



## Phytodiversity and Ecological Aspects Evaluation of Moist Temperate Himalayan Belt, Azad Jammu and Kashmir

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### Abstract

To access floristic composition and ecological characteristics, present study was carried out in moist temperate territories of district Bagh. The altitude of the study area varies between 1500 m and 3500 m. Vegetation of the area was mostly therophytic, hemicryptophytic, nanophanerophytic, nanophyllus and microphyllus. Based on IVI twelve plant stands were recognized and all of them were found to be heterogeneous. Environmental factors such as climate, soil condition etc. were studied in relation to vegetation structure. The soil of investigated area varied from heavy loam to clay and clay loam with pH of 5.83 - 7.31 while saturation% age differed from 43 – 62%. Electrical conductivity ranged from 0.8 - 0.21 ds/m, organic matter% age from 3.3 - 6.2, phosphorus from 9 - 21 ppm and potassium from 240 - 412 ppm. The highest recorded Simpson Diversity Index value was 15.67 while lowest was 6.30, species richness was high at an altitude of 2520 m i.e. 1.11 while lowest at 1926 m which was 0.71. Maturity index value lies in between 40.5 - 60.7 while equitability values ranged from 0.66 to 1.63. The present research would serve as baseline information for the future researchers in related fields.

**Key words:** Phytodiversity, Environmental, Soil, Vegetation.

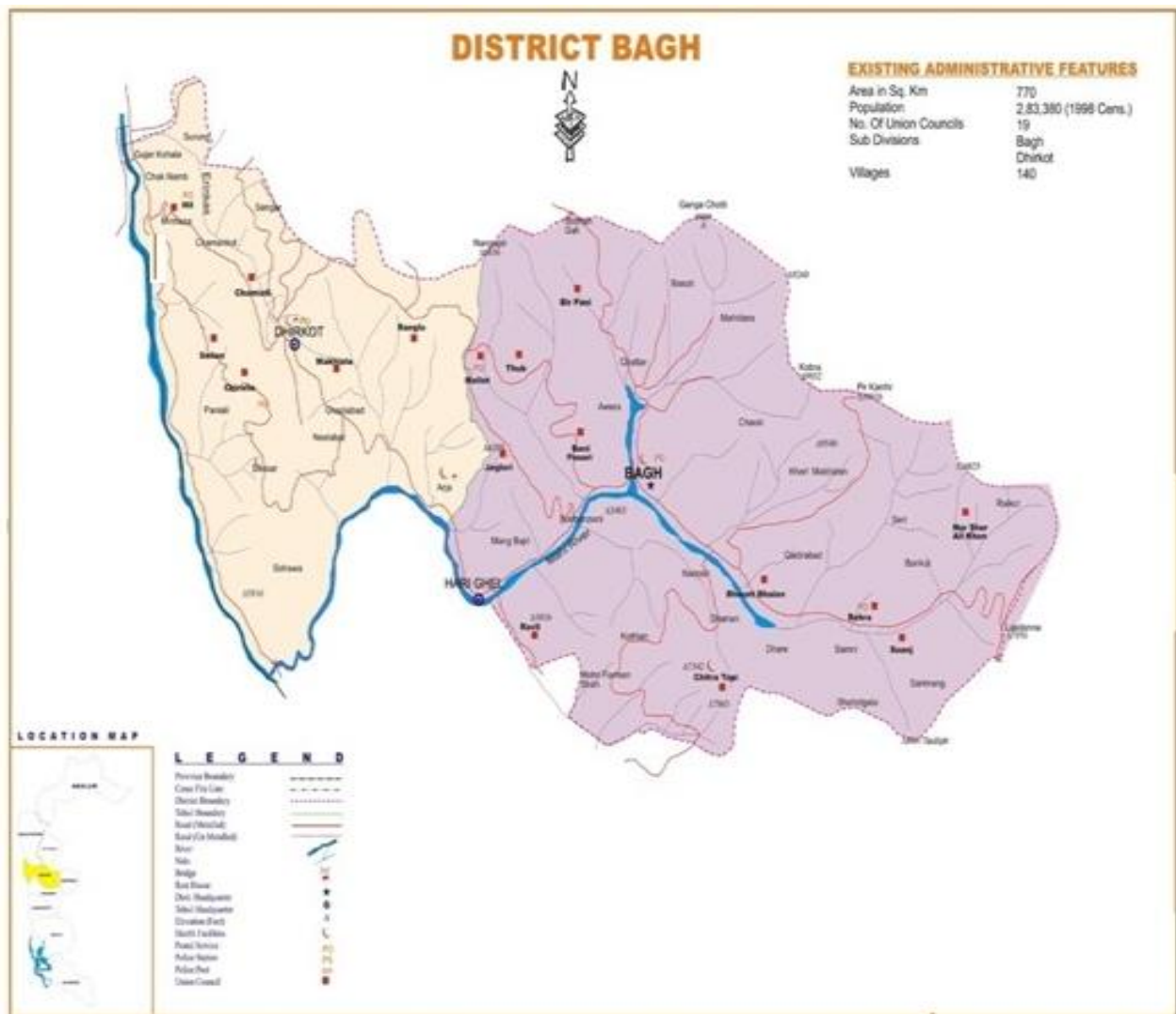
### Introduction

District Bagh of Azad Jammu and Kashmir state lies in the western Himalayas, with varying climatic zones namely sub-tropical, temperate and alpine which exhibits rich floristic diversity. In present study three different sites of this district namely Mehmood Galli, Lasdanna and Bankhori lies between 73° - 75° east and 33° - 36° north with altitudinal variations of 1500 - 3500 meters were phytosociologically investigated (Fig 1). Dogra slates and Murree formation are the major types of rocks while Mahal and Malvani are two main water tributaries within the Bagh sub-division however each individual pocket (Valley) of the area has its own stream, emerging from the mountain springs distributed generously by nature as described by Anonymous 2007.

Plant taxa in any specific geographic site represents flora of that location while assemblages of plant species and the ground cover they provide is termed as vegetation

(Burrows 1990). Hence flora of an area includes number of plant species while vegetation refers to distribution, number and size of individuals (Ali, 2008). Characteristics of vegetation or flora of an area i.e. floristic profile, species distribution, cover, richness and diversity varies particularly with slopes, aspects, environmental condition, soil character, location etc. (Uniyal et al., 2006). Phytosociology or plant sociology is actually floristic diversity estimation and valuation including physiognomies of plant populations via modest and swiftly employs field practices (Rieley and Page, 1990).

Various quantitative phytosociological works has been reported from numerous parts of Pakistan. Some of the most important studies include Qureshi et al. (2009 and 2011), Ahmed et al. (2010), Shaheen et al. (2012), Khan et al. (2013) and Malik et al. (2007 and 2013) etc.



**Figure 1.** Map of district Bagh, AJ&K.

Due to diverse habitats, such as forests, lakes, rivers, tributaries, springs, pastures and sharp altitudinal gradients AJ&K state is well off in phytodiversity. In spite of rigorous floristic and vegetation studies in the AJ&K state including district Bagh, there is still no

single comprehensive up-to-date information on the vegetation and biodiversity of Lasdanna, Mehmood Galli and Bankhori. Keeping in view the importance of plants, present study aims to enumerate vegetation by using various phytosociological techniques as done by Shaheen et al. (2011 and 2012) and Qureshi et al. (2009 and 2011).

### **Materials and Methods**

Vegetation data was recorded randomly by using quadrat method during August 2011. The area was divided into twelve stands on the basis of altitude and physiognomic characters. The size of quadrat was  $10 \times 10$  m<sup>2</sup> for trees,  $5 \times 5$  m<sup>2</sup> for shrubs and  $1 \times 1$  m<sup>2</sup> for herbs (Amjad et al. 2013). In each stand five quadrats were laid for trees, ten for shrubs, and twenty for herbs. Total quadrats in all the stands were 420 (Malik et al. 2007). Phytosociological attributes viz density, frequency & basal area was calculated, according to the method described Curtis and McIntosh (1950). Importance Value Index (Kent & Coker, 1995) was used to rank each species and the plant species with the highest importance value in the stand was considered the dominant species.

Soil was collected from each site up to 15cm depth and analyzed physico-chemically. The analysis techniques were as follows: total organic matter was determined by using wet combustion method, total potassium by flame photometer, actual acidity by beckman expanded scale pH meter, and phosphorus by olsen method (Dasti & Malik 1998). Physical analysis of soil were done by bouyoucos hydrometer method, and classified according to american soil classification triangle (Champion & Pratt 1961). Phytodiversity of the investigated area was calculated by using Simpson index while components of diversity e.g. species richness, equitability and degree of maturity were calculated by using Menhinick., 1964, Peet., 1974 and Pichi-sermolli's., 1948 methods respectively. Life form and leaf spectra were recorded by using Mueller Dum Boiss and Ellenberg., 1974 and Raunkiaer., 1934 methods respectively.

### **Results**

#### **Floristic Structure**

On the basis of IVI twelve plant communities containing 41 plant species amongst 25 families were recorded from the investigated area. Tree layer comprises of *Pinus wallichiana*, *Quercus baloot*, *Aesculuc indica*, *Abies pindrow*, *Cedrus deodara*, *Persea duthiei* and *Lonicera quinquelocularis*. Dominant shrubs of the area were *Sarcococca saligna*, *Viburnum grandiflorum*, *Berberis lyceum*, *Indigofera heterantha* and *Rosa brunonii* while herb layer, ferns and grasses contained *Impatiens edgeworthii*, *Fragaria nubicola*, *Onychium japonicum*, *Dryopteris stewartii*, *Adiantum venustum*, *Digitaria ciliaris* and *Cynodon dactylon* etc (Table 1).

Table 1. IVI of the plant species recorded from Mehmood Galli, Bankhori and Lasdanna, district Bagh AJ&amp;K.

Communities	1	2	3	4	5	6	7	8	9	10	11	12
<b>Tree layer</b>	<b>IVI</b>											
<i>Pinus wallichiana</i> . A.B.jackson	48.01	54.71	75.1	60.98	51.74	53.33	32.62	94.78	-	-	-	-
<i>Quercus baloot</i> . Griff	7.60	9.92	7.08	9.16	-	-	-	-	-	-	-	-
<i>Aesculus indica</i> . Wall.ex.camp	-	13.54	12.63	17.87	-	8.16	7.86	8.29	4.17	3.11	3.70	8.27
<i>Persea duthiei</i> . King.ex.Hook	-	-	-	-	8.08	3.21	12.08	13.62	-	-	-	-
<i>Cedrus deodara</i> . Rox.ex.D.Don	-	-	-	-	-	8.04	13.9	-	-	-	-	-
<i>Abies pindrow</i> . Royle	-	-	-	-	-	-	-	-	113.8	103.6	115.8	118
<i>Lonicera quinquelocularis</i> . H	-	-	-	-	-	-	-	-	-	-	9.27	8.93
<b>Shrub layer</b>	<b>IVI</b>											
<i>Viburnum grandiflorum</i> . Wall.ex.Dc	25.25	24.35	20.63	26.7	-	24.96	20.35	9.96	28.81	23.41	29.16	12.09
<i>Sarcococca saligna</i> . D.Don	20.28	29.75	28.38	22.17	27.3	25.24	24.17	19.9	-	-	-	-
<i>Berberis lycium</i> . Royle	6.98	1.52	6.78	5.09	19.01	10.73	13.93	19.53	29.2	28.62	8.05	12.05
<i>Rosa brunonii</i> . Lindl	-	7.35	3.44	8.2	12.19	3.81	6.18	3.11	-	-	-	-
<i>Indigofera heterantha</i> . L	-	-	-	-	-	-	-	-	-	-	10	16.9
<b>Herb layer</b>	<b>IVI</b>											
<i>Viola odorata</i> . L	21.23	12.54	11.26	9.3	4.66	5.79	6.39	7.63	5.58	8.19	12.69	10.49
<i>Dryopteris stewartii</i> . Fess	26.06	25.48	15.31	26.33	31.75	20.94	23.73	14.95	-	-	-	-
<i>Digitaria ciliaris</i> . Roth	38.52	34.71	33.19	26.49	25.14	29.68	37.51	24.7	26.98	29.09	11.75	8.17
<i>Fragaria nubicola</i> . Lindl.ex.Lacaia	15.57	8.83	8.52	7.94	13.9	7.56	8.79	7.59	8.64	9.7	-	-
<i>Myriactis nepalensis</i> . Lessing	11.66	8.31	6.5	5.15	5.07	4.46	8.17	3.57	-	-	-	-
<i>Onychium japonicum</i> . Kunze	47.36	24.33	16.79	21.03	59.59	45.94	34.44	25.14	-	-	-	-
<i>Impatiens edgeworthii</i> . Hook	8.60	7.45	7.52	4.56	6.22	4.9	7.29	5.08	-	-	-	-
<i>Viola biflora</i> . L	12.12	8.67	6.69	5.57	2.7	4.44	7.02	5.74	-	-	-	-

**Table 1. IVI of the plant species recorded from Mehmood Galli, Bankhori and Lasdanna, district Bagh AJ&K. ( Continue )**

<i>Anaphalis nepalensis.</i> (Spreng)Hand	10.50	-	5.51	6.33	2.7	6.69	5.31	5.88	-	-	-	-	-
<i>Bergenia ciliata.</i> Boriss	-	-	-	-	-	-	-	-	6.63	11.9	14.51	10.73	-
<i>Anemone vitifolia.</i> Buck-Ham	-	-	-	-	-	-	-	-	8.74	5.26	3.81	3.41	-
<i>Rumex hastatus.</i> D.Don	-	-	-	-	-	-	-	-	17.1	16.26	14.06	16.1	-
<i>Urtica dioica.</i> L	-	-	-	-	-	-	-	-	6.41	11.9	14.51	10.73	-
<i>Prunella vulgaris.</i> L	-	-	-	-	-	-	-	-	6.41	5.85	-	-	-
<i>Stellaria decumbens.</i> Edgeworth	-	-	-	-	-	-	-	-	-	-	2.25	7.54	-
<i>Adiantum venustum.</i> D.Don.ex.Hook	-	-	-	-	14.16	8.47	14.31	11.52	5.25	10.53	8.88	11.25	-
<i>Impatiens balsanina.</i> L	-	-	-	-	-	-	-	-	4.83	5.08	7.06	5.88	-
<i>Geranium nepalensis.</i> Sweet	-	-	-	-	-	-	-	-	4.31	6.76	10.3	11.01	-
<i>Taraxacum officinale.</i> Weber	-	-	-	-	9.48	7.58	6.39	6.97	9.69	-	5	5.62	-
<i>Cynodon dactylon.</i> L	-	-	-	-	-	-	-	-	-	-	20.31	19.44	-
<i>Campanula benthamii.</i> Wall	-	-	-	-	-	-	-	-	5.37	5.26	-	-	-
<i>Ceterach dalhousiae.</i> Hooker	-	-	-	-	-	-	-	-	2.51	6.59	-	-	-
<i>Saxifragara androsacea.</i> Dc Sch	-	-	-	-	-	-	-	-	4.31	3.1	-	-	-
<i>Pteris vitata.</i> L	-	16.58	-	-	-	8.71	3.74	7.63	-	-	-	-	-
<i>Arisaema flavum.</i> Schott	-	-	-	-	-	-	-	-	0.93	-	-	-	-
<i>Achilla millefolium.</i> L	-	-	8.44	6.72	-	-	-	-	-	-	-	-	-
<i>Arisaema jacquemontii.</i> Blume	-	11.72	11.77	6.42	6.09	4.9	5.51	4.05	-	-	-	-	-
<i>Swerita paniculata.</i> Wall	-	-	14.2	14.6	-	-	-	-	-	5.26	-	-	-
<i>Ranunculus sceleratus.</i> L	-	-	-	9.14	-	-	-	-	-	-	-	-	-

### Climatic Conditions

Climatic data of Bagh was taken as an average of last eight years climatic data of Poonch division. Results indicated that climate of investigated area varies with altitude. The main eastern part was very cold in winters and moderate in summers. Average annual rainfall is 142.9 mm. Maximum rainfall 281.7 mm and 174.6 mm occur during the months of July and August while minimum rainfall 44.5 was recorded in November. June and July were the hottest months with temperature of 28.45 C° and 27.23 C° whereas December and January were coldest months representing -2.55 C° and -0.86 C° respectively (Fig 2 & 3).

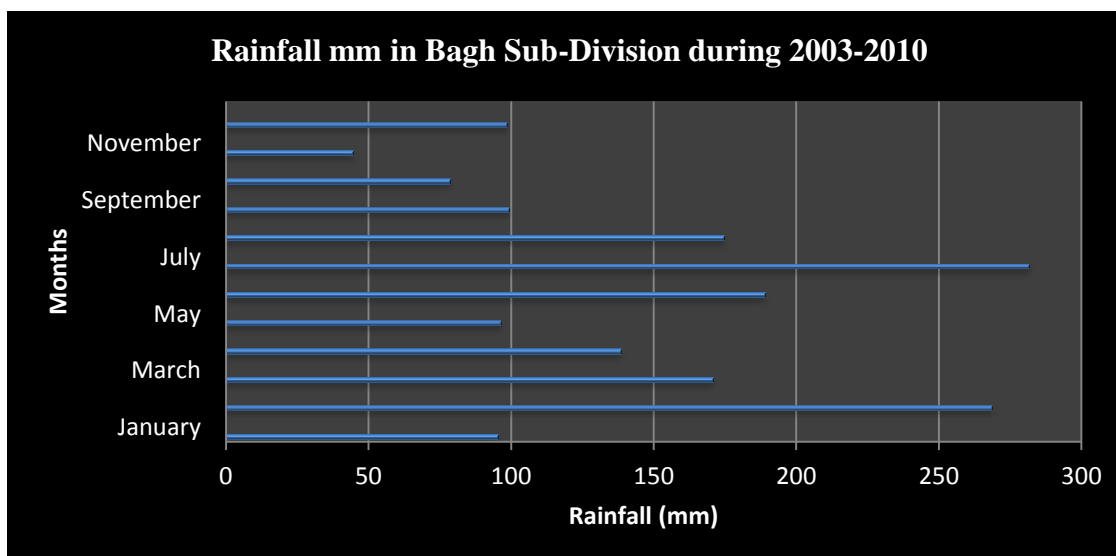


Figure 2. Graphical representation of recorded rainfall mm in district Bagh AJ&K.

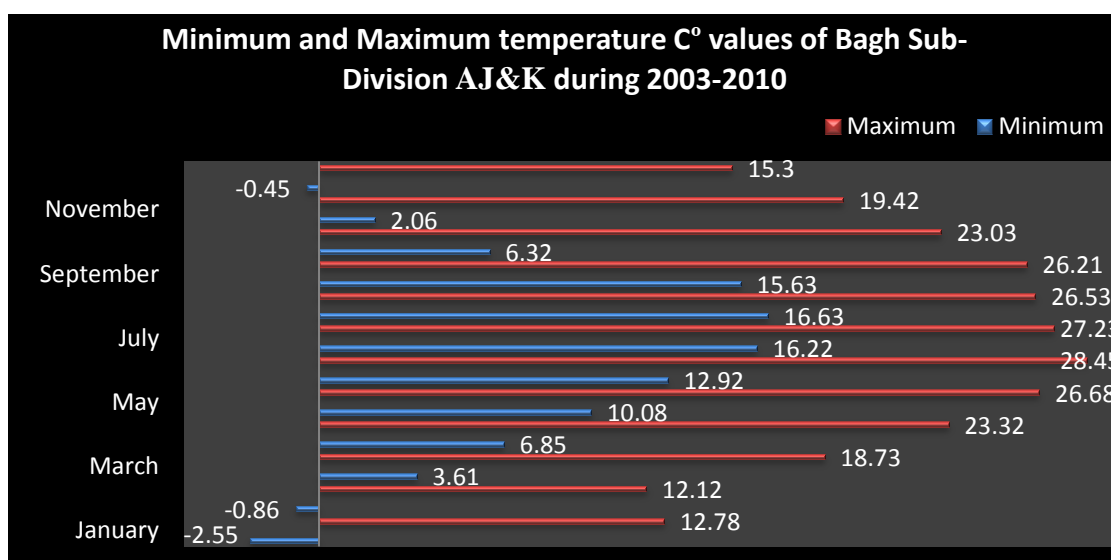


Figure 3. Graphical representation of recorded temperature C° in district Bagh AJ&K.

### Soil Analysis

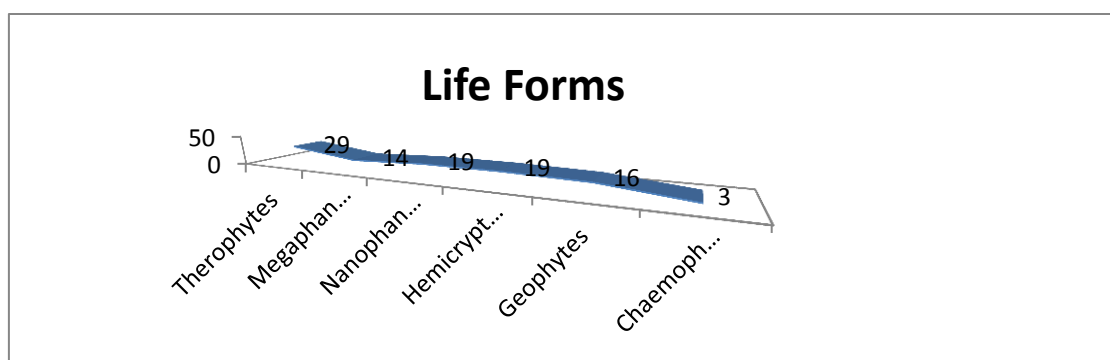
Out of twelve investigated stands eight have soil with heavy loam; three have clay loam while only one stand possesses loamy soil. The pH ranges from 5.83 – 7.31; nine sites have acidic pH hence only three sites were with basic pH. The saturation differed from 43% to 64% while electrical conductivity lies in between 0.8 ds/m to 0.21 ds/m in all stands. Organic matter varies from 3.3 – 6.2. Highest contents of potassium were recorded at 2565 m while lowest at 2494 m (Table 2).

**Table 2.** Soil Physico-Chemical analysis of the stands recorded from Mehmood Galli, Bankhori and Lasdanna, district Bagh AJ&K.

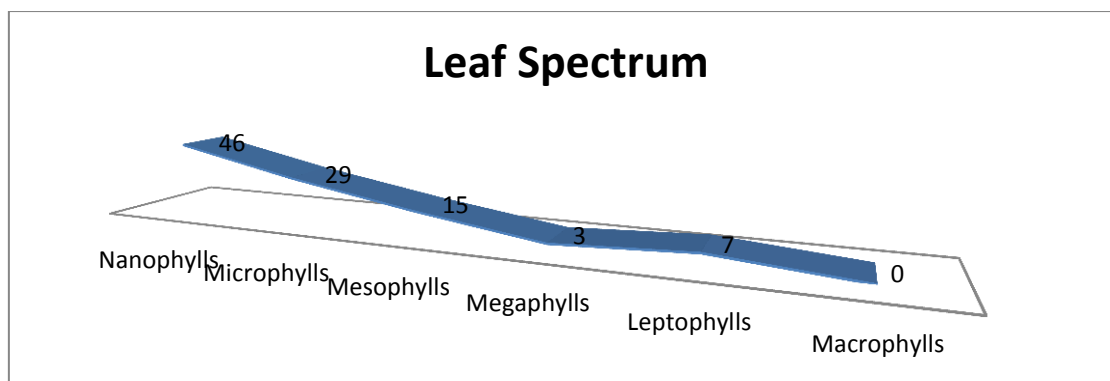
Stands	Altitude (m)	E.C ds/m	Saturation %	O.M %	P (ppm)	K (ppm)	pH	Texture
Stand 1	1926	0.12	52	5.0	13	253	6.52	Heavy Loam
Stand 2	2028	0.19	61	3.3	09	309	7.12	Heavy Loam
Stand 3	2132	0.10	44	4.6	15	324	6.89	Loam
Stand 4	2194	0.9	49	4.4	19	312	5.90	Heavy loam
Stand 5	2494	0.13	46	6.0	16	240	6.40	Clay Loam
Stand 6	2520	0.8	56	5.4	12	289	7.23	Heavy Loam
Stand 7	2544	0.11	62	5.9	17	358	6.93	Heavy Loam
Stand 8	2565	0.17	49	6.2	13	412	6.66	Clay Loam
Stand 9	2804	0.15	43	4.8	21	345	6.78	Heavy Loam
Stand 10	2829	0.21	64	5.6	15	401	7.31	Clay Loam
Stand 11	2730	0.14	58	4.9	19	242	5.83	Heavy Loam
Stand 12	2665	0.16	51	6.1	16	295	6.32	Heavy Loam

### Biological Spectrum and Leaf Spectra

Concerning biological spectrum based on life forms it was cleared that most of plants in the investigated area were therophytic in nature contributing 29% followed by nanophanerophytes and hemicryptophytes 19% each, geophytes 16%, magaphanerophytes 14% while only 3% were chaemophytes (Fig 4). Leaf spectrum of the vegetation of these twelve stands was dominated by nanophylls flora i.e. 46% followed by microphylls plants 29%, then leptophylls 7% and mesophylls 3% taxa respectively (Fig 5).



**Figure 4.** Biological spectrum based on life forms recorded from district Bagh AJ&K.



**Figure 5.** Leaf spectra recorded from district Bagh AJ&K.

### Diversity and Its Component

Index of diversity and its component recorded from district Bagh, AJ&K are presented in Table 3. The highest diversity value (15.67) was recorded from stand 12 while lowest from stand 5 similarly species richness was high at 2544 m and low at 2494 m respectively. The maximum equitability (1.63) was recorded for stand 12 at the top (2665m) thereafter it decreases up to 0.66 in stand 5 at 2494 m. Maturity index showed that only one community was mature with 60.72% maturity value, while all the remaining communities of the investigated area were immature.

**Table 3.** Diversity and its component recorded from district Bagh AJ&K.

Stands	Altitude (m)	Simpson Diversity	Species Richness	Equitability	Maturity Index
Stand 1	1926	7.92	0.71	0.90	60.72
Stand 2	2028	10.73	0.85	1.14	52.36
Stand 3	2132	12.15	0.97	1.24	48.16
Stand 4	2194	11.88	0.93	1.19	49.50
Stand 5	2494	6.30	0.86	0.66	47.06
Stand 6	2520	8.34	1.11	0.82	40.72
Stand 7	2544	11.48	1.13	1.13	43.58
Stand 8	2565	12.91	1.05	1.29	45.75
Stand 9	2804	12.44	1.08	1.25	40.50
Stand 10	2829	10.46	1.01	1.07	46.58
Stand 11	2730	13.30	1.04	1.38	41.39
Stand 12	2665	15.67	1.08	1.63	44.73

### Discussions

Composition and distribution status of plant communities was found to depend on soil components and other environmental factors including, climate, topography, geology and altitudinal range. If there is change in any one, the composition of community will be



changed. The relationship between plants and soil are very close and vegetation cover and its component species are reasonably good indicator of soil conditions. Soil provides a foremost reservoir for the collection of water within (Mahmood 2005). Community structure provides data about recognition and definition of different vegetation types; their mapping and the study of relationship between plant species distribution and environmental control. Human interaction moulds the shape and course of succession of a community. Amongst major factors that influenced vegetation structure are human disturbance, extensive grazing, trampling and soil erosion.

The present study area was between 1500 and 3500 m high from sea level. There were twelve plant communities in monsoon season. The communities recorded in present study actually reflected various remnants; degraded stages of major vegetational unit as identified by Champion et al. 1965; Beg 1984 & Malik 2005. The upper most stratum was dominated by *Pinus wallichiana*, *Abies pindrow*, *Quercus baloot*, *Aesculus indica*, *Persea duthiei*, *Cedrus deodara* and *Lonicera quinquelocularis* while the middle stratum of shrubs was dominated by *Berberis lycium*, *Indigofera heterantha*, *Viburnum grandiflorum*, *Sarcococca saligna* and *Rosa brunonii* at different elevations and aspects. The herb layer contained *Dryopteris stewartii*, *Digitaria ciliaris*, *Onychium japonicum* and *Cynodon dactylon* as dominant species. With slight deviation the present findings are in line with those of Ahmad & Qadir 1976; Malik et al. 2001; Shaheen et al. 2011.

The distribution and composition of plant communities in the surveyed area seem to be controlled by a complex of environmental factors including climate, topography, soil and biotic influence. These all undergo changes of different degrees due to their own interactions and may result in micro-gradients Ahmed et al. 2010. Soil characteristics influence plant distribution on smaller scale i.e. more local scale Siddiqui et al. 2009. Topography and different altitudes are main factors that play important role in structural characteristics of vegetation and support different communities in district Bagh. The main biotic and anthropogenic factors influencing the vegetation of district Bagh are the deforestation, unnecessary uproot of medicinal plants and overgrazing. The biotic interference completely upsets the natural process of interaction between climatic, edaphic and topographic factors to control growth and occurrence of individuals and results in quite an unpredictable pattern of vegetation distribution (Wahab et al., 2008). The species composition as well as vegetation patterns are mainly determined by man's impact and only to a minor extent by natural site factors Haider & Qaiser 2009; Hussain & Ilahi 1991; Mughal, 2006).

### **Conclusion**

The present study indicated that district Bagh has great potentialities for plant biodiversity conservation in the form of ecosystem diversity, species diversity and genetic diversity. If the anthropogenic and other biotic interferences continue in the area at present pace, the valuable bio resources of the area may be wasted and lost soon Hussain et al. 1994. The area needs proper attention by government agencies, naturalists and nongovernmental organizations for protection, management, sustainable use and improvement. Any effort directed for improving the area cannot be successful without the cooperation and involvement of local inhabitants. The indigenous people have a

comprehensive ability to recognize, classify, name and perceive nature that lead them to understand the ecology, reproductive biology and uses of organism in their ecosystem Connor, 2007; Akhani & Ziegler 2002. Thus it is suggested that the conservation of plant biodiversity should be considered as integral needs in the process of development today Noroozi et al. 2008. If handled with a true spirit, the improvement of the forest resources of district Bagh will not only improve the socioeconomic condition of the present people but will also serve as a valuable gift for generations to come.

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