Apiaceae	Herb	Th	Me	0.96
Artimesia vulgare L.	Asteraceae	Herb	H	N	0.94
Aesculus indica Hook (Wall. ex Cambess) Hook	Hippocastinaceae	Tree	Mp	Me	4.52
Atropa baladona L.	Solanaceae	Herb	Th	Me	2.87
Berberis lycium Royle.	Berberidaceae	Shrub	Np	N	8.05
Breberis aristata DC.	Berberidaceae	Shrub	Np	N	2.39
Cannabis sativa L.	Canabaceae	Herb	Th	Mi	1.26
Cedrus deodara (Rox. Ex D.Don) G. Don.	Pinaceae	Tree	Mp	L	29.89
Chrysopogon echinulatus Nees.W. Watson	Poaceae	Herb	Th	N	13.26
Daphne olioides Schreb	Thymelaeaceae	Shrub	Np	Mi	0.94
Dichanthium annulatum (Sw.) Roberty	Poaceae	Herb	Th	N	1.91
Diospyros lotus L.	Ebinaceae	Tree	Mp	Me	0.93
Dryopteris filix-mas (L.) Schott.	Dryopteridaceae	Herb	G	Me	3.28
Dryopteris stewartii D.Don	Dryopteridaceae	Herb	G	Me	12.09
Dryopteris sieboldii (T. Moore) Kuntze	Dryopteridaceae	Herb	Th	Me	6.14
Euphorbia heliscopia L.	Euphorbiaceae	Herb	H	Mi	3.34
Fargaria nubicola (Lindle. Ex Kook f.) Lacaita	Rosaceae	Herb	H	Mi	7.54
Geranium wallichianam (D.Don ex Sweet)	Ggeraniaceae	Herb	G	Me	1.17
Impatiens thomsonii Hook. f.	Balsimaceae	Herb	G	Me	1.33
Indigofera heterarantha Wall ex. Brandis	Papilionaqceae	Shrub	Np	N	13.3
Iris hookeriana Foster	Iridaceae	Herb	G	N	2.47
Isodon rugosus (Wall ex. Benth) Codd.	Lamiaceae	Shrub	Np	Me	1.19
Lonicera govaniana Wall ex. DC.	Caprifoliacaee	Shrub	Np	Mi	8.48
Mentha spicata L.	Lamiaceae	Herb	H	Mi	2.49
Origanum vulgare L.	Lamiaceae	Herb	G	Mi	9.15
Osmunda regalis L.	Osmundaceae	Herb	G	Me	3.01
Parotiopsis jacquemontiana (Decne.) Rehder	Hamamelidiacea	Tree	Mp	Me	2.87
Persicaria nepalensis (Meisn.) Miyabe	Plygonaceae	Herb	Th	Mi	2.06
Phlaris minor Retz.	Poaceae	Herb	Th	N	8.86
*Picea smithiana (*Wall.) Bloss	Pinaceae	Tree	Mp	L	5.86
Pinus wallichiana A.B.Jackson	Pinaceae	Tree	Mp	L	26.12
Pistacia integerrima Stewart ex. Brandis	Anacardiaceae	Tree	Mp	Me	0.88
Plantago lanciolata L.	Plantginacee	Herb	H	Mi	1.03
Poa attenuata Trin	Poaceae	Herb	G	L	1.73
Polygonum amplexicaule D.Don.	Polygonaceae	Herb	G	Me	0.97
Primula denticulata Smith	Primulaceae	Herb	G	Mi	0.97
Pseudomertensia moltkioides Royle ex. Benth	Boraginaceeae	Herb	Th	Mi	0.96
Quercus dilatata Royle	Fagaceae	Tree	Mp	Me	1.84
Quercus incana Bartram	Fagaceae	Tree	Mp	Me	6.86
Rostraria pumila (Desf.) Tzrelev.	Poaceae	Herb	Th	N	3.79
Rhus saxidinea D.C.	Anacardiaceae	Tree	Mp	Me	0.93
Rumex nepalenses Meisn.	Polygonaceae	Herb	G	Me	5.49
Salvia nubicola Wall ex. Sweet.	Lamiaceae	Herb	Th	Mi	2.71
Sambucus wightiana Wall ex Wigt & Arn	Sambucaceae	Herb	Ch	Me	6.76
Sarcococca saligna D.Don	Buxaceae	Shrub	Np	Mi	2.8
Sonchus asper (L.) Hill	Asteraceae	Herb	Th	Me	0.97
Sorbaria tomentosa (Lindl) Rehder	Rosaceae	Shrub	Np	Me	3.96
Themeda anathera (Nees ex Steud.) Hack	Poaceae	Herb	Th	N	5.9
Thymus linearis Benth.	Lamiaceae	Herb	H	Mi	3.04
Trifolium repens L.	Trifoliaceae	Herb	H	N	0.97
Viburnum grandiflorum Wall ex D.Don	Caprifoliaceae	Shrub	Np	Me	12.5
Viola canescens Wall	Violaceae	Herb	G	Mi	8.12

Table 4. Ethnomedicinal information recorded from the rural populations.

No.	Plant species	Local name	Parts used	Ethnomedicinal utilization
1.	*Allium humile*	Mali Ka Piaz	WP	Condiment, stomachache, vegetable
2.	*Angelica glauca*	Chora	R,L	Acute abdominal pain, stomachache, rheumatism, hepatitis & condiment
3.	*Angelica cyclocarpa*	Murchar	Rh	Cough, constipation and cure of asthma in animals
5.	*Chaerophyllum reflexum*	Hasbay ki Jar	Rh	Antifungal and anti-bacterial, paste given to cure typhoid fever and skin diseases
6.	*Achillea millefolium*	Dand jari	L,Rh	Stomachache, urinary complaints, toothache, antiseptic
7.	*Sassurea costus*	Kutth	Rh	Constipation, worm killing, joint pain, antiseptic, toothache, and backache
8.	*Jurinea macrocephala*	Gugal Dhoop	Rh	Digestion, backache, diarrhea, and joint pains
9.	*Taraxacum officinale*	Hand	L,R	Vegetable, Also used in cold, cough and diabetes
10.	*Taraxacum* spp.	Bhuti Hand	WP	Vegetable, diabetes
11.	*Berberis aristata*	Sunbal	R,B,F	Eye diseases, joint pains, skin diseases, jaundice, piles, stomach ulcer, backache, malaria, and fractures. Fruit is laxative and anti a scorbutic
12.	*Rhodiola fastigiata*	Bag Masti	Rh	Stomach diseases and headache
13.	*Taxus baccata*	Thoonri	L,B	Leaves sedative, antiseptic. Bark used for asthma, bronchitis, epilepsy
14.	*Dryopteris filix-mas*	Langroo	WP	Vegetable, rhizome is used for the treatment of cholera and dysentery
15.	*Veronica gentianoides*	Bhangri	R	Used to inhibit the pathogenic activity of yeast and to cure lecoria
16.	*Geranium wallichianum*	Ratan Jot	WP	Tonsillitis and toothache. Oil is astringent. Decoction is used for joint pain, constipation, and digestion
17.	*Mentha longifolia*	Podeena	WP	Used fot digestion and diarrhea
18.	*Ajuga bracteosa*	Jan-e-adam	Wp	Decoction is used to cure skin diseases, diabetes, worms, blood purification
19.	*Origanum vulgare*	Ban Babri	WP	Cure skin diseases, fever, cough, rheumatism and intestinal worms
20.	*Thymus linearis*	Ban Ajwaen	L,Fl	Suppression of urine, constipation, shivering
21.	*Malva parviflora*	Dag Sounchil	WP	Vegetable, seeds are used as demulcent in cough and ulcers in the bladder
22.	*Indigofera heterantha*	Kenthi	R	Decoction used for cough. Root powder is applied externally for pain in chest
23.	*Bistorta amplexicaulis*	Masloonr	Rh,F	Used for the treatment of diarrhea, dysentery and hemoptysis. Flower tea is used to treat stomach problem.
24.	*Polygonum alpinum*	Chikroon	Ar,R,Se,St	Arial parts used as vegetable. Seeds used for colic pain. Roots used as astringent. Stalk used for ulcers, constipation
25.	*Polygonum amplexicaule*	Masloonr	Rh	Extract has antibacterial activity against pseudomonas aeruginosa.
26.	*Rheum australe*	Goal Chotial	L.Rh,S	Stem edible, root paste is applied for muscular injury, cuts. Stem used for stomachache dysentery, swelling of throats
27.	*Rheum webbianum*	Chipti Chotial	L,Rh,S	Stem edible. root paste is applied on wounds, mumps. Decoction used for headache, constipation, earache and blood purification
28.	*Rumex nepalensis*	Hola	L,Rh	Vegetable. Root paste is anti-lice
29.	*Aconitum heterophyllum*	Patrees	Rh	Paste is applied on chest to treat pneumonia, cold, fever
30.	*Bergenia stracheyi*	Bat Bhaiwa	Rh	Paste used on burns, piles. Decoction used for kidney stone, diabetes, ulcer dysentery, and obesity. Roots used for backache
31.	*Picrorhiza kurrooa*	Kor Katki	Rh	Used for bilious fever, asthma, cough, burning sensation, lucoderma, jaundice and purifies the nurse's milk
32.	*Trillium govanianum*	Tre Patra	Rh,Ar	Extract has antifungal activity. Used in rheumatism and sexulal potency
33.	*Valeriana wallichii*	Mushk-e-Bala	Rh	Hypotonic and insecticide. Mental disorders, pain in joints, eye, ear and hair
34.	*Phytolacca acinosa*	Lubber	Ar,R	Used for swellligs and inflammation in wounds. Oil used for joint pains, chronic rheumatisim and weight loss. Treat cattle dysentery.
35.	*Amaranthus viridis*	Ganhiar	Ar,Se	Used for backache, joint pain and burning of stomachache
36.	*Skimmia laureola*	Nere	L	Decoction used for obesity, cough, and cattle dysentry. Insect repellent
37.	*Abies pindrow*	Rever	B	Bark used in fever, cough, and stomach pain
38.	*Borago officinalis*	Gow zuban	Rh	Joint pain, stomachache, fever, and ulcer

Key: WP: Whole plant, **R**: Root, **L**: Leaf, **Rh**: Rhizome, **Se**: Seed, **S**: Stem, **B**: Bark, **St**: Stalk, **Fl**: Flower, **Re**: Resin, **Ar:** Arial parts, **F**: Fruit

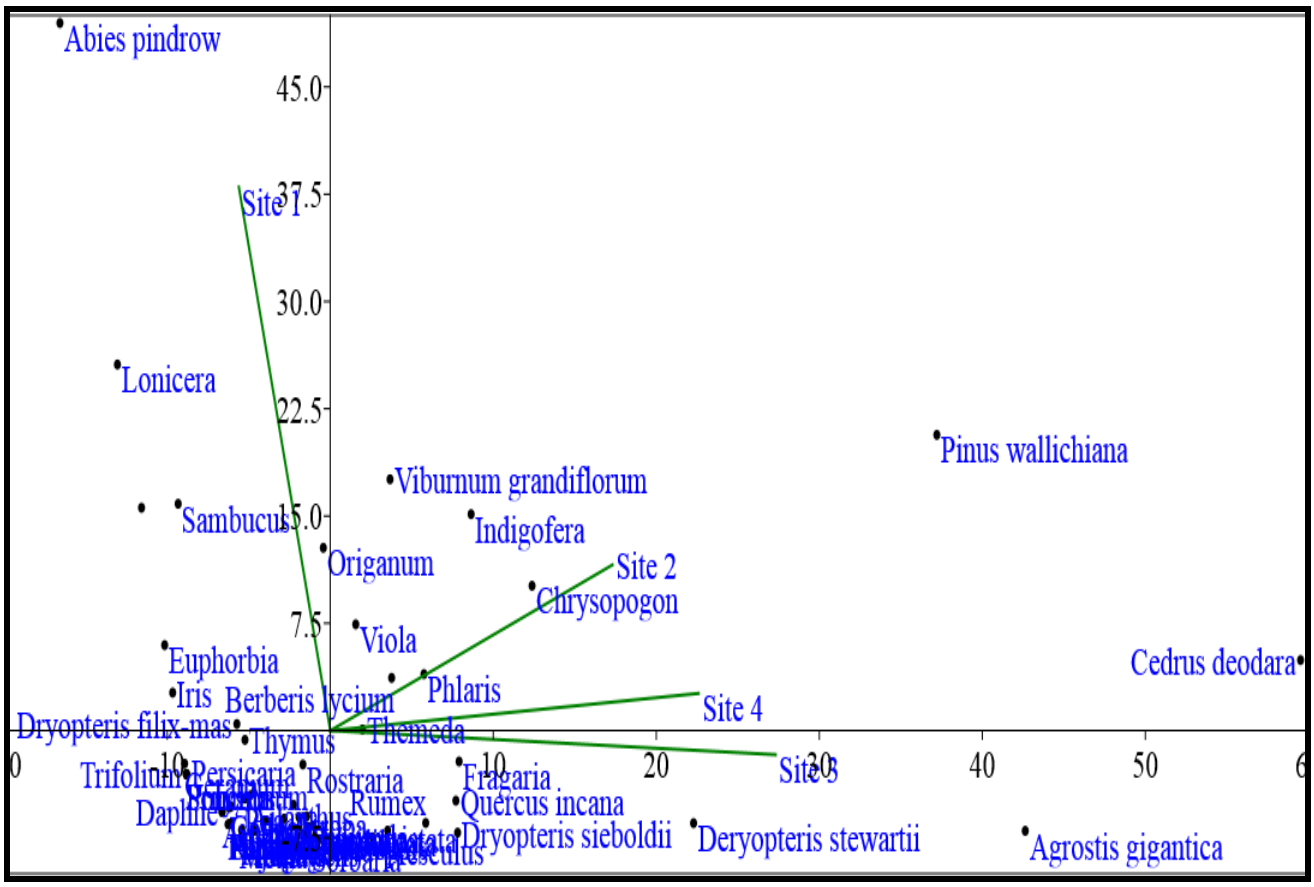

Fig. 2. Principal Component Analysis biplot of samples Vs. study sites.

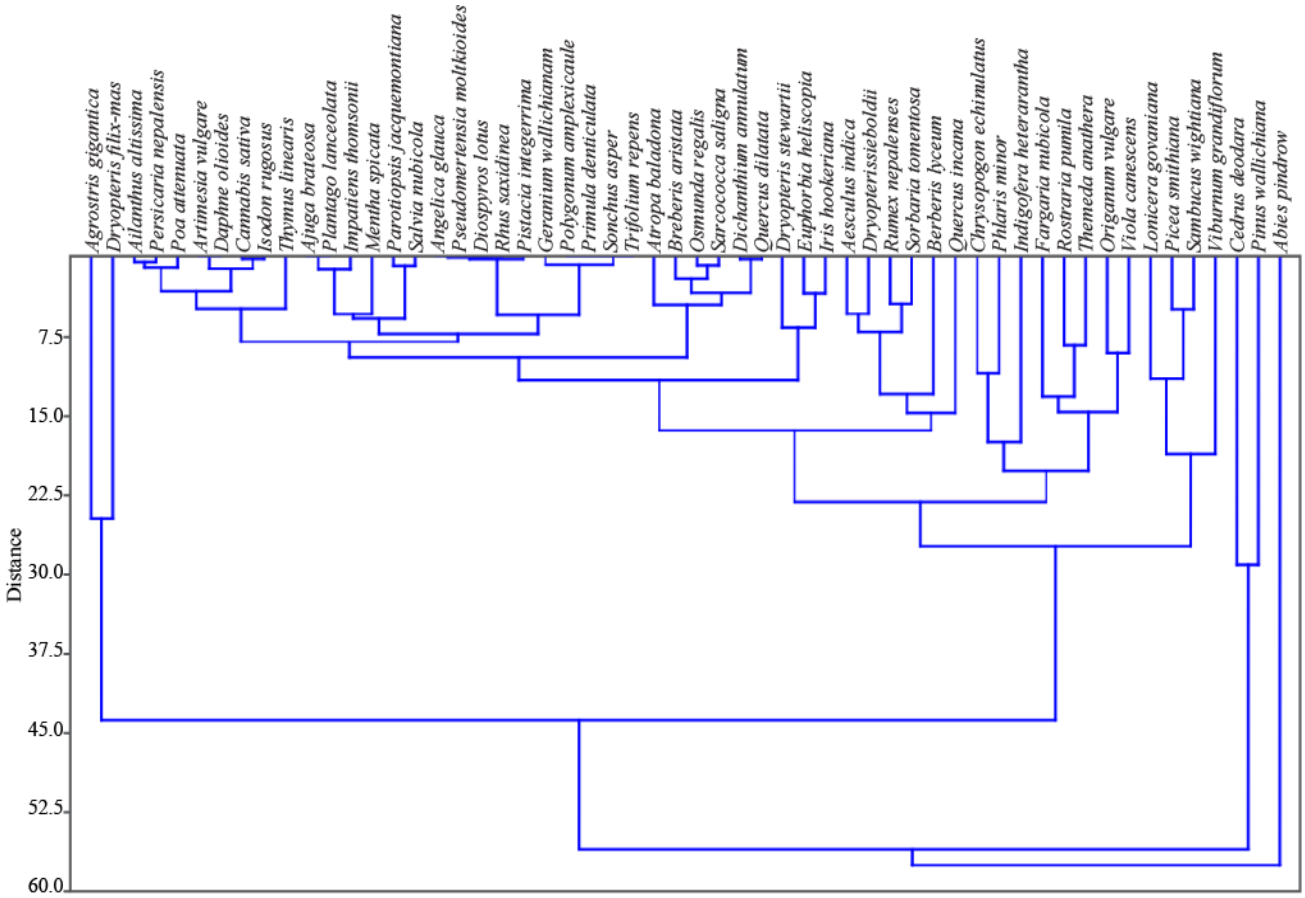

Fig. 3. Paired Group Agglomerative Cluster analysis dendrogram of species data set.

Among the interesting findings of the results is that few understory herbaceous species like *Agrostris gigantica* and *Chrysopogon echinulatus* have higher IVI values than the keystone species like *Abies pindrow* and *Quercus sp* (Table 2). This indicates the prevailing lumbering pressure upsetting the natural equilibrium of these conifer dominated communities (Kelly & Goulden, 2008). Therophytic vegetation dominated the communities indicating the gazing and tree felling regimes in the area. Therophytes have specialized niches having greater adaptations for disturbed, semiarid and unhospitable habitats (Kumar & Bhatt, 2006; Sharma *et al.*, 2009). Mesophylls and microphylls were the prominent leaf spectra which are characteristic of temperate Himalayan vegetation (Bhatt *et al*., 1994). An increasing trend of forest land encroachment was observed in the area. Locals with very little land holding (1.59 acres/family) and large herds use the forest land for cattle ranching, subsidence agriculture and construction as well (Sahu *et al*., 2008). Low values of maturity index also result due to heterogeneity in the species composition of stands (Ram *et al*., 2004).

Local forest flora was found to have high medicinal importance used for the treatment of several ailments by the locals (Khan & Khatoon, 2004). Old age group (>40 yrs.) showed higher preference of ethnomedicine over modern allopathic treatment due to longer interaction with forest resources, traditional organic lifestyle and efficiency of ethnomedicine and firm belief (Ibrar *et al*., 2007). Wild vegetables and mushroom cultivation from the forests contributes significantly in livelihood support of local populations. *Morchella esculenta* is the most favorite NTFP which is sold at reasonable market price (Prasad *et al*., 2002). The average household annual collection ranged from 3-5kg dry weight of *Morchella* being sold at rates in rupees 50000-90000/kg (Hussain & Ghani, 2008).

Our reults reveal that forests contribute significantly to the local communities in terms of fuelwood, fodder, wild vegetables, medicinal plants and mushrooms. High anthropogenic pressure has resulted in degradation of local forest reserves. Area requires immediate attention for conservation management and sustainable utilization of forest services.

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