INTERNATIONAL JOURNAL OF PLANT, ANIMAL AND ENVIRONMENTAL SCIENCES
IJPAES
VOLUME-2, ISSUE-2 APRIL-JUNE-2012 ISSN 2231-4490

Coden : IJPAES www.ijpaes.com

*Received: 12th Mar-2012* *Revised: 16th Mar-2012* *Accepted: 19th Mar-2012*

***Research article***

# PLANT DIVERSITY ASSESSMENT IN RELATION TO DISTURBANCES IN SUBTROPICAL CHIRPINE FOREST OF THE WESTERN HIMALAYA OF DISTRICT RAJOURI, J&K, INDIA

L.R. Dangwal, Tajinder Singh, Amandeep Singh & Antima Sharma

Herbarium and Plant Systematic Lab., Department of Botany, H.N.B Garhwal University ( A Central University),

SRT Campus, Badshahithaul, Tehri Garhwal, Uttarakhand, India -249199

Email: drlrdangwal@gmail.com, tajkhalsa@gmail.com

**ABSTRACT:** The aim of the present study is to assess the diversity of plants in relation to disturbances effects in subtropical Chirpine forest of the western Himalaya of district Rajouri, J&K, India. The high diversity of trees, shrubs and herbs was found in Hill Base as compared to Hill Slope and Hill Top. The decreasing in the number of seedling and sapling in Hill Slope due to higher anthropological pressure on trees and another side increasing in the number of shrubs and herbs mainly *Parthenium hysterophorus* and *Cynodon dactylon* was reported in Hill Slope, because opening of canopy and anthropological interference provides greater opportunities for the recruitment of these species. *Pinus roxburghii* was the dominant species which are formed Chirpine type of forest. It was also observed that, studied forest is under risk and will be vanished soon if not maintained properly.

**Key words:** Plant diversity, disturbances, regeneration status.

## INTRODUCTION

High percentage of biodiversity favors ecological stability, whereas accelerating species loss could leads to disintegrate the ecosystem. Biodiversity is the totality of genes, species and ecosystem in a region [1]. Human dominance on biosphere markedly reduces the diversity of species with many habitats worldwide, which leads to species extinction [2]. The biodiversity of present forest area is overtime, often heavily influenced by the cycles of human activity such as fire, agriculture, technology and trade [3]. Over and excessive exploitation may results in alteration of natural ecosystem balance. Hence, if the natural ecosystem and their function are to be kept in equilibrium conditions than there is a need to have correct assessment of natural resource availability. The over destruction of vegetation has been continuing at an alarming pace due to a variety of causes [4]. Disturbance influences species diversity in much landscape and a better understanding of interaction between spatial pattern and disturbances is needed [5]. The Himalaya embodies a diverse and characteristics vegetation describe over a wide range of topographical regions. The lesser Himalayan region with *ca*900-1800m. altitude, is colonized by subtropical broad leaved forests, mainly dominated by Chirpine (*Pinus roxburghii*) and Oak (*Quercus*) species [6]. The forest diversity, environmental and anthropological disturbances in Himalayan region has been studied by some phytosociologists [7-11]. Himalayan forest are considered as globe‘s most depleted forest [12-14]. This has been attributed to the high population increase, associated with land use changes, socio-economic transformations and unsustainable exploitation of natural forest resources [15-17].

The present study deals with the plant diversity, vegetational composition and regeneration status of subtropical Chirpine forest of Western Himalaya of District Rajouri, J&K, in relation to natural and anthropological disturbances.

## MATERIALS AND METHODS

The study area, Tehsil Nowshera of district Rajouri, J&K, India is located in between of $32^0$-57/to $33^0$-17/ N and longitude of $70^0$-0' to $74^0$-33/ E between *ca*470-1200m. elevation in the foot hill of Pir Panjal and Siwalik range of J&K Himalaya. Tehsil Nowshera lies in South-West of the district Rajouri and in Western circle of the Jammu division. It is bounded by block Rajouri in North, Kalakote and Sunderbani in East and (Mirpur) Pakistan in West and South. Most of the area is mountainous and rugged. Landscape consists of low lying undulating hills and valleys. Northward topography become very steep and high merging ultimately with Pir Panjal range. The annual rainfall ranges from 920-960mm. The minimum and maximum temperature throughout the year ranges from $9^0$C to $32^0$C. Forest disturbance is occurring in the form of natural or anthropological disturbances like grazing, lopping, litter removal, and forest fire. For the detailed plant diversity and other vegetational parameters, the area was divided into three sites and the whole study was conducted by choosing North aspect of the study area. The detail descriptions of sites are given in Table. 1.

**Table.1 Showing the Detailed Description of selected sites**

| Area | Altitude | Latitude | Longitude |
|---|---|---|---|
| Hill Base (Nowshera forest near Department of Forest) | 500-700m asl. | $33^0$10.068/ | $74^0$16.230/ |
| Hill slope (Bhata) | 700-900m asl. | $33^0$12.058/ | $74^0$14.363/ |
| Hill top (Androth) | 900-1200m asl. | $33^0$14.119/ | $74^0$10.554/ |

The study was conducted during the year 2009-10. From each site composite soil sample were collected from 0-10cm, 10-20cm, and 20-30cm depth and analyzed for physical and chemical properties. Vegetation analysis was made for all three layers of forest. The collected plants were identified with the help of taxonomists, available literature and regional floras [18-19]. Tree layer was analysed by sampling of ten randomly quadrats of 10×10m size in each site. The size and number of samples was quantitatively analysed for abundance, density and frequency [20]. Importance Value Index (IVI) was determined by sum of the relative frequency, relative density and relative dominance [21]. The distribution pattern of different species was studied by using ratio of abundance to frequency [22]. Tree species were considered to be individuals >30cm cbh (circumference at breast height) and sapling 10-30cm cbh and seedling <10cm cbh [23]. The shrubs layer and seedling were analyzed by sampling of quadrats of 5×5m and 1×1m randomly on each site. Thus relative value calculated and summed to get IVI. Species diversity was calculating by using Shannon Wiener information index [24] as:

$H=\sum (ni/n) \log2 (ni/n)$
Where, **ni** is the IVI of the species and **n** the total IVI of all the species.
The floral diversity and concentration of dominance was calculated by Simpson's index [25] as: $Cd=\sum (ni/n)^2$.

Where, **n** is the total number of species and **ni** is individuals of a species.

## RESULTS

### Soil

Sandy loam type of soil was present in all three sites. There was a little variation in N, P& K value in all three sites as shown in Table.2. The pH value of the study sites was basic, ranges from 7.6 to 7.9. Water holding capacity was more in Hill Base and Hill Top as compared to Hill Slope as shown in Table.2.

**Table.2. Showing the Physiochemical Properties of Soil of the Study Sites at Elevation gradient**

| | Hill Base | | | Hill Slope | | | Hill Top | | |
|---|---|---|---|---|---|---|---|---|---|
| | 0-10cm | 10-20cm | 20-30cm | 0-10cm | 10-20cm | 20-30cm | 0-10cm | 10-20cm | 20-30cm |
| **N** | 0.61% | 0.51% | 0.87% | 0.67% | 0.58% | 0.33% | 0.58% | 0.49% | 0.65% |
| **P** | 0.28 | 0.014 | 0.054 | 0.031 | 0.012 | 0.026 | 0.025 | 0.056 | 0.047 |
| **K** | 101.9 | 126.0 | 136.7 | 97.8 | 109.6 | 127.4 | 136.2 | 120.6 | 153.5 |
| **pH** | 7.6 | 7.9 | 7.8 | 7.6 | 7.7 | 7.8 | 7.9 | 7.9 | 7.7 |
| **WHC%** | 20.40% | 19.5% | 19.28% | 19.40% | 19.56% | 19.78% | 20.15 | 19.80 | 19.80 |
| **Soil Texture** | Sandy loam | - | - | - | - | - | - | - | - |

Where, N=Nitrogen, P=Available Phosphorus, K= Potassium, WHC=Water Holding Capacity

## Plant diversity

A total of 52 plant species were reported from the study area, out of which 20 species were trees, 10 were shrubs and 22 were herbs. More diversity of tree, shrubs and herbs were observed in Hill base as compared to both Hill Slope and Hill Top Shown in Table.3, 4&5 in terms of IVI. In Hill base more dominant species was *Acacia modesta* (IVI=103.80) and least dominant were *Phyllanthus emblica* & *Morus alba* (IVI=4.05 each). Co-dominant species of Hill base was *Pinus roxburghii*, *Mallotus philippensis* & *Lannea coromandelica* with IVI= 42.93, 30.29 & 24.48 respectively. In Hill slope *Pinus roxburghii* was the dominant species *i.e.* (IVI=207.01), *Dalbergia sissoo* was the least dominant species(IVI=14.06) and in Hill Top *Pinus roxburghii* again the dominant species (IVI=211.03), *Ficus palmata* was the least dominant species (IVI=8.31) shown in Table 3.

**Table.3 Showing the Diversity and Regeneration Status of Trees Species along with Elevation Gradients in terms of IVI**

| | Hill Base | | | Hill Slope | | | Hill Top | | |
|---|---|---|---|---|---|---|---|---|---|
| | Trees | Sapling | Seedling | Trees | Sapling | Seedling | Trees | Sapling | Seedling |
| **Name of Species** | **IVI/ 100m²** | **IVI/ 100m²** | **IVI/ 100m²** | **IVI/ 100m²** | **IVI/ 100m²** | **IVI/ 100m²** | **IVI/ 100m²** | **IVI/ 100m²** | **IVI/ 100m²** |
| *Acacia modesta* | 103.80 | 136.06 | 119.32 | - | - | - | - | - | - |
| Pinus roxburghii | 42.93 | - | - | 207.01 | 242.74 | 49.80 | 211.03 | 181.79 | 89.58 |
| Dalbergia sissoo | 4.93 | - | - | 14.06 | - | - | - | - | - |
| Lannea coromandelica | 24.48 | 23.03 | 30.84 | - | - | - | - | - | - |
| Rhus parviflora | 12.71 | 7.46 | - | - | - | - | - | - | - |
| Mallotus philippensis | 30.29 | 31.27 | 105.94 | 29.43 | 57.24 | 250.18 | 27.40 | 62.81 | 38.90 |
| Grewia optiva | 21.54 | 6.35 | - | - | - | - | - | - | - |
| Celtis eriocarpa | 8.72 | 13.47 | 43.85 | - | - | - | - | - | - |
| Phyllanthus emblica | 4.05 | - | - | - | - | - | 25.97 | 33.55 | 52.13 |
| Morus alba | 4.05 | 17.18 | - | - | - | - | - | - | - |
| *Cassia fistula* | 7.42 | - | - | - | - | - | - | - | - |
| *Toona ciliata* | 4.51 | - | - | 17.57 | - | - | - | - | - |
| *Euphorbia royleana* | 11.38 | 21.72 | - | - | - | - | - | - | - |
| *Albizia lebbek* | 10.00 | 23.87 | - | - | - | - | - | - | - |
| *Acacia catechu* | 8.98 | 19.46 | - | - | - | - | - | - | - |
| *Terminalia chebula* | - | - | - | - | - | - | 9.25 | - | - |
| *T. bellerica* | - | - | - | 14.32 | - | - | 9.25 | 11.43 | 40.37 |
| *Olea cuspidata* | - | - | - | 17.52 | - | - | - | - | - |
| *Ficus palmata* | - | - | - | - | - | - | 8.31 | 10.37 | - |
| *Pyrus pashia* | - | - | - | - | - | - | 8.68 | - | 78.95 |
| | 299.79 | 299.87 | 299.95 | 299.91 | 299.98 | 299.98 | 299.89 | 299.95 | 299.93 |

Where, IVI=Importance Value Index

**Table.4. Showing the Diversity of Shrubs along with Elevation Gradients in terms of IVI**

| Name of Species | Hill Base IVI/100m$^2$ | Hill Slope IVI/100m$^2$ | Hill Top IVI/100m$^2$ |
|---|---|---|---|
| *Carissa spinarum* | 97.07 | 132.24 | 62.16 |
| *Justicia adhatota* | 77.76 | - | - |
| *Punica granatum* | 44.40 | 23.69 | - |
| *Dodonaea viscosa* | 19.09 | 24.36 | 78.89 |
| *Nerium indicum* | 14.48 | - | - |
| *Vitex negundo* | 22.68 | 77.65 | - |
| *Ziziphus mauritiana* | 24.42 | 17.22 | 24.31 |
| *Ipomoea carnea* | - | 24.77 | - |
| *Woodfordia fruticosa* | - | - | 117.96 |
| *Myrsine africana* | - | - | 16.69 |
| | 299.90 | 299.93 | 300.01 |

Where, IVI=Importance Value Index

**Table.5. Showing the Diversity of Herbs along with Elevation Gradients in terms of IVI**

| Name of Species | Hill Base IVI/ 100m$^2$ | Hill Slope IVI/ 100m$^2$ | Hill Top IVI/ 100m$^2$ |
|---|---|---|---|
| *Parthenium hysterophorus* | 25.75 | 39.92 | 11.49 |
| *Achyranthes aspera* | 5.69 | - | - |
| *Paspalidium flavidum* | 5.11 | - | - |
| *Andropogon fascicularis* | 139.57 | - | - |
| *Cynodon dactylon* | 14.72 | 102.53 | 57.91 |
| *Oxalis corniculata* | 23.00 | 24.08 | 17.59 |
| *Stellaria media* | 15.51 | - | - |
| *Malvastrum coromandelianum* | 25.79 | 12.17 | 9.01 |
| *Taraxacum officinale* | 10.99 | - | - |
| *Micromeria biflora* | 16.02 | - | - |
| *Rumex dentatus* | 10.43 | - | - |
| *Vervascum thapsus* | 3.49 | - | - |
| *Sida cordata* | 3.70 | 17.78 | - |
| *Silybum marianum* | - | 17.58 | 12.14 |
| *Chrysopogon fulvus* | - | 42.78 | 84.12 |
| *Imperata arundinacea* | - | 8.83 | 26.47 |
| *Fragaria indica* | - | 5.33 | - |
| *Setaria virdis* | - | 12.51 | 63.78 |
| *Amaranthus viridis* | - | 9.82 | - |
| *Sida acuta* | - | 6.66 | - |
| *Oenothera rosea* | - | - | 8.14 |
| *Cyperus niveus* | - | - | 9.35 |
| | 299.77 | 299.99 | 300 |

Where, IVI=Importance Value Index

*Carissa spinarum* was the dominant shrubs species of Hill base and Hill slope but Hill Top *Woodfordia fruticosa* was the dominant one shown Table. 4. In case of herbs *Andropogon fascicularis* was the dominant species of Hill Base (IVI=139.57), *Verbascum thaupus* was the least one (IVI=3.49), *Cynodon dactylon* was the dominant species of Hill Slope (IVI=102.53) and *Chrysopogon fulvus* was the dominant species of Hill Top as shown in Table.1.

## Regeneration status

Regeneration of tree species for sapling and seedling are given in Fig.1 (a,b&c) and Table.3. The comparative study of regeneration status of tree species were analysed on the basis of seedling and sapling. Hill Base study showed good regeneration of the tree, Hill Top shows fair regeneration and Hill slope showed very poor regeneration due to more anthropological pressure.

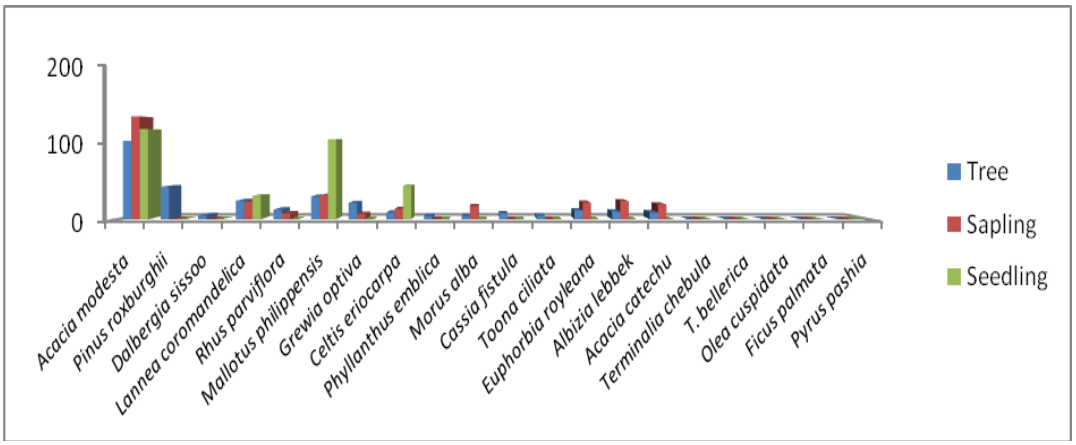


Fig.**1 Showing the Diversity and Regeneration in terms of IVI.**

Fig.**1. (a) Showing the Diversity and Regeneration Status of Hill Base.**

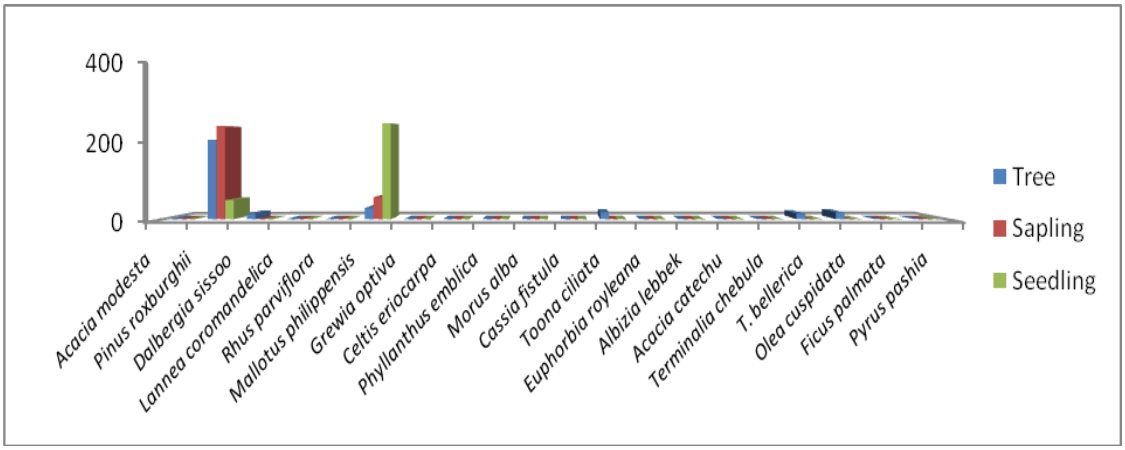


**Fig.1. (b) Showing the Diversity and Regeneration Status of Hill Slope.**

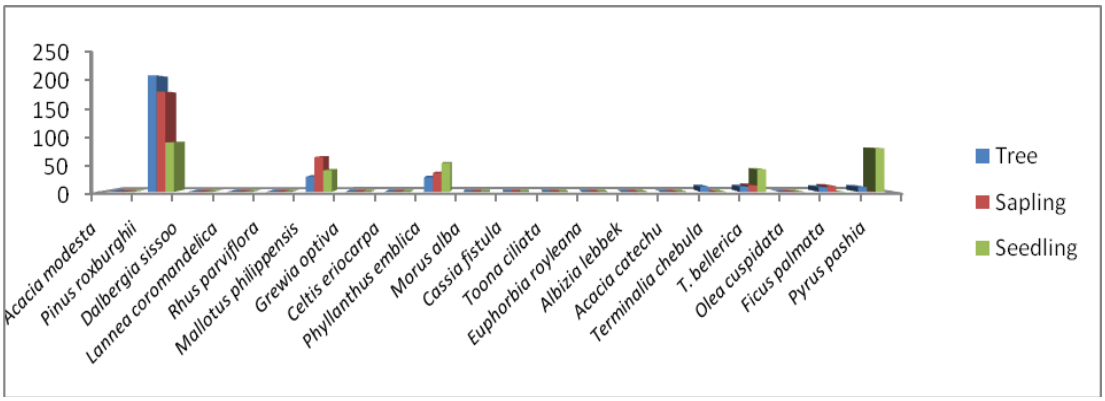


**Fig.1. (c) Showing the Diversity and Regeneration Status of Hill Top.**

## Species Diversity

Both species diversity (Shannon Wiener index) and concentration of dominance (Simpson's index) was higher for all three layers i.e tree, shrubs, and herb in Hill Base, which is followed by Hill Top and least species diversity was found from Hill Slope, which showed markedly reduction of tree layer and increase the diversity of herbs and shrubs which showed the open type of forest as shown in Table.6.

**Table.6. Showing the Species Diversity.**

| | | Hill Base | Hill Slope | Hill Top |
|---|---|---|---|---|
| **Trees** | **SD** | 20.81 | 6.28 | 8.37 |
| | **CD** | 0.17 | 0.50 | 0.51 |
| **Shrubs** | **SD** | 6.63 | 5.46 | 4.02 |
| | **CD** | 0.21 | 0.28 | 0.28 |
| **Herbs** | **SD** | 17.67 | 14.99 | 11.69 |
| | **CD** | 0.25 | 0.18 | 0.18 |

Where, SD=Species Diversity, & CD=Concentration of Dominance

## DISCUSSION

The present study reveals the plant diversity in relation to natural and anthropological disturbances. The biodiversity of Himalaya is severely threatened by natural and anthropological disturbances. One of the foundations for the conservation of biological diversity in forest landscapes is understanding and managing the disturbances regimes of landscapes under past-natural and natural conditions [26]. Conservational biologist warns that 25% of all species could become extinct during the next 20-30 years [27]. A total of 52 plant species was reported from the study area. Hill Base showed the more species diversity of all three layers as compared to Hill Slope and Hill Top, whereas, Hill Slope shown by the minimum diversity of trees than all sites and increases the diversity of Herbs and Shrubs. Presence of higher diversity of *Parthenium hysterophorus* and *Cynodon dactylon* showed the open type forest canopy in Hill Slope which showed highly disturbed forest due to colonization of villages near forest. A strong correlation was observed between tree felling and population density, fuel wood consumption as well as ease of access in the area [28]. The forest sites surrounded by larger villages and having easy road access represented lower tree values.

However, Hill Base showed higher plant diversity and was shown by the broad leaved forest type and *Pinus roxburghii* was the dominant species of all the sites which showed Chirpine type of forest. In Hill Top showed fairly disturbed type of forest and in Hill Slope was the highly disturbed one. The high intensity of anthropological disturbances regularly disturbed the natural balance of forest and alpine vegetation communities, thus preventing them to reach a climax stage of community maturity [29]. The present study recorded that the local villagers and Gujjar tribes are the main cause for the depletion of forest trees for their own purposes. They mainly attack on the seedling and sapling for the various purposes which lead to effect the regeneration of the particular species. They also employ the forest fire for obtaining better grazing opportunities leads to great forest destruction.

## CONCLUSION

Thus we may conclude that the studied forest is dominated by *Pinus roxburghii* and hence it is Chirpine forest. It was also found that the studied forest is under risk due to more anthropological pressure on it in the form of fuel wood consumption, forest fire for obtaining better grazing opportunities, timber wood, use of forest land of agriculture purposes etc. and not much natural pressure on it. So Govt. of J&K as well as Deptt. of Forest should take unitary steps for the regeneration and conservation of forest diversity for future generation.

### ACKNOWLDGEMENT

The authors are highly thankful to DFO an RFO of Tehsil Nowshera for providing important guidelines and available facilities during the course of study.

## REFERENCES

[1] Khera N, Kumar N, Ram J & A Tewari. 2001. Plant biodiversity of assessment in relation to disturbances in mid-elevational forest of Central Himalaya,India. Journal of Tropical Ecology, 42(1): 83-95.
[2] Vitousek, P.M., Mooney, H.A., Lubchenko, J. and Melillo,J.M.1997. Human domination of Earth Ecosystem. Secience,277:494-499.
[3] McNeely, J.A.1994. Protected area for the 21st century: Working to provide benefits to society. Biodiversity and Conservation, 3: 390-405.
[4] Prance,G.T., Beentje,H., Dransfield,J and Johns,R.2000. The tropical flora remains under collected. Ann.Miss.Bot.Gard,87:71-76.
[5] Roberts, M.R. and Gilliam, F.S.1995. Patterns and mechanisms of plant diversity in forested ecosystem: implications for forest management.Ecol.Appl,51:317-959.
[6] Kharkwal,G and Y.S.Rawat.2010. Structure and composition of vegetation in subtropical forest of Kumaun Himalaya, African journal of Plant Secience,4(4): 116-121.
[7] Todaria,N.P., Prerna Pokhriyal, Pooja Uniyal and D.S. Chauhan,2010. Regeneration status of tree species in forest in Phakot and Pathri Rao watersheds in Garhwal Himalaya, Current secience,98(2):171-175.
[8] Kharkwal, G. 2009. Qualitativeanalysis of tree species in evergreen forest of Kumaun Himalya, Uttarakhand, India. African Journal of Plant Science..3(3):049-052.
[9] Gairola, S., R.S, Rawal and N.P, Totaria. 2008. Forest vegetation pattern along an altitudinal gradient in sub-alpine zone in west Himalaya, India. African Journal of Plant Secience, 2(6):042-048.
[10] Ahmed, M., T. Husain, A.H.S., Heik, S,S Hussain and M Siddiqui.2006. Phytosociology and structure of Himalaya forest from different climatic zones of Pakistan.Pak.J.Bot.,38(2):361-383.
[11] Kunwar, R.M and S.P, Sharma, 2004. Quantitative analysis of tree species in two community forests of Dolpa district, mid-west Nepal. Him.J.Sci. 2(3): 23-28.

[12] Duke,G.1994. A participatory approach to conservation safeguarding the Himalayan forest of Palas Valley, district Kohistan. In: Asian Study Group(Afganistan circle), editors. The Destruction of Forest and Wooden Architecture of Eastern Afghanistan and Northern Pakistan: Nuristan to Baltistan, Islamabad, Pakistan: Asian study Group,pp.40-48.
[13] Schickhoff, U.1995. Himalayan forest-cover change in historical perspective. A case study from the Kaghan Valley, Northen, Pakistan. Mountain Research and Development, 15(1): 3-18.
[14] Shaheen, H., R.A. Qureshi, Z, Ullah and T, Ahmad. 2011. Anthropogenic pressure on the western Himalayan moist temperate forest of Bagh, Azad Jammu & Kashmir.Pak.J.Bot.43(1): 695-703.
[15] Nayar,M.P. and A.R.K.Sastry.1990. Red Data book of Indian plants,vol.III. Botanical Survey of India, Calcutta.
[16] Ghosh, P.K. 1994. The red data book on Indian animals (part 1 vertebrata), Zoological survey of India, calcutta.
[17] Myers,.1986. Environmental repercussions of deforestion in the Himalayas, Journal of world forest Resource Management,2:63-72.
[18] Sharma,B.M & P. Kachroo.1983. Flora of Jammu and plants of neighborhood. Bishen Singh Mahendra Pal Singh, Dehradun.
[19] Swami,A. & B.K. Gupta.1998. Flora of Udhampur, Bishan Singh Mahendra Pal Singh, Dehradun, India.
[20] Curtis, J.T. & McIntosh., R.P. 1950. The Interrelation of certain analytic and synthetic phytosociological characters. Ecology, 31: 434-455pp.
[21] Curtis J.T., 1959. The vegetation of Wisconsin. An ordination of plants communities. University Wisconsin Press, Madison, Wisconsin, 657pp.
[22] Whitford, P.B., 1949. Distribution of woodland plants in relation to Succession & clonal growth. Ecology, 30: 199-208.
[23] Saxena, A.K., Singh, S.P. & Singh, J.S.,1984.Popilation structure of forests of Kumaun Himalaya. Implications for management. Journal of environmental Management, 19:307-324.
[24] Shannon,C.E. & W. Weaver. 1963. The Mathematical Theory of Communicaztion. University of Illinois Press, Urbana.
[25] Simpson, E.H., 1949. Measurement of Diversity. Nature (London),163:688pp.
[26] Spies, T.A. and M.G.Turner. 1999. Dynamics forest mosaics. Pp. 95-160. In: M..L Hunter, Jr. (ed.). Maintaing Biodiversity in Forest Ecosystems. Cambrigde University Press, Cambridge, U.K.
[27] Gurarni D., Arya N., Yadava A & J Ram. 2010. Studies on plant biodiversity of pure Pinus Roxburghii Sarg. Forest and mixed pine oak forest in Uttarakhand Himalaya.. New York Science Journal, 3(8): 1-5.
[28] Shinwari,Z.k and Syed Shahinshah Gilani. 2003. Sustainable harvest of medicinal plants at Bulashbar Nullah, Astore(Northern Pakistan). Journal of Ethnopharmacology, 84(2-3): 289-298.
[29] Saxena, A.K. & J.S Singh. 1984. Tree population structure of certain Himalayan forests and implications concerning the future composition, Vegetatio, 58: 61-69.