

# PHYTODIVERSITY, COMMUNITY ASSESSMENT AND PHYSIOCHEMICAL STUDIES OF CONIFEROUS FOREST OF KALASH VALLEY CHITRAL, PAKISTAN

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**Abstract-**The current investigation reveals the presence of 70 plant species spreading over 30 families within the Conifer Forest of Kalash Valley. Noteworthy among these are nine gymnosperm species, with four namely *Cedrus deodara*, *Juniperus excelsa*, *Juniperus communis*, *Pinus gerardiana* and *Pinus wallichiana*, prominently shaping various communities. The study identifies 11 distinct communities distributed across diverse localities. The *Cedrus deodara* and *Pinus gerardiana* Community emerges as dominant with open canopy. Moreover, they also support maximum floral diversity. Soil and soil component study discerns that the soil in the Bumburet Kalash area proves more conducive to forest ecosystems average pH, moderate electrical conductivity, lower salinity and facilitating enhanced water movement and nutrient transport and in contrasts with Rambur, which appears to exhibit comparatively poorer fertility in comparison to the other two regions and Rambur was in between.

**Index terms-**Conifer, communities, floral diversity, Kalash Valley, soil components

## INTRODUCTION

A landlocked mountainous region of Hindukush Range named Chitral, situated between 35°15' to 36°55' North latitudes and 71°01' to 73°05' East longitudes. It is extended to an area of 14,850 km<sup>2</sup> (DCR, 1998; Ali and Qaiser, 2009). Chitral is divided to two separate district in 2018; Upper Chitral and lower Chitral. The Study area, Kalash valley, falls in south east of Lower Chitral. It is positioned 40 km downstream from Chitral city from 35° 70' to 35°42' North latitudes and 71°69' to 71°41' East longitudes. The elevation ranges from 1900 to 2200 meters (GoP, 1998; Open Location Code 8J7 HPM6H). The valley comprises of three sub-valleys, Bumburet, Rambur and Birir. These valleys host diverse flora including oak and coniferous forests. These forests also known as Taiga or Boreal forests are rich in biodiversity due to its sharp topographic changes from lower to higher elevation (Hadi and Ibrar, 2015; Ullah et al., 2014; Zeb, 2019). Kalash valley, despite its arid nature, exhibits significant floristic diversity, mainly because it is considered convergence point for of the Irano-Turanian (winter rain), Sino-Himalayan (summer rain), and Central Asiatic (permanently arid) regions (Birgees et al., 2022). The flora of the area reflects transitional and ecotone status due altitudinal gradients, climatic variation and the geographical position making the distribution patterns of various taxa (Nusser and Dickore, 2002). According to Ahmed and Latif (2007), the inhabitants of the area rely on forests and forest products for their livelihood entirely according to a report approximately 25 thousand metric tons of forest wood is used as a source of fuel by 13% of the population Irum et al., 2014).

Bumburet, the largest valley among the Kalash valleys, is situated at coordinates 35°41' N and 71°38' E, characterized by rugged topography and steep slopes. Rambur, positioned at a higher elevation than Bumburet, with more feeding glaciers and alpine meadows, approximately 8 kilometres north of Bumburet, between coordinates 35°46' N and 71°40' E while Birir Valley is situated at the southernmost end of Chitral city. I has a narrower width at coordinates 35°40' N and 71°45' E, with an elevation of 1360 meters (Zeb, 2019).

Floristic surveys serve as a systematic inventory for studying and utilizing plant and plant related wealth. It provides valuable insights for proper identification of plants, its communities and niche (Gordon and Newton, 200). These studies are crucial in presenting local plants and plant communities with details on their distribution, distinct characteristics (Gotzenberger et al., 2012). Along with floristic survey Phytosociological approach is crucial for better understanding of plant and health of plant communities. It focuses on understanding plant communities, structural relationships, and compositional distribution of flora of a region. It also aids in the planning, management and exploitation of natural resources (Pot, 2011). It also provides insights into plant distribution under different ecological influence of biotic and abiotic factors (Morris, 2020). As forests face ongoing dramatic changes due to pollution, human population pressure, deforestation, habitat destruction and invasive species. So regular updates on floral diversity and plant

communities are essential for understanding species interactions and their relationships with the environment (Shaheen et al., 2014; Stter, 2017).

The research focuses on coniferous forest of Kalash valley as Conifers are distinguished by the dominance over other plant species due to their enduring capabilities to extremely cold seasons. Conifers including *Cedrus deodara*, *Juniperus exelsa*, *Juniperus communis*, *Pinus gerardiana* and *Pinus wallichiana*.

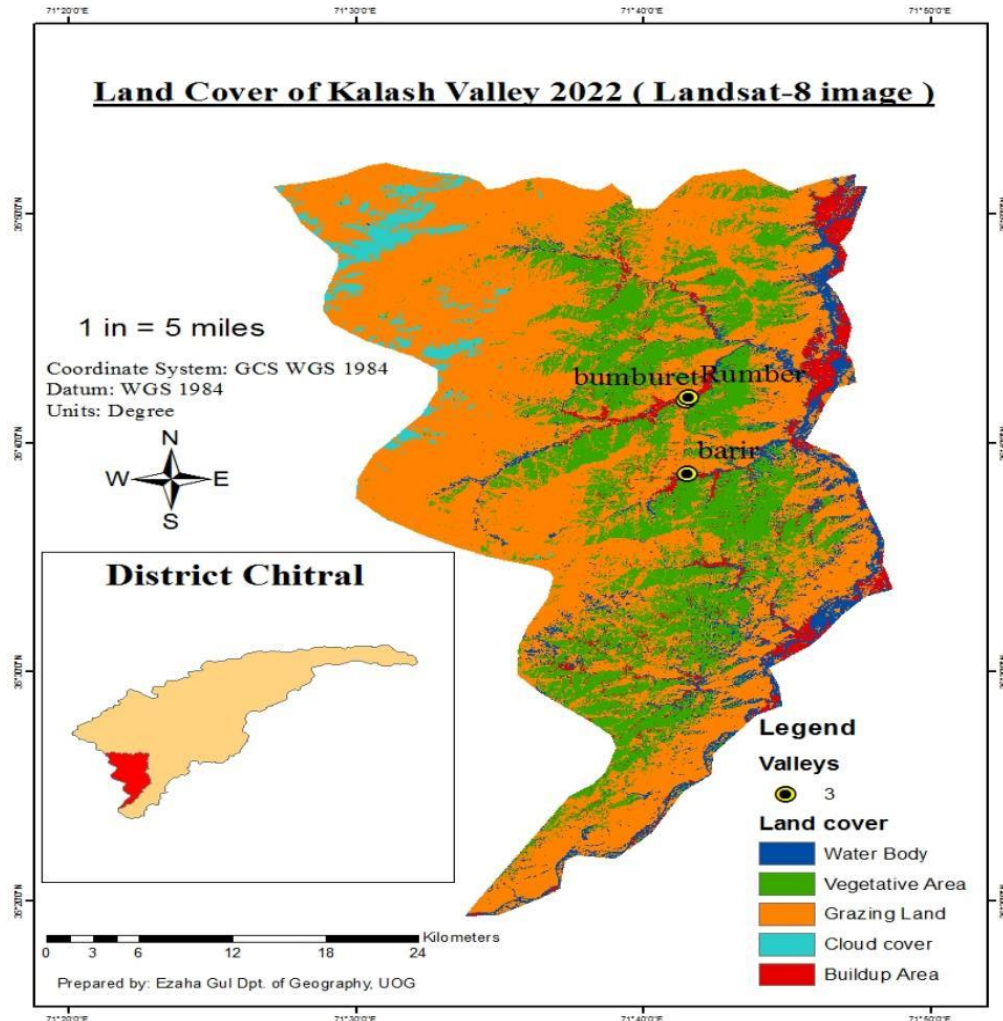


Fig.1. Map of the area showing LULC taken using NDVI Land Sat-8 on August, 2022).

## MATERIALS AND METHODS

### Field work

#### A. Sampling

Field work for this study were carried out between 2021 and 2023 in various parts and altitudinal zones of Bumburet, Birir and Rumber region of Chitral specifically above 1800 masl as Conifers dominate in Higher altitude. The study was to find communities of Four Conifer trees i.e., *Cedrus deodara*, *Juniperus exelsa*, *Juniperus communis*, *Pinus gerardiana* and *Pinus wallichiana* and communities coexist with these gymnosperms. *Picea smithiana* and *P. roxburghii* were occasionally reported so contribution was not mentionable. Ephedra species were found in lower story of communities. The specimens were identified with help of literature (Ali et al., 2016; Stewart, 1972; Nasir and Ali, 1970-1989; Ali and Nasir, 1989-1991; Ali and Qaiser, 1993-2022; Khan, 2010). The collected plant specimens were deposited at Herbarium Centre of Plant Biodiversity, University of Peshawar. Soil from each sampling site was collected with the help of soil bucketed agar. The soil was weighed and packed in plastic bags for further laboratory analysis.

## **B. Taxonomic key**

In the process of crafting taxonomic keys for trees, a hectic survey and measurement of various tree components was conducted. Bark, twigs, fresh leaves, cones, seeds and fruits underwent thorough observation. Precise measurements of these parts were taken using both a scale and vernier calliper. Twigs and leaves were carefully collected for mounting and preservation. The locations for observations and measurements were diligently recorded with the aid of GPS for accuracy and reference in the taxonomic key preparation.

## **C. Field statistics**

Nine gymnosperm species were identified in the region, with seven exhibiting a canopy in the upper story, while two were herbaceous, presenting a more or less erect stature. A total of 50 plots, each measuring 0.1 hectares, were randomly established to assess vegetation indices. Additionally, similar in number more or less one hectare was employed to characterize plant communities (Feely et al., 2020; Jiajia, 2023). Stands of forest minimally disturbed vegetation by grazing or other activities were selected to represent the communities. They had either homogeneity or somewhere heterogeneous. Elevation was estimated by Altimeter and penned down and slope measurements were obtained by Clinometer. GPS was employed for estimating geographical coordinates. Local guides and informers were accompanied during the field work. A species list of upper and under storey was compiled using counting and identifying all shrubs and herbs. Tree seedlings (<10 cm dbh) were counted in in lower storey.

## **Quantitative analysis**

Quantitative information for gymnosperms particularly conifers including Angiosperms was summarized following method of Bonham (2005). Percentage distribution, average DBH and average height were also measured.

## **Soil analysis**

For collection of soil samples stratified random sampling methodology was used. Soil samples with in each block of representing communities were collected using Soil bucked agar from 1×1 m<sup>2</sup> sub-plots within a quadrat. Soil from depths of 0-20 cm, 20-40 cm, and 40-60 cm were collected. In each Community, eight 5 to 10 samples were collected. Soil Augur was used for obtaining a core volume of 198.24 cm<sup>3</sup> and a height of 7.25 cm. Collected soil samples were labelled, underwent weighing and packing before being transported to the laboratory for further studies. Then they were dried in drying oven for 48 hour at 72°C for further analysis, including the determination of soil bulk density from air-dried samples. Moreover pH, Electrical Conductivity (EC), Electrical Conductivity in deci Siemens per meter (EC dS/m), Total Suspended Solids (TSS), Calcium Carbonate (CaCO<sub>3</sub>), Organic Matter (OM), Nitrogen, Phosphorus and Potassium level were measured. The soil samples were shifted to Agriculture Research Institute Tarnab Farm Peshawar for analysis. The standard procedure was adopted for this study (Bonham, 2005; Khan, 2010).

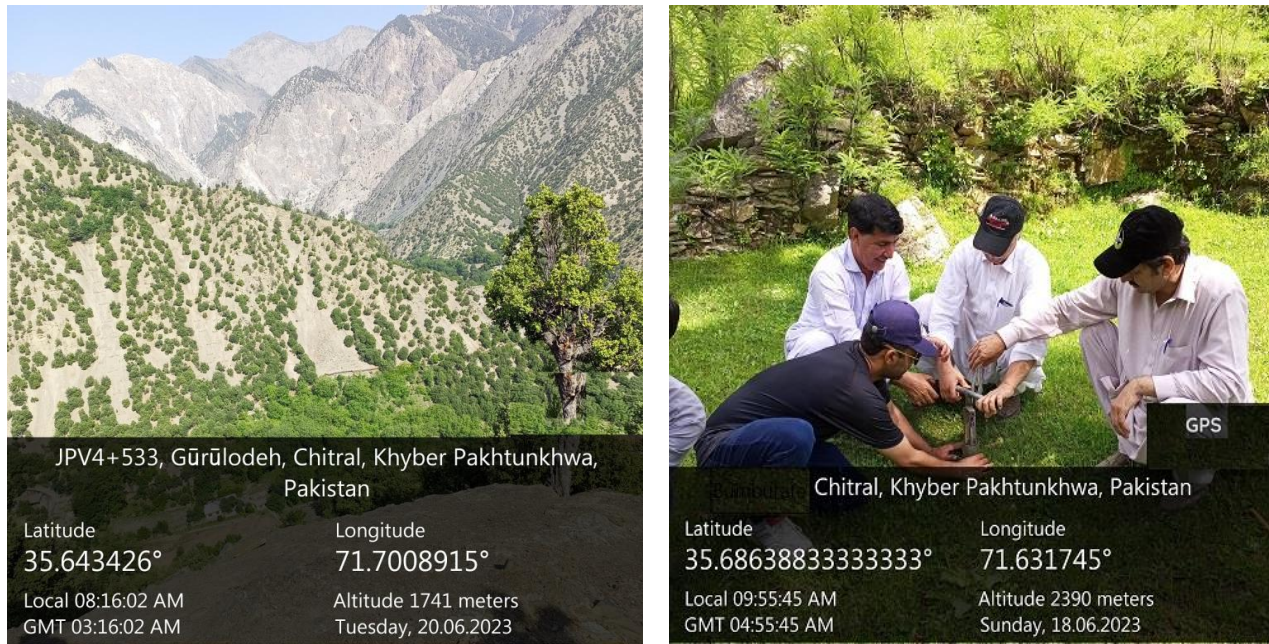


Fig.2. Community studies and soil sampling at the study area.

## RESULTS AND DISCUSSION

The Present study reveals 70 plant species belong to 30 families were common in Conifer forest of Kalash Valley. Among these 9 species were gymnosperms, out of which 4 species dominated to shape different types of communities were *Cedrus deodara*, *Juniperus excelsa*, *Juniperus communis*, *Pinus gerardiana* and *Pinus wallichiana*. There were 11 communities found positioned in different localities. These communities were *Cedrus deodara* Community (Monospecific) *C. deodara*, *Cedrus deodara* and *Pinus gerardiana* community, *Cedrus deodara* & *Pinus wallichiana* Community (*C. deodara* Dominant), *Cedrus deodara* and *Quercus* community (*C. deodara* Dominant), *Pinus gerardiana* Community (Mono-specific), *Pinus gerardiana* and *Quercus* community (*P. gerardiana* Dominant), *Juniperus excelsa* & *Juniperus communis* community (Either is Dominant), *Juniperus excelsa* and *Betula* community (*J. excelsa* Dominant), *Pinus wallichiana* Community (Mono-specific/ Dominant), *Pinus wallichiana* and *Juniperus excelsa* Community (Either is dominant), *Quercus* spp. and *P. gerardiana* Community (*Quercus* Dominant). Regarding distribution of Conifers *Juniperus* spp. comprises 21.88% of the population, *Cedrus deodara*, 28.62%, *Pinus gerardiana* constitutes 36.73%, followed by *Pinus wallichiana* at 12.73% and *Pinus roxburghii* at less than 1%. 61 species were common in lower strata.

*Cedrus deodara* Community was monospecific regarding Upper story with open canopy with 18 species in lower story as herbaceous plants. *Cedrus deodara* and *Pinus gerardiana* community was common in the region where either one was dominant. It also supports 28 other plant species. In *Cedrus deodara* and *Pinus wallichiana* Community where *C. deodara* was dominant also supported 23 species in lower strata. *Pinus wallichiana* and *Juniperus excelsa* community was found to support least flora of 16 species.

The physico-chemical analysis of soil in the Bumburet Kalash region reveals average pH of 7.27, electrical conductivity (EC) at 0.16 dsm<sup>-1</sup>, organic matter (OM) content of 2.31%, calcium carbonate (CaCO<sub>3</sub>) content of 4.72%, nitrogen (N) content of 0.19%, phosphorus (P) at 5.99 mg kg<sup>-1</sup>, and potassium (K) at 105.05 mg kg<sup>-1</sup>. While in Birir Valley pH of 7.8, (EC) at 0.21 dsm<sup>-1</sup>, OM of 2.10%, CaCO<sub>3</sub> of 5.70%, N 0.35 mg kg<sup>-1</sup>, P at 6.61 mg kg<sup>-1</sup> and K at 89.3 mg kg<sup>-1</sup>, OM 1.15 mg kg<sup>-1</sup>. Soil of Rambur reveals that pH of 7.55, EC 0.22 dsm<sup>-1</sup>, OM of 1.98%, CaCO<sub>3</sub> at 1.31%, N content of 0.12%, P at 5 mg kg<sup>-1</sup>, K at 77.92 mg kg<sup>-1</sup>, C content of 1.12 mg kg<sup>-1</sup>. Among the three regions analysed, the soil in the Bumburet Kalash area appears to be better suited for forest ecosystems. With an average pH of 7.27, and moderate electrical conductivity (EC) of 0.16 dsm<sup>-1</sup> indicates lower salinity, supporting improved water movement and nutrient transport. The organic matter content of 2.31% is relatively higher. While Rambur appears to have relatively poorer fertility compared to the other two regions.

Table 1. Table of taxonomic description, distribution and economic utility of Gymnosperms of Kalash Valley

| Plant species                                | Taxonomic description   | Specimen examined  | Distribution In Pakistan                              | Economic utility   |
|--|---|--|---|--|
| <i>Juniperus communis</i> L.                 | H-4-8m , Medium-sized monoecious trees, stem spreading, rarely upright stems, bark reddish-brown, leaves in whorls of 3, measuring 0.5-1.7 x 0.1-0.3 cm. Male cones 0.2-0.7 x 0.2-0.35 cm), 6-8 pairs microsporophylls, Female cones 0.3-0.8 x 0.3-0.6 cm), 3 to 4 pairs. | Bu-35.42/71.38E (3103 m )<br>Ru-35.40 N/71.36 E(2939m)<br>Bi-35.36N /71.44E (3011m)      | Chitral, Baluchistan and Kashmir                      | Fuel, medicinal, beams & thatching   |
| <i>Juniperus excelsa</i> M. Bieb.            | H 4-18m, Medium-sized, leaves ovate 1-2 mm. dens and irregular twigs, The male cones with scales, seeds 3-5.  | Bu-35.42N/71.37E (3178m)<br>Bi 35.41N/ 71.40E (2915)<br>Bu-35.42 N/71.38 E (3028 m)      | Chitral, Baluchistan and Kashmir                      | Medicinal, fuel charcoal, beams & thatching  |
| <i>Cedrus deodara</i> (Roxb. Ex Lamb.) G.Don | H-14-50 m tall, brown furrowed bark. Needle-like leaves - 7-30, persistent, 2-6.5 cm, Male cones 3-5.5 x 1-2.5 cm), seeds are winged.   | Bu-35.419N/71.37 E (2987m)<br>Ru-35.47 N/ 71.38 E( 2838m)<br>Bi-35.479N/ 71.37 E (3030m) | Chitral, Kaghan, Kashmir Kurram Agency, Swat-Kohistan | Construction purpose, Furniture industries, fuel, medicinal, bridge making, poles            |
| <i>Pinus gerardiana</i> Wall. ex Lamb.       | H-18 meters, thin bark with silvery-grey hue. Leaves needle like in clusters of 3, 6-12 cm in length, seeds cylindrical short winged.   | Bu-35.43N/71.42E (2460 m)<br>Ru-35.47N /71.49E (2,359 m)<br>Bi-35.37N/71.39 E (2578 m)   | Chitral, Himalaya and in Baluchistan.                 | Construction purpose, Furniture industries, fuel, medicinal, bridge making, poles, Carets,   |
| <i>Pinus wallichiana</i> A. B. Jacks         | H- 5-50 m in height, greyish-brown, fissured bark ,needle-like leaves in 5, 5-13 cm, Male cones in cluster, 1-2 x 0.5-1 cm), Female cones, in pairs of 2-3, 8-19 x 3-8.5 Seeds are winged.  | Ru-35.42N/71.38 E (3022m)<br>Bu-35.41N/71.40E (2093m)<br>Bi-35.38N/71.45E (3011)         | Chitral, Himalaya and in Baluchistan.                 | Furniture making, bridges, resin as medicinal, fuel& charcoal, poles, construction of houses |
| <i>Pinus roxburghii</i> Sarg.                | H- 40-50 m , bark is brownish-red, deeply fissured, Needle-like leaves in fascicles of 3, Male cones, 1-4 x 0.3-0.87 cm, overlapping microsporophylls. Female cones 5.5-9.5 x 4.0-7.5 cm. The seeds are winged.   | Bi-35.37N/71.39 E (2578 m)<br>Bu-35.43N/71.42E (2460 m)<br>Ru-35.479N/71.39 E (1764m)    | Chitral, Kashmir Swat-Kohistan, Himalaya              | Construction purpose, Furniture industries, fuel, medicinal, bridge making, poles, Carets,   |

|  |  |  |  |  |
|--|--|--|--|--|
| <i>Picea smithiana</i><br>(Wall.) Boiss          | H-20-45 m tall, bark is brown, Needle-like leaves arranged spirally, 1.5-4.5cm .Male cones ,solitary, ovoid (1.0-3 x 1.5 cm), , Female cones 6-12 x 3.0-6 cm, winged Seed. | Bu-35.41 N/71.37 E<br>( 2929m)<br>Ru-35.40 N/71.36<br>E(2939m                              | Chitral,<br>Gilgit,<br>Kaghan,<br>Kashmir,<br>Kurram,<br>Swat-<br>Kohistan | Framing<br>material,<br>boxes, crates<br>and<br>Sitarboards. |
| <i>Ephedra<br/>gerardiana</i> Wall<br>ex. Stapf. | Shrubby & compact, 10 to 120 cm, green ascending and smooth branches. Male strobili in clusters of 2-3, Female strobili are solitary , fruit are berries                   | Bi-35.37N/71.39 E<br>(2578 m)<br>Bu-35.41N/71.40E<br>(2267m<br>Bu 35.42 N/71.39E<br>3008m) | Chitral,<br>Kashmir<br>Swat-<br>Kohistan                                   | Medicinal,<br>Fuel   |
| <i>Ephedra<br/>intermedia</i> Schrenk<br>& Meyer | Compact shrubby up to 55 cm long, spreading, striated branches, Male strobili in whorls up to 8 in number, Female strobili a in whorls. The berries are ovoid and red.     | Bi-35.37N/71.39 E<br>(2578 m)<br>Bu-35.41N/71.40E<br>(2267m<br>Bu 35.42 N/71.39E<br>3008m) | Chitral,<br>Kashmir<br>Swat-<br>Kohistan                                   | Medicinal,<br>Fuel   |

Table 2. Gymnosperms Predominant upper storey (except *Ephedra* species) community, percentage distribution, Average DBH and average AGB

| Family       | Plant Species                                | Communities | Percentage distribution | Avg. DBH (cm) | Avg Height (m) |
|--------------|--|-------------|-------------------------|---------------|----------------|
| Cupressaceae | <i>Juniperus communis</i> L.                 | Y           | 21.88                   | -             | -              |
|              | <i>Juniperus excelsa</i> M. Bieb.            | Y           |                         | 19.64         | 11.22          |
|              | <i>Cedrus deodara</i> (Roxb. Ex Lamb.) G.Don | Y           | 28.62                   | 20.25         | 26.95          |
| Pinaceae     | <i>Pinus gerardiana</i> Wall. ex Lamb.       | Y           | 36.73                   | 21.64         | 18.88          |
|              | <i>Pinus wallichiana</i> A. B. Jacks         | Y           | 12.73                   | 26.6          | 30.94          |
|              | <i>Pinus roxburghii</i> Sarg.                | N           | <1                      | 24.5          | 20.5           |
| Ephedraceae  | <i>Ephedra gerardiana</i> Wall ex. Stapf.    | Y           | NA                      | NA            | NA             |
|              | <i>Ephedra intermedia</i> Schrenk & Meyer    | Y           | NA                      | NA            | NA             |

Table 3. Plant species of lower storey in Gymnosperm Forest Community with their families and botanical names

| # | Family             | Plant species                |    | Family         | Plant species              |
|---|--------------------|------------------------------|----|----------------|----------------------------|
|   | <b>Gymnosperms</b> |                              |    |                |                            |
| 1 | Cupressaceae       | <i>Juniperus communis</i> L. | 17 | Asclepiadaceae | <i>Cynanchum acutum</i> L. |

|                    |                |  |    |               |  |
|--------------------|----------------|--|----|---------------|--|
|                    |                | <i>Juniperus excelsa</i> M. Bieb.            |    |               | <i>Periploca aphylla</i> Dcne.                     |
| 2                  | Ephedraceae    | <i>Ephedra gerardiana</i> Wall ex. Stapf.    | 18 | Asteraceae    | <i>Anaphalis nepalensis</i> (Spreng.) Hand.        |
|                    |                | <i>Ephedra intermedia</i> Schrenk & Meyer    |    |               | <i>Artemisia brevifolia</i> Wall. Ex DC.           |
|                    |                | <i>Cedrus deodara</i> (Roxb. Ex Lamb.) G.Don |    |               | <i>Artemisia maritima</i> L.                       |
|                    |                | <i>Picea smithiana</i> (Wall.) Boiss.        |    |               | <i>Artemisia parviflora</i> Roxb.                  |
| 3                  | Pinaceae       | <i>Pinus gerardiana</i> Wall. ex Lamb.       |    |               | <i>Artemisia sacrorum</i> Ledeb.                   |
|                    |                | <i>Pinus wallichiana</i> A.B.Jacks.          |    |               | <i>Aster flaccidus</i> var. <i>flaccidus</i> Bunge |
|                    |                | <i>Pinus roxburghii</i> Sarg.                |    |               | <i>Bellis perennis</i> L.                          |
| <b>Angiosperms</b> |                |  |    |               | <i>Bidens tripartita</i> L.                        |
| 4                  | Alliaceae      | <i>Allium chitralicum</i> Wang & Tang        |    |               | <i>Cichorium intybus</i> L.                        |
| 5                  | Amaryllidaceae | <i>Ixiolirion montanum</i> (Labill.) Herb.   | 19 | Balsaminaceae | <i>Impatiens brachycentra</i> Kar. & Kir.          |
| 6                  | Araceae        | <i>Arum jacquemontii</i> Blume               | 20 | Berberidaceae | <i>Berberis lycium</i> Royle                       |

|    |              |   |    |               |  |
|----|--------------|---|----|---------------|--|
| 7  | Capparaceae  | <i>Capparis spinosa</i> L.<br><i>Aristida cyanantha</i> Nees ex Steud     | 21 | Fabaceae      | <i>Astragalus subumbellatus</i> Klotzsch.<br>ex Lacaita                      |
| 8  | Colchicaceae | <i>Colchicum luteum</i> Baker   |    |               | <i>Rosa webbiana</i> Wall. ex Royle<br><i>Astragalus nivalis</i> Kar. & Kir. |
| 9  | Cyperaceae   | <i>Calamagrostis emodensis</i> Griseb.<br><i>Carex orbicularis</i> Boott. | 26 | Orobanchaceae | <i>Orobanche kotschyi</i> L.<br><i>Sophora mollis</i> (Royle) Baker          |
|    |              | <i>Phleum pratense</i> L.<br><i>Cyperus diluta</i> M. Bieb.               |    |               |  |
|    |              | <i>Scirpus setaceus</i> L   |    |               |  |
| 10 | Iridaceae    | <i>Iris germinata</i> L.  | 22 | Fagaceae      | <i>Quercus baloot</i> Griffith   |
|    |              | <i>Iris lacteal</i> Pallas  |    |               | <i>Quercus dilatata</i> Lindl.<br><i>Quercus semicarpifolia</i> Sm.          |
| 11 | Liliaceae    | <i>Fritillaria imperialis</i> Hort.                                       | 23 | Lamiaceae     | <i>Mentha royleana</i> Benth.  |
| 12 | Orchidaceae  | <i>Epipactis wallichii</i> Schlech.                                       |    |               |  |
|    |              | <i>Spiranthes lancea</i> (Thunb.) Backer                                  | 24 | Leguminosae   | <i>Psoralea drupacea</i> Bunge   |
| 13 | Poaceae      | <i>Agropyron semicostatum</i> Nees ex Steud                               | 25 | Rosaceae      | <i>Cotoneaster bacillaris</i> Wall. ex Lindl.                                |
|    |              | <i>Agrostis viridis</i> Gouan.  |    |               | <i>Cotoneaster nummularius</i> Fisch. & C.A. Mey                             |

|    |               |   |    |               |  |
|----|---------------|---|----|---------------|--|
|    |               | <i>Piptatherum wendelboi</i> Bor                    | 27 | Oleaceae      | <i>Fraxinus xanthoxyloides</i> (Wall. ex G. Don) DC. |
| 14 | Anacardiaceae | <i>Pistacia integerrima</i> (L.) Steward ex Brandis | 28 | Polygonaceae  | <i>Rheum webbianum</i> Royle                         |
|    |               | <i>Pistacia khinjuk</i> Stocks                      |    |               | <i>Rumex hastatus</i> D. Don                         |
|    |               | <i>Rhus punjabensis</i> Steward ex Brandis          |    |               | <i>Rumex longifolius</i> DC                          |
| 15 | Apiaceae      | <i>Prangos pabularia</i> Lindl.                     | 29 | Saxifragaceae | <i>Bergenia ciliata</i> (Haw.)                       |
| 16 | Apocyanaceae  | <i>Vinca major</i> L.                               |    |               | <i>Verbascum thaspus</i> L.                          |
|    |               | <i>Periploca aphylla</i> Decne.                     | 30 | Violaceae     | <i>Viola canescens</i> Wall., Fl. Ind.               |

Table 4. Plant Communities location and plant species in Upper and Lower Storey (herbs and shrub)

| # | Locations  | Upper storey   | Under storey (Herbs and Shrubs)   |  |   |
|---|--|--|---|--|---|
| 1 | Bu-35.39 N /71375 E (2906m)<br>Rm-3546N/7140 E (2450m)<br>Bir-35.37 N/71.43 E (2521m)  | <i>C.deodara</i>   | <i>Allium chitralicum</i><br><i>Artemisia maritima</i><br><i>Artemisia parviflora</i><br><i>Berberis lycium</i><br><i>Bidens tripartita</i><br><i>C.emodensis</i>   | <i>F.xanthoxyloides</i><br><i>Fritillaria imperialis</i><br><i>Phleum pratense</i><br><i>Pistacia integerrima</i><br><i>Pistacia khinjuk</i><br><i>Prangos pabularia</i>   | <i>Rheum webbianum</i><br><i>Rhus punjabensis</i><br><i>Rumex hastatus</i><br><i>Scirpus setaceus</i><br><i>Sophora mollis</i><br><i>Spiranthes lancea</i>  |
| 2 | Bu-35.419N/71.37 E (2987m)<br>Bu-35.41 N/71.37 E( 2929m)<br>Bu-35.46 N / 71.39 E(2511m)<br>Ru-35.47 N/ 71.39( 2505m)<br>Ru-35.47N/71.39 E (764m)<br>Ru-35.47 N/71.38 E(2838m)<br>Bi-35.479N/ 71.39(2714m)<br>Bi-3542N/71395 E (2459 m)<br>Bi-35.37 N/71.42 (2293m) | <i>C.deodara</i><br><i>P.gerardiana</i><br><i>Q.baloot</i><br><i>Q. dilitata</i> | <i>Aconitum laeve</i><br><i>Agrostis viridis</i><br><i>Arum jacquemontiir</i><br><i>Artemisia brevifolia</i><br><i>Artemisia maritima</i><br><i>Artemisia parviflora</i><br><i>Astragalus grahmmianus</i><br><i>Astragalus nivalis</i><br><i>Astragalus subumbellatus</i> | <i>Bellis perennis</i><br><i>Bergenia ciliata</i><br><i>Carex orbicularis</i><br><i>Epipactis wallichii</i><br><i>Fraxinus xanthoxyloidess</i><br><i>Impatiens brachycentra</i><br><i>Phleum pratense</i> L.<br><i>Pistacia integerrima</i><br><i>Pistacia khinjuk</i> | <i>Rheum webbianum</i><br><i>Rosa webbiana</i><br><i>Rumex hastatus</i><br><i>Rumex longifolius</i><br><i>Saussurea albescens</i><br><i>Scirpus setaceus</i><br><i>Sophora mollis</i><br><i>Verbascum thaspus</i><br><i>Viola canescens</i><br><i>Vinca major</i> |



|   |   |   |  |   |  |
|---|---|---|--|---|--|
| 3 | Bu-35.42 N/ 71.39 E (2739)<br>Bu-35.45N/71.39 E ( 2819 m)<br>Ru-35.47 N/ 71.38 ( 2838m)<br>Ru- 35.47 N/71.37 ( 3050m)<br>Ru- 35.43N/71.387E 3034m)<br>Bi-35.479N/ 1.377E(3030m) | <i>C.deodara</i><br><i>P.wallichiana</i><br><i>J.exelsa</i>   | <i>Aconitum laeve</i><br><i>Aristida cynantha</i><br><i>Artemisia parviflora</i><br><i>Artemisia sacrorum</i><br><i>Bellis perennis</i><br><i>Bergenia ciliata</i><br><i>Berberis lycium</i> Royle<br><i>Carex orbicularis</i> | <i>Epipactis wallichii</i><br><i>Fraxinus</i><br><i>xanthoxyloides</i><br><i>Impatiens</i><br><i>brachycentra</i><br><i>Mentha royleana</i><br><i>Periploca aphylla</i><br><i>Periploca aphylla</i><br><i>Phleum pratense</i>   | <i>Pistacia khinjuk</i><br><i>Prangos pabularia</i><br><i>Rheum webbianum</i><br><i>Rhus punjabensis</i><br><i>Rumex longifolius</i><br><i>Sophora mollis</i><br><i>Spiranthes lancea</i><br><i>Viola canescens</i>                        |
| 4 | Bu-35.41 N /71.40E( 2315m)<br>Bu-35.41 N/71.40E (2356m)<br>Bu-35.41N/71.40E (2307m)<br>Ru-35.47 N/71.38 E (2668m)<br>Bi-35.41N/ 71.40E (2315m)                                  | <i>C.deodara</i><br><i>P. gerardiana</i><br><i>J.exelsa</i><br><i>Q.baloot</i><br><i>Q.dilitata</i> | <i>Agropyron</i><br><i>semicostatum</i><br><i>Agrostis viridis</i><br><i>Allium sativum</i><br><i>Artemisia parviflora</i><br><i>Bellis perennises</i>   | <i>Berberis lycium</i><br><i>Carex orbicularis</i><br><i>Colchicum luteum</i><br><i>Cyperus diluta</i><br><i>Epipactis wallichii</i><br><i>Fragaria nubicola</i><br><i>Fraxinus xanthoxyloid</i><br><i>Iris germinea</i><br><i>Iris lacteal</i><br><i>Ixiolirion montanum</i> | <i>Mentha royleana</i><br><i>Phleum pratense</i><br><i>Pistacia khinjuk</i><br><i>Rosa webbiana</i><br><i>Rhus punjabensis</i><br><i>Scirpus setaceus</i><br><i>Sophora mollis</i><br><i>Spiranthes lancea</i><br><i>Verbascum thaspus</i> |

|   |  |   |   |   |   |
|---|--|---|---|---|---|
| 5 | Bu-35.434N/71.42E (2460)<br>Bu- 35.41N/ 71.37 E( 2773m)<br>Ru-5°47"N/71°49"E(2,359m)<br>Ru-35.37 N /71.4E (2600m)<br>Bi-35.37N/71.39 E(2578 m)<br>Bi-35.41N/71.40E(2267) | <i>P.gerardiana</i>   | <i>A.semicostatum</i><br><i>Agrostis viridis</i><br><i>Allium sativum</i><br><i>Anaphalis nepalensis</i><br><i>Arum jacquemontii</i><br><i>Artemisia maritima</i><br><i>Artemisia parviflora</i><br><i>Artemisia sacrorum</i> | <i>A. grahammianus</i><br><i>Astragalus nivalis</i><br><i>Astragalus</i><br><i>subumbellatus</i><br><i>Berberis lycium</i><br><i>Carex orbiculari</i><br><i>Cynanchum acutum</i><br><i>F.xanthoxyloides</i><br><i>Iris germinea</i><br><i>Ixiolirion montanum</i> | <i>Periploca aphylla</i><br><i>Piptatherum wendelboi</i><br><i>Pistacia khinjuk</i><br><i>Rheum webbianum</i><br><i>Rumex longifolius</i><br><i>Scirpus setaceus</i><br><i>Sophora mollis</i><br><i>Spiranthes lancea</i><br><i>Verbascum thaspus</i><br><i>Vinca major</i> |
| 6 | Bu-35.43N/71.40E(2460 m)<br>Bu-35.41 N/71.40E(2309m)<br>Ru- 35.47N/71.39E (2358m)<br>Bi- 35.42N/71.38E (3103m)<br>Bi-35.41N/71.40E (2267m)                               | <i>C.deodara</i><br><i>P.gerardiana</i><br><i>J.exelsa</i><br><i>Q. baloot</i><br><i>Q.dilitata</i> | <i>Agropyron</i><br><i>semicostatum</i><br><i>Aconitum laeve</i><br><i>Anaphalis nepalensis</i><br><i>Aristida cynantha</i><br><i>Artemisia maritima</i> L.<br><i>Artemisia parviflora</i><br><i>A.grahmmianus</i>            | <i>Astragalus</i><br><i>subumbellatus</i><br><i>Bellis perennis</i><br><i>Berberis lycium</i><br><i>Carex orbicularis</i><br><i>Cotoneaster spp</i><br><i>Cyperus diluta</i><br><i>Impatiens</i><br><i>brachycentra</i><br><i>Orobanche kotschy</i>               | <i>Phleum pratense</i><br><i>Pistacia khinjuk</i><br><i>Quercus baloot</i><br><i>Rheum webbianum</i> Royle<br><i>Rhus punjabensis</i><br><i>Rumex hastatus</i><br><i>Rumex longifolius</i><br><i>Sophora mollis</i><br><i>Verbascum thaspus</i>                             |

|    |  |  |   |   |  |
|----|--|--|---|---|--|
| 7  | Bu-35.42 N/71.38E (3103 m)<br>Bu 35.42 N/71.39E(3008m)<br>Ru-35.40 N/71.36 E(2939m)<br>Bi- 35.36N/71.44E (3011)                            | <i>J.excelsa</i><br><i>J. communis</i>   | <i>Agropyron semicostatum</i><br><i>Agrostis viridis</i><br><i>Aristida cynantha</i><br><i>Artemisia parviflora</i><br><i>Aster flaccidus</i><br><i>Bellis perennis</i>   | <i>Bergenia ciliata</i><br><i>Berberis lycium</i> Royle<br><i>Calamagrostis emodensis</i><br><i>Iris germinea</i><br><i>Iris lacteal</i><br><i>Phleum pratense</i><br><i>Pistacia integerrima</i><br><i>Pistacia khinjuk</i>                              | <i>Prangos pabularia</i><br><i>Rheum webbianum</i><br><i>Rhus punjabensis</i><br><i>Rumex hastatus</i><br><i>Saussurea albescens</i><br><i>Sophora mollis</i><br><i>Spiranthes lancea</i><br><i>Vinca major</i>                            |
| 8  | Bu-35.42N /71.38 E (3028m)<br>Bu- 35.42 N/71.37E (3178m)<br>Bi 35.41N/ 71.40E (2915)   | <i>C.deodara</i><br><i>P.gerardiana</i><br><i>A.pindrow</i><br><i>P.smithiana</i><br><i>J.excelsa</i><br><i>B.utilis</i><br><i>Q.baloot</i><br><i>Q.dilitata</i> | <i>Agrostis viridis</i><br><i>Anaphalis nepalensis</i><br><i>Arum jacquemontii</i><br><i>Artemisia brevifolia</i><br><i>Artemisia parviflora</i><br><i>Artemisia sacrorum</i><br><i>Aster flaccidus</i><br><i>Aristida cynantha</i> | <i>Berberis lycium</i><br><i>Cichorium intybus</i><br><i>Nepeta floccosa</i><br><i>Cynanchum acutum</i><br><i>Cyperus diluta</i><br><i>Epipactis wallichii</i><br><i>Impatiens brachycentra</i><br><i>Ixiolirion montanum</i><br><i>Periploca aphylla</i> | <i>Phleum pratense</i><br><i>Pistacia integerrima</i><br><i>Psoralea drupacea</i><br><i>Rheum webbianum</i><br><i>Rhus punjabensis</i><br><i>Rumex hastatus</i><br><i>Sophora mollis</i><br><i>Verbascum thaspus</i><br><i>Vinca major</i> |
| 9  | Ru-35.42N/71.37 E (3062m)<br>Bi- 37.37EN/71.41E (3121m)  | <i>P.wallichiana</i>   | <i>Artemisia brevifolia</i><br><i>Artemisia parviflora</i><br><i>Artemisia sacrorum</i><br><i>Aster flaccidus</i><br><i>Berberis lyciums</i>  | <i>Cyperus diluta</i><br><i>Impatiens brachycentra</i><br><i>Phleum pratense</i><br><i>Pistacia integerrima</i>   | <i>Rumex hastatus</i><br><i>Rhus punjabensis</i><br><i>Saussurea albescens</i><br><i>Verbascum thaspus</i><br><i>Vinca major</i>   |
| 10 | Bu-3541N/7140E (2093m)<br>Bu-35.42 N/71.38 E (3028m)<br>Bi- 35.36N /71.44E (3011m)   | <i>P.gerardiana</i><br><i>J.communis</i><br><i>J.excelsa</i>   | <i>Artemisia maritima</i><br><i>Aster flaccidus</i><br><i>Astragalus grahamianus</i><br><i>Astragalus nivalis</i><br><i>Berberis lycium</i>   | <i>Bidens tripartita</i><br><i>Cynanchum acutum</i><br><i>Fraxinus xanthoxyloides</i><br><i>Periploca aphylla</i><br><i>Pistacia integerrima</i>  | <i>Pistacia khinjuk</i><br><i>Prangos pabularia</i><br><i>Rhus punjabensis</i><br><i>Sophora mollis</i><br><i>Verbascum thaspus</i><br><i>Vinca major</i>  |
| 11 | Bu-35.41 N /71.38 E 2828m)<br>Bu-35.41N/71.40E (2267m)<br>Bu-35.41N /71.40E (2235m)<br>Bi-35.42N/71.38E (2833m)<br>Bi-35.41N/71.40E (2267) | <i>C.deodara</i><br><i>P.gerardiana</i><br><i>Q.baloot</i><br><i>Q. dilitata</i>   | <i>Agropyron semicostatum</i><br><i>Arum jacquemontii</i><br><i>Artemisia maritima</i><br><i>Artemisia parviflora</i><br><i>Artemisia sacrorum</i><br><i>Astragalus grahamianus</i><br><i>Astragalus nivalis</i>                    | <i>Bellis perennis</i><br><i>Bergenia ciliata</i><br><i>Bidens tripartita</i><br><i>Colchicum luteum</i><br><i>Cotoneaster spp</i><br><i>Iris germinea</i><br><i>Iris lacteal</i><br><i>Orobanche kotschyi</i><br><i>Periploca aphylla</i>                | <i>Phleum pratense</i><br><i>Pistacia integerrima</i><br><i>Prangos pabularia</i><br><i>Rhus punjabensis</i><br><i>Scirpus setaceus</i><br><i>Sophora mollis</i><br><i>Spiranthes lancea</i>   |

Table 5. Physiochemical analysis of soil (fertility evaluation) of conifer communities of Kalash valley

| Community |                              | Physiochemical characteristics |       |          |       |       |     | Major Nutrients |    |     |     |
|-----------|------------------------------|--------------------------------|-------|----------|-------|-------|-----|-----------------|----|-----|-----|
| 1         | GPS-Co-ordinates             | PH                             | EC    | EC dsm-1 | TSS   | CaCO3 | OM  | N               | P  | K   | C   |
|           |                              |                                | dsm-1 |          | %     |       |     | mg kg-1         |    |     |     |
|           | Bu-35.40 N/ 71.40 E (2845m ) | 7.2                            | 0.3   | 0.12     | 0.098 | 1.25  | 3.1 | 0.16            | 15 | 280 | 1.8 |

|   |                              |     |      |      |       |      |      |       |      |    |      |
|---|------------------------------|-----|------|------|-------|------|------|-------|------|----|------|
|   | Bu-35.39 N/71375 E (2906m)   | 7.6 | 0.1  | 0.17 | 0.032 | 0.75 | 2.07 | 0.1   | 3.3  | 32 | 1.2  |
|   | Ru-35.463N /71.389E (3023)   | 7.9 | 0.4  | 0.14 | 0.03  | 6    | 4    | 0.5   | 5.5  | 77 | 0.89 |
| 2 | Bu-35.419N/71.37 E (2987m)   | 8.4 | 0.08 | 0.15 | 0.025 | 5.5  | 2.76 | 0.14  | 5.2  | 90 | 1.6  |
|   | Bu-35.41 N/71.37 E ( 2929m)  | 7.4 | 0.1  | 0.1  | 0.032 | 4.5  | 2.76 | 0.14  | 7    | 56 | 1.6  |
|   | Bu-35.46 N / 71.39 E (2511m) | 7.5 | 0.08 | 0.11 | 0.025 | 4.4  | 2.76 | 0.14  | 5.2  | 66 | 1.6  |
|   | Ru-35.47 N/ 71.39 E( 2505m)  | 7.4 | 0.11 | 0.1  | 0.035 | 0.75 | 2.69 | 0.13  | 4.4  | 76 | 1.56 |
|   | Ru-35.479N/71.39 E (1764m)   | 7.5 | 0.6  | 0.5  | 0.025 | 0.5  | 2.3  | 0.05  | 6    | 70 | 1    |
|   | Ru-35.47 N/ 71.38 E( 2838m)  | 7.5 | 0.1  | 0.1  | 0.032 | 0.5  | 3.1  | 0.155 | 7.8  | 84 | 1.8  |
|   | Bi-35.479N/ 71.39 E(2714m)   | 8.1 | 0.23 | 0.1  | 0.03  | 5.5  | 3.2  | 0.5   | 5.6  | 67 | 0.6  |
|   | Bi-3542N/71395 E (2459 m)    | 7.7 | 0.33 | 0.14 | 0.1   | 6    | 1.5  | 0.4   | 6.4  | 54 | 0.4  |
|   | Bi-35.37 N/71.42 (2293m)     | 7.9 | 0.17 | 0.11 | 0.054 | 5.5  | 2.76 | 0.13  | 17.1 | 42 | 1.6  |

|   |                              |     |      |      |       |      |      |       |      |     |      |
|---|------------------------------|-----|------|------|-------|------|------|-------|------|-----|------|
| 3 | Bu-35.42 N/ 71.39 E (2739 m) | 7.9 | 0.42 | 0.13 | 0.132 | 7.75 | 1.58 | 0.7   | 7    | 220 | 1    |
|   | Bu-35.45N/7139 E ( 2819 m)   | 7.5 | 0.11 | 0.1  | 0.035 | 5    | 2.27 | 0.11  | 2.3  | 74  | 1.32 |
|   | Ru-35.47 N/71.38 E(2838m)    | 7.8 | 0.2  | 0.02 | 0.06  | 4.5  | 2.2  | 0.103 | 3.7  | 78  | 1    |
|   | Ru- 35.47 N/71.37 E( 3050m)  | 7.5 | 0.08 | 0.12 | 0.025 | 0.5  | 0.82 | 0.04  | 5.1  | 87  | 0.48 |
|   | Ru- 35.43N/71.38E (3034m)    | 7.3 | 0.2  | 0.1  | 0.064 | 1.25 | 2.07 | 0.10  | 2.8  | 30  | 1.2  |
|   | Bi-35.479N/ 71.37 E (3030m)  | 7.8 | 0.21 | 0.1  | 0.05  | 4.3  | 0.6  | 0.8   | 5.3  | 76  | 1    |
| 4 | Bu-35.41 N /71.40 E ( 2315m) | 7.4 | 0.24 | 0.12 | 0.077 | 6    | 1.72 | 0.09  | 4.2  | 76  | 1    |
|   | Bu-35.41 N/71.40E (2356m)    | 7.1 | 0.11 | 0.12 | 0.035 | 6    | 1.38 | 0.07  | 6    | 88  | 0.8  |
|   | Bu-35.41N/71.40E (2307m)     | 8.0 | 0.14 | 0.12 | 0.045 | 4.6  | 1.03 | 0.05  | 5.5  | 70  | 1.6  |
|   | Ru-35.47 N/71.38 E (2668m)   | 8   | 0.2  | 0.12 | 0.04  | 0.5  | 1    | 0.04  | 3    | 129 | 0.6  |
|   | Bi-35.43N/ 71.42E (2314m)    | 7.9 | 0.1  | 0.11 | 0.032 | 5.25 | 2.41 | 0.12  | 10   | 64  | 1.4  |
| 5 | Bu-35.43N/71.42E (2460 m)    | 0   | 0.11 | 0.2  | 0.035 | 4    | 1.38 | 0.3   | 3.3  | 78  | 0.8  |
|   | Bu-35.41 N /71.38 E (2828m)  | 8.2 | 0.15 | 0.11 | 0.048 | 2    | 3.1  | 0.15  | 10.4 | 84  | 1.8  |
|   | Ru-35°47"N /71°49"E(2,359m)  | 7.8 | 0.12 | 0.09 | 0.045 | 1    | 0.9  | 0.13  | 4.4  | 68  | 0.5  |
|   | Ru-35.37 N /71.44E (2600m)   | 7.5 | 0.14 | 0.11 | 0.045 | 4.5  | 2.76 | 0.13  | 9.1  | 84  | 1.6  |
|   | Bi-35.37N/71.39 E (2578 m)   | 7.4 | 0.14 | 0.12 | 0.044 | 6.2  | 3.1  | 0.155 | 6.2  | 68  | 1.8  |
|   | Bu-35.41N/71.40E (2267m)     | 7.9 | 0.1  | 0.11 | 0.032 | 5.25 | 2.41 | 0.12  | 6.7  | 64  | 1.4  |
| 6 | Bi-35.41N/71.40E (2267m)     | 7.5 | 0.25 | 0.11 | 0.08  | 3.4  | 3.1  | 0.155 | 4.2  | 56  | 1.8  |
|   | Bu-35.41 N/71.40E (2309m)    | 7.5 | 0.14 | 0.14 | 0.044 | 5    | 2.89 | 0.144 | 2.8  | 250 | 1.68 |
|   | Ru- 3547N/7139E (2358m)      | 8   | 0.9  | 0.1  | 0.04  | 1    | 1    | 0.3   | 4.5  | 87  | 0.8  |

|    |                             |     |      |      |        |      |      |       |      |     |      |
|----|-----------------------------|-----|------|------|--------|------|------|-------|------|-----|------|
|    | Bi- 35.42N/71.38E (3103m)   | 8.0 | 0.11 | 0.1  | 0.035  | 7.7  | 1.38 | 0.069 | 10.4 | 108 | 0.8  |
|    | Bi-35.41N/71.40E (2267m)    | 8.0 | 0.14 | 0.12 | 0.045  | 4.6  | 1.03 | 0.05  | 5.5  | 70  | 1.6  |
| 7  | Bu-35.42 N/71.38E (3103 m)  | 7.8 | 0.21 | 0.4  | 0.05   | 4.3  | 1    | 0.05  | 5.3  | 76  | 1    |
|    | Bu 35.42 N/71.39E 3008m)    | 7.4 | 0.09 | 0.1  | 0.029  | 4    | 2.41 | 0.12  | 8.8  | 44  | 1.4  |
|    | Ru-35.40 N/71.36 E(2939m)   | 6.8 | 0.07 | 0.11 | 0.022  | 0.5  | 2.07 | 0.103 | 8.1  | 98  | 1.2  |
|    | Bi- 35.36N /71.44E (3011m)  | 7.4 | 0.06 | 0.1  | 0.019  | 5.5  | 2.07 | 0.103 | 2.1  | 28  | 1.2  |
| 8  | Bu-35.44N /71.387E (3027m)  | 7.4 | 0.1  | 0.2  | 0.03   | 4    | 2.76 | 0.138 | 3.1  | 88  | 1.6  |
|    | Bu- 35.42 N/71.37E (3178 m) | 7.1 | 0.06 | 0.13 | 0.019  | 3.7  | 3.1  | 0.155 | 4.2  | 72  | 1.8  |
|    | Bi 35.41N/ 71.40E (2915m)   | 7.7 | 0.1  | 0.13 | 0.0032 | 5.5  | 2.07 | 0.103 | 6.6  | 56  | 1.2  |
| 9  | Ru-35.43N/71.38 E (3065m)   | 7.4 | 0.07 | 0.5  | 0.075  | 0.75 | 2.76 | 0.138 | 2.8  | 90  | 1.6  |
|    | Ru-35.42N/71.38 E (3022m)   | 7.4 | 0.08 | 0.12 | 0.04   | 0.6  | 4    | 0.2   | 7    | 79  | 1.8  |
| 10 | Bu-35.41N/71.40E (2093m)    | 7.5 | 0.14 | 0.12 | 0.044  | 4.6  | 3.1  | 0.155 | 8.3  | 62  | 1    |
|    | Bu-35.42 N/71.38 E (3028 m) | 8.1 | 0.41 | 0.1  | 0.023  | 4    | 1    | 0.04  | 6.5  | 120 | 1    |
|    | Bi- 35.38N/71.45E (3011m)   | 8.3 | 0.19 | 0.12 | 0.061  | 8    | 1.38 | 0.4   | 3.6  | 280 | 0.8  |
| 11 | Ru-35.42N/71.37 E (3062 m)  | 7.4 | 0.08 | 0.12 | 0.075  | 0.75 | 2.76 | 0.138 | 2.8  | 90  | 1.6  |
|    | Bi- 37.37N/71.41E (3121m)   | 7.5 | 0.09 | 0.11 | 0.029  | 6    | 2.41 | 0.12  | 3.9  | 44  | 1.4  |
|    | Bi-35.41N/71.40E (2267)     | 7.9 | 0.42 | 0.13 | 0.132  | 7.75 | 1.58 | 0.7   | 7    | 220 | 0.92 |
|    | Bu-35.41N /71.40E (2235m)   | 7.4 | 0.14 | 0.12 | 0.044  | 6.2  | 3.1  | 0.155 | 6.2  | 68  | 1.8  |
|    | Bu-35.42N /71.40E (2315m)   | 8   | 0.43 | 0.1  | 0.16   | 8    | 2    | 0.4   | 8    | 90  | 1.8  |

**Key note of Column 1 of table 4 and table 5:**

1. *Cedrus deodara* Community (Monospecific) *C. deodara* (dominant species)
2. *Cedrus deodara* & *Pinus gerardiana* community (either is Dominant)
3. *Cedrus deodara* & *Pinus wallichiana* Community(*C. deodara* Dominant)
4. *Cedrus deodara* & *Quercus* community (*C. deodara* Dominant)
5. *Pinus gerardiana* Community (Mono-specific)
6. *Pinus gerardiana* & *Quercus* community (*P. gerardiana* Dominant)
7. *Juniperus excelsa* & *Juniperus communis* community (Either is Dominant)
8. *Juniperus excelsa* & *Betula* community(*J. excelsa* Dominant)
9. *Pinus wallichiana* Community (Mono-specific/ Dominant)
10. *Pinus wallichiana* and *Juniperus excelsa* Community (Either is dominant)
11. *Quercus* sp. and *P. gerardiana* Community (*Quercus* Dominant)

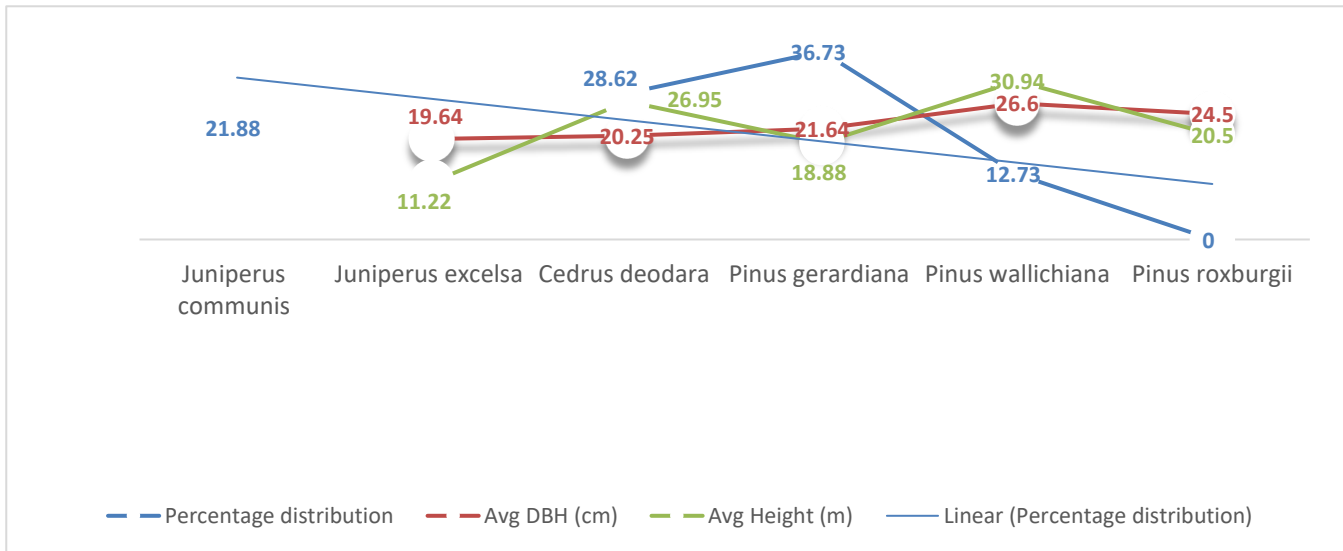


Fig.3. Showing Percentage distribution, average DBH and Height of Gymnosperm trees

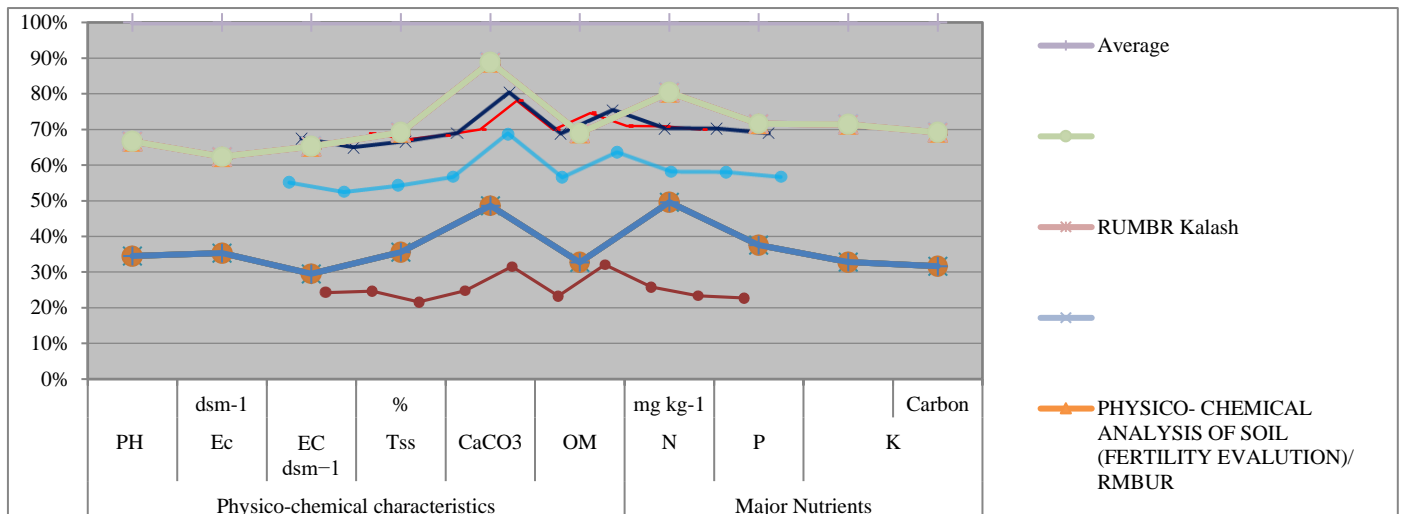


Fig.4. Showing comparison of soil inn Bumburet, Birir and Rambur

**CONCLUSION**

It has concluded during the present study that among all the three Valleys of Kalash, Bumburet has the most fertile soil and has therefore, presenting the maximum floristic diversity followed by Birir and Rambur Valleys. Eleven communities were found and it was concluded that *Cedrus deodara-Pinus gerardiana* community has more species diversity as compare to *Pinus wallichiana-Juniperus excelsa* communities.

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