# FLORISTIC COMPOSITION OF NAGAR VALLEY GILGIT BALTISTAN, PAKISTAN WITH SPECIAL EMPHASIS ON MEDICINAL PLANTS

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## Abstract

Being rich in medicinal plant resource traditional herbal remedies have been utilized in Nagar valley since ancient times and have gained large acceptance throughout the country. Plant resources of Gilgit Baltistan are used for the aliment of different health issues viz., blood pressure, stomach disorder, diabetes, asthma, jaundice, and against kidney stone. Floristic appraisal with special emphasis on medicinal and traditional use based on indigenous knowledge has been focused in this study. Quadrat method was used for phytosociological analysis. Floristic composition I was derived with the help of Importance Value Index (IVI), Two Way Indicator Species Analysis (TWINSPAN**)** and Detrended Correspondence Analysis (DCA) in PCORD (ver: 5.0). The medicinal usage of plant species was documented by conducting a survey through questionnaires and interviews. Four ecological zones viz., Agro-ecological zone, Dry rocky mountainous zone, Subtropical/desert zone and Sub-alpine zone were identified on the basis of altitude and floristic compositions. A total of 42 species from 24 plant families were recorded. It showed the importance of the Compositae family (eight species) followed by Rosaceae family (six species) as an important remedial sources for curing digestive and rheumatic problems, blood pressure, and respiratory disorders. Our findings indicate that many plants are being used excessively as remedial source to cure various diseases. This has put pressure on plant resource bringing them under threat. People lack of knowledge, overgrazing and climate change are also major drivers.

**Keywords:** Detrended Correspondence Analysis, Indigenous Knowledge, Medicinal Plants, Phytosociology, Plant Communities, TWINSPAN.

## Introduction

Phytosociology deals with complexities of all levels of plant communities that helps in bringing a new solution to an old problem of plant species being deteriorated. It is helpful to illustrate the population dynamics of each plant species and to know how they relate with other species in the existing community (Mishra *et al.*, 2012). Floral diversity is an essential element of any community as it is frequently related to their performance and probability to transform. Inventory of plant diversity is the fundamental basis for conservation, sustainable use, and management (Coddington *et al.*, 1991). It refers to the systematic spatio-temporal collection of data with effective and rigorous documentation (Kutt *et al.*, 2009).

Medicinal plants are also known as herbal remedies that are essential for healing, culinary and therapeutic processes as well as of pharmacological and pharmaceutical

compounds. Medicinal flora is an important inexhaustible source and is commonly considered to contribute a vital role in human health care (Shinwari *et al.*, 2006).

World Health Organization (WHO) states that about 70% of the world population depends on plants for their health problems and 35,000 to 70,000 species are utilized as medicine (Padulosi *et al*., 2002). Ancient Unani document, Egyptian papyrus and Chinese script illustrate the use of plants for different ailments (Khan, 2014). Around 30,000 plant species (vascular plants) are discovered worldwide and more than 30 percent are used for medicinal purposes (Khan, 2014). Amongst Ancient evolution, India is one of the largest storage hub of therapeutic plant species used for the development of pharmacological and pharmaceutical products. Approximately, 8000 herbal medicines have been contributed to the AYURVEDA system (Mukherjee and Wahile, 2006).

The medicinal importance of herbs is a distinct feature that has a physiological importance for human health. Many civilizations still rely on herbs for daily needs and drugs. Few of the medicines which are extracted from plants are Aspirin, Morphine, Tubocurarine, and Reserpine (Ekka and Dixit, 2007). Biotic elements have been a source of therapeutic means for thousands of years. Indigenous knowledge is a basis of transfer of definite utility of herbs in different treatments that is transferred from parents to offspring (Pie and Manandhr, 1987).

Medicinally important plants contribute about 10 percent in the flora of Pakistan. The country is alienated into nine natural zones containing 6,000 plant species. Although 410 are widespread species; however 200 are categorized as endangered species (Sher *et al.*, 2005). Apart from the ecological zones of Gilgit Baltistan (GB) those occurring in Himalayas and Hindu-Kush are very much diverse from a floral point of view. In the perspective of floral diversity, approximately 2500 species of plant have been reported from Himalayas-Hindu Kush containing 90% of endemic plant species (Adnan *et al.*, 2006).

The floral rich region of Pakistan (GB) is so far inadequately explored (Qureshi *et al.*, 2006). Number of many widespread species has decrease due to pharmacological, pharmaceutical, and ethnobotanical uses (Shinwari and Qaisar, 2011). Other factors such as deforestation, grazing, and unsustainable utilization, climate change, poor implementation of rules, and land tenure are also major drivers of decline of floral diversity (Hameed *et al.*, 2011). The rural population of GB in isolated areas also depends on endemic plants to overcome their everyday requirements (Qureshi and Khan, 2001). The present study provides information about medicinally important species of GB effective for the treatment of diseases.

**Aim and objectives of study**

The aim of present study to provides information about medicinally important species of GB effective for the treatment of diseases. The

following specific objectives will be pursued in order to achieve the aim of this study is:

i. To generate baseline data and inventory of abundance of existing plant species in the area.
ii. To emphasize on medicinal use of plants of the study area based on traditional use and indigenous knowledge.

## Materials and Methods

### Study area

Nagar Valley is the seventh district and is one of the most spectacular regions of GB, Pakistan. Nagar Valley is located in the northeastern region of Pakistan and the oldest district. It is situated in the northeast of Gilgit-Baltistan at 36°16'North, 74°44' East with an altitude of 2688 meters from sea level, covering an area of 5000 sq kilometers. Nagar experiences a cold dry climate. The summer season is temperate with a standard maximum temperature of 35.9 ˚C and a minimum of 16 ˚C. The Nagar valley lack significant rainfall, averaging 136.2 mm with a maximum of 28.3mm in April and a minimum 2.1mm in November annually (Figure 1).

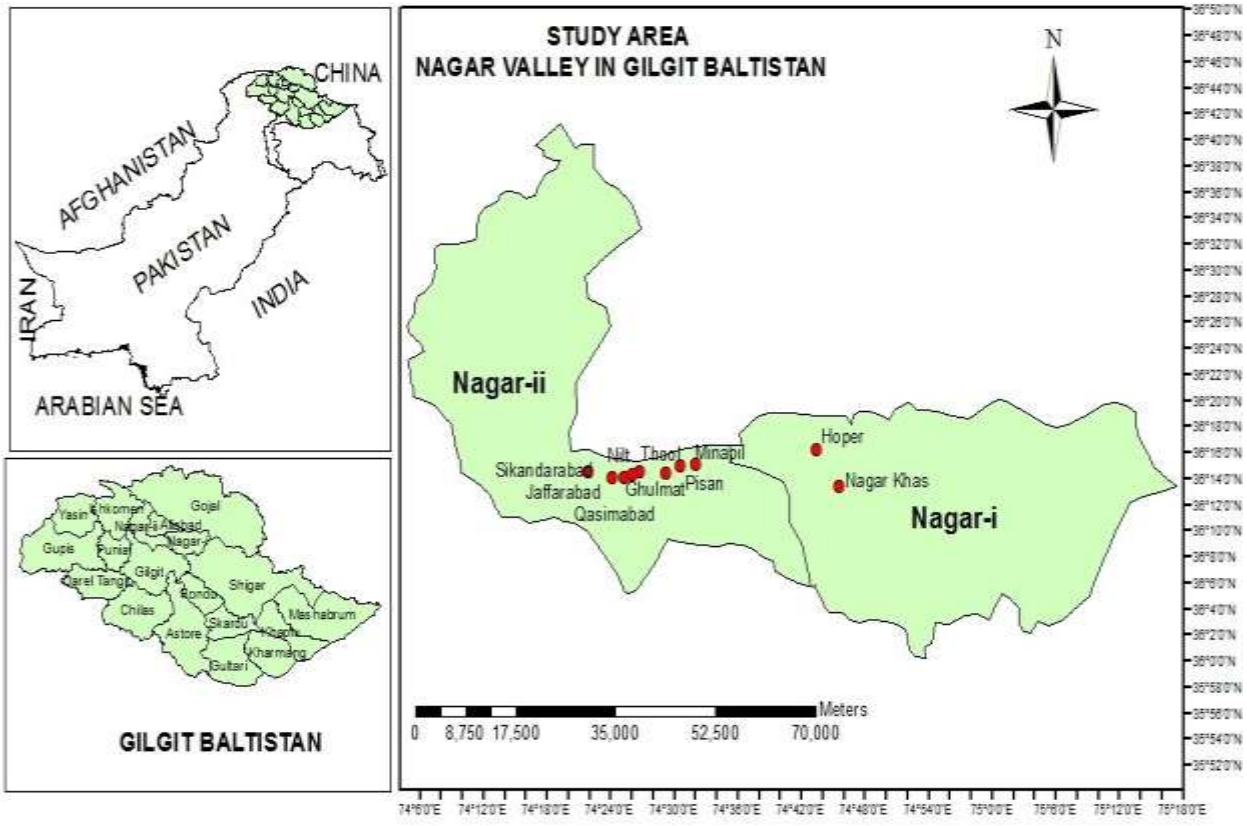


**Figure 1.** Map of study area showing sampling locations in Nagar Valley, Gilgit Baltistan

**Data Collection**

To record floristic species composition, Nagar valley was divided into four ecological zones. Primary data was collected during the spring of 2016-2017. A total of 800 quadrats were sampled in different localities from ten valleys viz., Skinderabad, Jaferabad, Nilt, Thol, Qasimabad, Ghulmat, Pisan, Minapin, Nagar proper, and Hoper in District Nagar. Percent cover of all species was recorded through quadrat size of 10meter square from four ecological zones. The plant species were identified with the flora of Pakistan (Nasir and Ali, 1980-2005). The geographical coordinates of each quadrat were recorded by a geographical positioning system (GPS).

**Data Analysis**

The Phytosociological data of individuals of each species in each quadrat was analyzed and interpreted. It includes assessment of plant density, frequency and cover values to compute Importance Value Index (IVI) of each plant species**.** Species abundance and quadrat data were classified by using Two Way Indicator Species Analysis (TWINSPAN) (Hill, 1979a), to determine associations between species and species abundance. The vegetation communities were named after the first and second dominant species.

Detrended Correspondence Analysis (DCA) examined the vegetation type, an association between samples and dominant species in the sample plot (Hill, 1979b) based on gradient length (Jongman *et al.,* 1995). DCA ordination presented 2 important ordination axes (gradient) for communities and species. The analysis was carried out through PCORD version (5.0).

**Results and Discussion**

Based on topographic information, Nagar Valley of Gilgit-Baltistan area is divided in to four ecological zones viz., agro ecological zone, subtropical/ desert zone, dry- rocky mountainous zone and sub-alpine zone. The **agroecological *zone*** is the man made the system such as plantations, cultivated fields and orchids which supports cropland vegetation (Khan and Khatoon, 2007).

***The subtropical/ desert zone*** is situated along with river and road banks. In summer the temperature rises up to 40°C and in winters it falls below -4°C. Due to extreme in temperatures, xerophytes and drought-resistant plants are found here (Khan and Khatoon, 2007). In ***rocky mountainous zone*** due to environmental and anthropogenic conditions like natural disasters, soil erosion, climate change and heavy grazing, the mountains are uncovered into bedrocks and many of plant species are endangered.

***The sub-alpine zone*** is the zone of plant species just below treeline around the world. Plant species in this zone vary according to where they are on the Earth (Khan and Khatoon, 2007).

**Phytosociological Analysis**

During entire course of study 13 medicinal species were recorded in ***Agro-***

***ecological zone***. Dominant species were *Cichorium intybus* L with IVI value of 22.88 and the co-dominating species was *Chenopodium album* L (IVI = 22.43). Regarding the rank of IVI distribution for plant species shearing in agro-ecological zone, three species are highly dominant followed by 7 species of medium dominance and 3 species of least dominance (Table 1).

Medicinal plants are botanical raw materials, also known as herbal drugs that are primarily used for therapeutic, as components of cosmetics and other natural health products. In Pakistan about 600 to 700 medicinal plants have been reported out of these we have collected 13 medicinally important species belonging to 9 families of plants from agro ecological zone of Nagar valley. The local people of Nagar valley predominantly used these plants for different remedial purposes (Table 1).

In **subtropical/desert zone** of Nagar valley, a total of 9 plant species were recorded. Distribution Analysis of plant species of desert area shows that the dominant species was *Cynodon dactylon* L, (IVI=30.96), *Bothrio chloe* bladhii (Retz.) S.T.Blake (IVI=30.62) and *Digitaria Sanguinalis* L, (IVI=30.03). The co-dominating species were found to be Peganum harmala L, (IVI = 27.25), *Artemisia scoparia* Waldst. and Kit, (IVI = 27.09), and *Capparis spinosa* with 25.28IVI value. The IVI distribution pattern of plant species in desert zone of study area were ranked as three species of high dominance, two species of medium dominance and four of least dominance (Table 1).

In total six medicinal plants were reported from sub-tropical/desert zone of Nagar valley. The inhabitants of valley used these species extensively for different therapeutic purposes like *Artemisia scoparia* used against diabetes and blood pressure, Daphne *mucronata* Royle is used in treatment of bones (Table1).

A total of ten plant species were recorded in ***dry rocky mountainous zone*** of selected areas of Nagar valley. The maximum IVI value of plant species in dry rocky zone shows that the abundant species was *Pistacia integerrima* (J.L.Stewart ex Brandis) Rech with an IVI value of 47.32. The co-dominant species were *Urtica hyperborean* Jacquem.exWedd (IVI = 34.95), *Tribulus terrestris* L (IVI = 32.68), Isodon rugosus (Wall ex. Benth.) (IVI = 29.63) and *Artemesia scoparia* with 29.41 IVI value. (Table 1). Traditional knowledge and questionnaire revealed ten medicinally important plants belonging to 10 families from dry rocky mountainous zone of Nagar valley. These plants have significant role in treatment of different health problems and are used considerably to remove blockage of blood, urinary diseases, uterus and menstruation, kidney stone problem, healing of broken bones and fruit is used for blood pressure and their seed oil is used as anti-cancer respectively (Table 1).

A total of ten species were recorded in ***subalpine zone*** of selected areas in Nagar valley. The highest IVI =30.03 value was recorded for *Trifolium repens* L. The co-dominating species

were *Pinus wallichiana* A. B. Jacks (IVI =29.230), *Thymus linearis* Benth (IVI = 28.32), *Primula macrophylla* D. Don (IVI = 27.46), *Juniperus excelsa* M. Bieb (IVI = 26.07).

Regarding distribution patterns of plant species of subalpine zone one species were found to have highest distribution followed by four species have medium distribution and five species with least distribution. The local people of Nagar valley predominantly used these plants in tea to reduce blood pressure and headache, mature root of plant is used to treat throat infection, tonsil problems, asthma and chest problems (Table 1).

**Vegetation Description and analysis based on TWINSPAN and DCA.**

**Agro-ecological Zone** is the man made system constituting plantations, cultivated fields and orchids which supports cropland vegetation. The plantation of *Salix alba* L, *Populus alba* L and *Robinia pseudo-acacia* L is commonly seen in cultivated fields. Besides these a number of wild herbs are used for many medicinal purposes were found in this zone. TWINSPAN classification with 0.1827 eigenvalue at second level resulted in four types of vegetation communities with distinct floristic characteristics (Figure 2a).

***Robinia–Cuscuta*** **Community(I)** comprised of 53 quadrats with eigenvalue of 0.1605, which identified different vegetation associations of *Chenopodium album* and *Cichurium intybus* L, and these species are significantly use to control blood pressure and used for cough (Figure 2a).

**Plantago-Artimisia Community(II)** consisting of 68 quadrats with an eigenvalue of 0.1964 in association with *Ephedra garardiana* Wall.ex Stapf, and *Populus alba* L, *Plantago major* L and *Artimisia sieversiana* Ehrhex. Willd. These species are greatly used for stomach disorders.

**Populus-Verbscum Community (III)** comprising 41 quadrats with an eigenvalue of 0.1537 supporting agro ecological zone of Nagar valley. *Verbascum Thapsus* L is a wild herb significantly used for treatment of uretic and pulmonary problems (Figure 2a).

**Salix-capusii Franchet Community (IV)** containing 38 quadrats with an eigenvalue of 0.2020, and identifies different vegetation associations of *Cichorium intybus* and *Artemisia rotifolta* (Figure 2a). Both wild herbs are used to control blood pressure. *Datura stramonium* L is coordinated species of the community and identified as invasive species of Pakistan used for treatment of asthma by inhabitants of Nagar valley (Table 1).

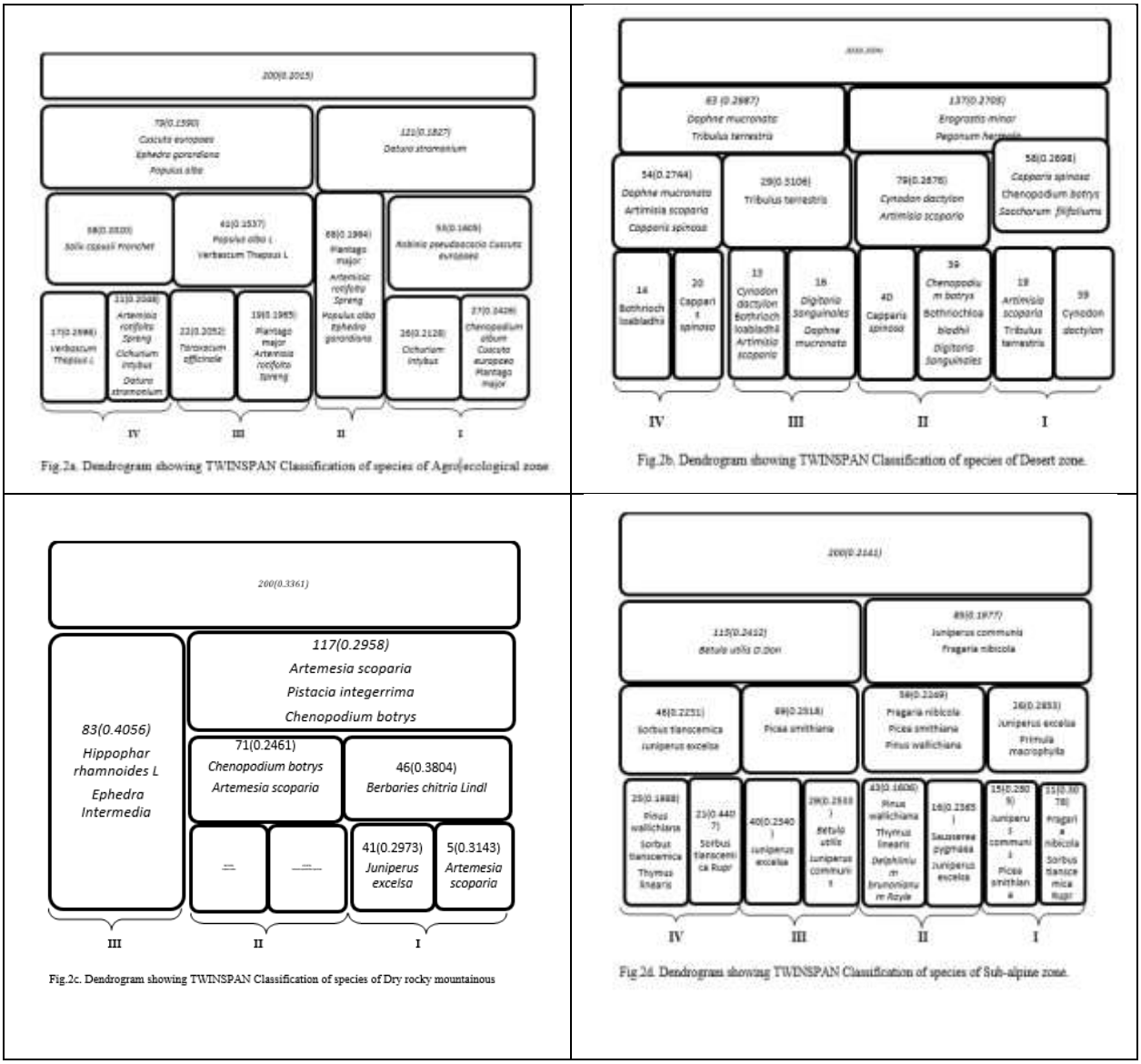


**Figure 2:** Dendrogram showing TWINSPAN classification of species of a) Agro ecological zone b) Desert zone c) Dry rocky mountainous zone d) Sub-alpine zone

In **Agro-ecological zone,** DCA ordination plot also illustrated segregation of vegetation communities, with an eigen values of 0.2589 and 0.2178. First ordination axis exhibited species classification distribution influenced by occurrence of non-native species like *Plantago major* L, *Artimisia sieversiana*, *Cuscuta europaea* L, *Populus alba* L, *Verbascum Thapsus* L and *Robinia pseudo-acacia* .

Whereas, axis 2 was interpreted as disturbed zone due to conversion of native wild land into cropland and construction activities (Figure 3a). Due to improvement in development of road maps and agricultural activities resulted in the extinction of wild medicinal flora from agro ecological zone. Presence of non-native species in the area indicates a serious threat to wild native plants of the area that is bringing change in species distribution and composition of the area (Ali and Malik, 2010).

Non-native species dominated by *Plantago major, Artimisia sieversiana, Cuscuta europaea* L., *Populus alba* L., *Verbascum Thapsus* L. and *Robinia pseudo-acacia* occur on disturbed gradient towards left side of the axis 2. This is mainly contributed by road development and shifting of rural towards urban mode of life. The areas in agro ecological region that are less inhabited by non-native species and is still under less effect of urbanization is dominated by native plant species *Salix capusii* Franch, that occur on the right side of axis 1 (Figure 3a). Dominance of non-native species cause harm to local diversity and environment, and change species composition (IUCN, 2013).

**The subtropical/ Desert Zone** situated along main Nagar River (Indus River). In summers temperature of this area rises up to 40˚C but in winter it fall below -5˚C. Due to extreme cold winters and hot summers, Xerophytes and drought resistant plant species were found. TWINSPAN Classification at second level resulted in four types of communities. ***Capparis-Chenopodium*** **Community (I)** associated with *saccharum filifolium* Steud consisting of 58 quadrats, with eigenvalue of 0.2698, which Show floristic diversity of desert area. The species *Chenopodium botrys* is significantly used for abdominal problems while other two were drought resistant plants (Figure 2b). ***Cynodon-Artimisia*** **Community (II)** consisting of 79 quadrats with eigenvalue (0.2676). *Cynodon dactylon* is invasive plant species and significantly contributed in vegetation of streets and parks of city. *Artimisia sieversiana* is wild herb greatly used for stomach pain.

***Tribulus-terrestris*** **Community (III)** consisting of 29 quadrats with eigenvalue of 0.3106. It is considered as harmful weed that has been designated by an agricultural authority as one that is injurious to agriculture crops, natural ecosystem and human (Pacanoski *et al.*, 2014). ***Daphne-Artimisia*** **Community (IV)** in association with *Capparis spinosa* having 34 quadrats with eigenvalue (0.2744). *Daphne mucronata* Royle is native xerophytic shrub of

western Pakistan, and leaves of the plant are poisonous (Table 1).

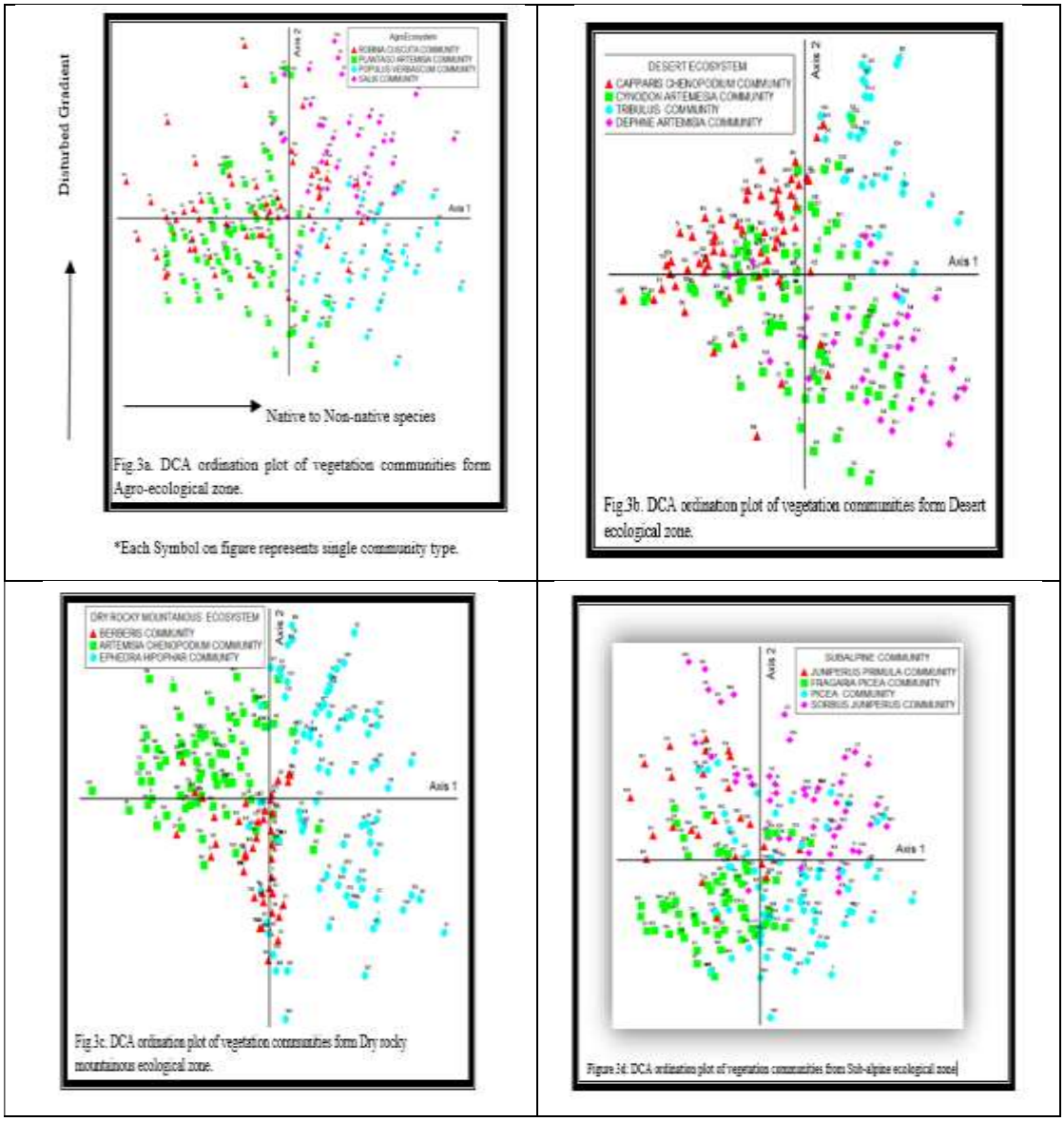


Fig.3a. DCA ordination plot of vegetation communities form Agro-ecological zone.

*Each Symbol on figure represents single community type.

Fig.3b. DCA ordination plot of vegetation communities form Desert ecological zone.

Fig.3c. DCA ordination plot of vegetation communities form Dry rocky mountainous ecological zone.

Figure 3d: DCA ordination plot of vegetation communities from Sub-alpine ecological zone

**Figure 3:** Detrended Correspondence Analysis showing ordination plots for a) Agro ecological zone b) Desert zone c) Dry rocky mountainous zone d) Sub-alpine zone

In **Desert zone,** DCA ordination plot also illustrated segregation of vegetation communities with an eigenvalues 0.3641 and 0.3226. First ordination axis shows species classification distribution influenced by occurrence of non-native species such as *Artimisias scoparia, Capparis spinosa* L., *Chenopodium botrys, Cynodon dactylon and Tribulu sterrestris* L. While, axis 2 was understand as disturbed zone due to conversion land in to agriculture land and development of Karakorum High way resulted in the extinction of wild medicinal flora from desert ecological zone. Abundance of invasive species in area show severe threats to native vegetation which modify species composition and diversity (Ali and Malik, 2010). Non-native species dominated by *Artimisia scoparia, Capparis spinosa, Chenopodium bortys, Cynodon dactylon* and *Tribulus terrestris*, occur on disturbed gradient towards left side of the axis 2. This is largely contributed by road development activities. The areas in desert ecological zone that are less populated by invasive species and is still under less effect of urbanization is dominated by native plant species *Daphne mucronata* Royle that occur on the right side of axis 1. Notably there is appreciable degree of overlay by *Cynodon - Artimesia* community involving approximately one third of plot in each community (Figure 3b).

In **Dry-Rocky Mountainous Zone,** due to environmental and anthropogenic conditions such as natural disasters, soil erosion, climate change and heavy grazing, the mountains are uncovered into bed rocks and many of plant species are endangered. TWINSPAN classification at second level resulted in four types of vegetation communities with distinct floristic characteristics. ***Berberies-chitria*** **Community (I)** consisting of 46 quadrats with an eigenvalue of 0.3804, which identified different vegetation associations of dry rocky mountainous zone. *Berberis chitria* Buch.-Ham is a wild shrub predominantly used for healing of broken bones (Figure 2c).

***Artemesia-Chenopodium*** **Community (II)** comprising of 71 quadrats with eigenvalue of 0.2461. *Artemesia scoparia* Waldst. and Kit is wild herb and used for treatment of hepatitis and jaundice (Yeung.Him-Che, 1985). *Chenopodium botrys* is wild herb significantly used for abdominal problems (Figure 2c). ***Ephedra – Hippophae*** **Community (III)** consisting of 83 quadrats with eigenvalue (0.4056). *Ephedra Intermedia* Schrenk.ex C.A.Mey is medicinal herb used to control swelling of feet (Hyder *et al.,* 2013). The *Hippophae rhamnoide* L fruit mainly have large amount of vitamin c, more than in the oranges and lemons (Hussain *et al.,* 2008). The leaves and fruits are used as therapeutic purposes and also in traditional drug within juice, syrup and tea for aliment of diseases (Figure 2c).

In **Dry Rocky Mountainous zone,** DCA ordination plot also explained division of vegetation communities with an eigenvalue of 0.4275 and 0.3657. First ordination axis illustrated species associations influence by presence of non-native medicinal species like

*Berberies chitria, Chenopodium botrys*, *Hippophae rhamnoide* and *Artemesia scoparia* whereas, axis 2 was interpreted as disturbed zone due to enlargement of Karakorum High way and overharvesting of medicinal plants like *Berberies chitria*, shows extinction along upper sides of axis (Figure 3c).

Non-native species dominated by *Berbaries chitria, Chenopodium botrys*, *Hippophae rhamnoide* and *Artemesia scoparia* is occurring on disturbed gradient towards left side of the axis 2. The area in dry rocky mountainous ecological region that are less inhabited by non-native species and is still under less effect of urbanization is dominated by native plant species *Ephedra intermedia,* is wild herb effectively used for asthma and cough that occur on the right sides of both axis. (Figure 3c). Dominance of non-native species alters composition and diversity of natural flora and cause soil erosion (Marwat *et al.,* 2010).

**Sub-alpine Zone** is the zone of plant species just below tree line around the world. Plant species in this zone vary according to where they are on the Earth. The vegetation along this zone may classify into forest vegetation and grassland vegetation. There are many herbaceous and woody species found. TWINSPAN Classification with an eigenvalue 0.2141 at second level resulted in four types of communities. ***Juniperus-Primula*** **Community (I)** consisting of 26 quadrats with eigenvalue of 0.2853. *Primula macrophylla* Don is medicinal herb of Pakistan, used to treat fever and inflammation of liver (Tsarong, 1994). *Juniperus excelsa* M. Bieb is ever green plant planted for beautifying street landscape and also for kidney stone problem. ***Fragaria-Picea*** **Community II** associated with *Pinus wallichiana* comprises of 59 quadrats with eigenvalue of 0.2249. *Fragaria nibicola* (Hook. f.) Lindl. Ex Lacaita, is medicinal herb, significantly used to increase sexual power in man. *Picea smithiana* (Wall) Boiss is evergreen ornamental plant, planted for beautifying street, timber and paper production. While *Pinus wallichiana* A.B Jacks is evergreen plant native to Karakoram and Hamalaya. The plant has important role for its comparatively high resistance to air pollution and medicinally the plant is very much important. Throughout the Himalayan region the plant is used for the cure of a number of diseases including treatment of fever, cough and cold, bone fracture, healing of injury and wounds (Sinha, 2019) (Figure 2d). ***Picea smithiana*** **Community(III)** comprising of 69 quadrats with eigenvalue of 0.2518. *Picea smithiana* (Wall) Boiss is largest evergreen tree and popular ornamental tree in gardens and also planted for timber and paper production (IUCN, 2006) (Figure 2d). **Sorbus-Juniperus Community (IV)** comprises of 46 quadrates with an eigenvalue of 0.2231. *Sorbus tianschanica* Rupr, Juniperus excelsa M. Bieb are evergreen plants and significantly used for many remedies such as colic, diarrhea and asthma (Khan *et al.,* 2012) (Figure 2d).

In **Subalpine zone,** DCA ordination plot showed separation of vegetation communities with

eigenvalue of 0.2712 and 0.2560. First ordination axis showed species classification distribution influenced by occurrence of non-native species like *Fragaria nibicola, Sorbus tianschamica* Rupr, *Juniperus communis* L, *Juniperus excelsa*. While axis 2 was interpreted as disturbed zone due to overgrazing by animals and exploitation of plants by inhabitants of area for medicinal and other purposes shows decline in medicinal flora of area. Non-native species dominated by *Fragaria nibicola, Sorbus tianschamica, Juniperus communis , Juniperus excelsa* occur on disturbed gradient towards left side of the both axis used for different medicinal purposes. This is mainly contributed by overgrazing and overharvesting of flora of area. The areas in subalpine ecological region that are less inhabited by non-native species and is still under less effect of urbanization is dominated by native plant species *Picea smithiana* that occur on the right side of axis 1 (Figure 3d). Dominance of non-native species cause harm to local diversity and environment, and change species composition (IUCN, 2013).

**3.4 Demographic feature and indigenous knowledge**

Based on questionnaire information A total of 120 respondents with 48.3% male and 51.6% female were interviewed to gather information on therapeutic utilization of plant species from different localities of Nagar valley. Furthermore, the information was categorized into different age groups i.e. 20-40years, 40-60years and above the 60 years. The middle age people 40-60 years old had more indigenous knowledge as compared to other age groups. This is due to lack of interest in early age people about traditional medicines (Figure 4).

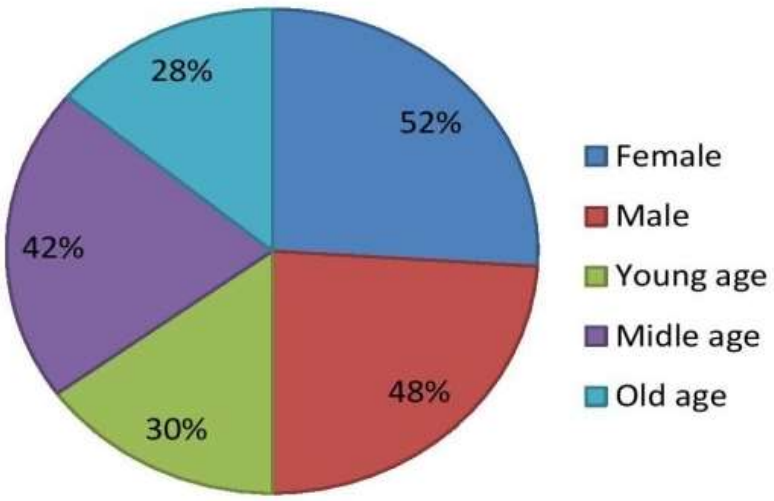


**Figure 4**: Comparison of age and gender-wise respondents and their traditional knowledge of medicinal plants

### 3.5 Family wise distribution of Medicinal Plants of Nagar valley

The inhabitants of different areas of Nagar valley use 60 species belonging to 31 plant families for medicinal purposes. Among these the largest families are Compositae with 8 species followed by Rosaceae with 6 species, Papilionaceae with 4 species, Brassicaceae, Chenopodiaceae, Labiatae with 3 species each, and Poaceae, Solanaceae, Elaeagnaceae, Linaceae, Polygonaceae, Alliaceae, Cucurbitaceae and Malvaceae having 2 species each. While, Asteraceae is the largest and widespread family in Pakistan, and in Nagar valley as well. Similarly, same family has been accounted as a prevalent family in research carried out in different areas of Shigar Valley. Similarly (Khan and Khatoon, 2007) conducted a study and demonstrated Rosaceae as largely widespread family from different area of Himalaya and Karakorum ranges. The local people of Nagar valley mainly used these plants for therapeutic purposes (Figure 5).

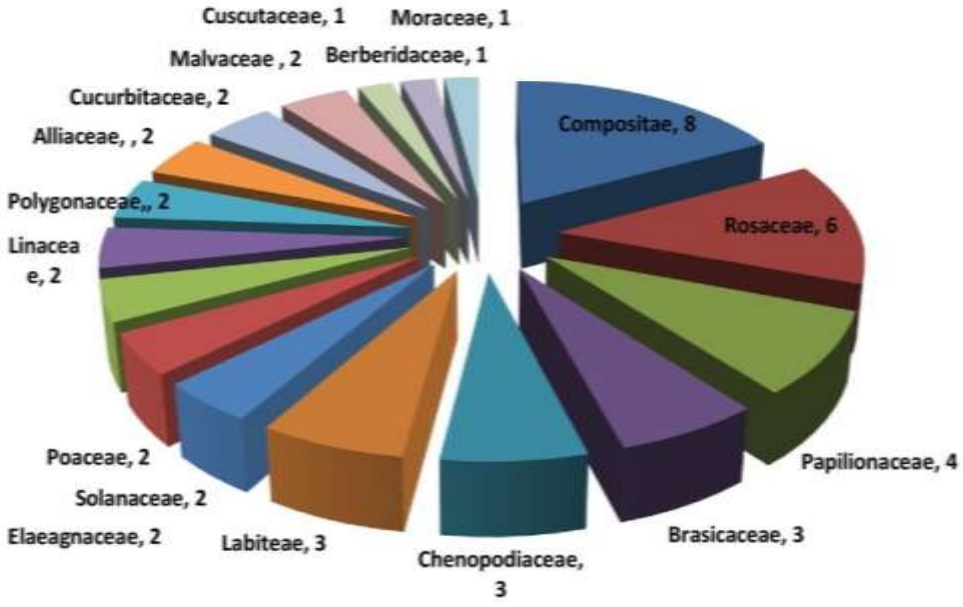


**Figure 5:** Family wise distribution of medicinal plants of study area

### Habit of medicinal plant species used in Nagar valley

Inhabitants of Nagar Valley use cultivated and wild plants species with 57.5 and 42.5 respectively, in traditional drug therapies. Herbs were amongst the dominant group with 80.8% followed by trees 9%, shrubs 2% and climbers 2 % respectively. The environmental

conditions, easy and quick growth might help in prevailing herbaceous habit in Nagar valley (Figure 6).

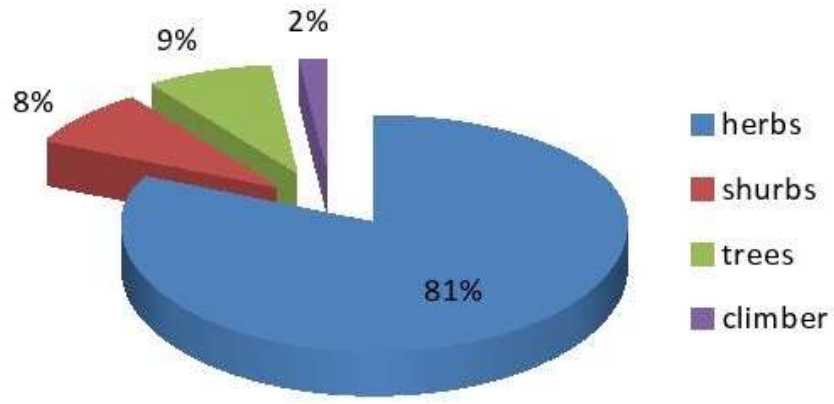


**Figure 6:** Habit of medicinal plant species used in Nagar valley

**Medicinal Plant species part used by inhabitants of Nagar valley**

The plant parts used for more than one treatment are based upon the availability and indigenous knowledge of inhabitants of Nagar valley. The plant species part usage was classified into 9 groups depending on their nature such as fruit, whole plant, leaves, seed, root, bulb, flower, grains, bark and stem were one part used categories, whereas fruit and bark (*Berberis chitria* B), and Fruit and seeds (*Hippophae rhamnoide*) were two parts used categories respectively. Fruits 27% were the most frequently used, followed by whole plant 21%, leaves 15%, seeds 12%, root 10%, bulb and flower 4% each, bark and grains 3% each and stem 1% (Figure 7).

**Conclusions and recommendations**

The plant resources in area are utilized to cure various human health problems. Compositae are the high ranked family having most medicinal plants as compared to others. *Berberis chitria* Lindl, *Metha royleana* Benth, *Artimisia sieversiana* Ehrh, *Carthamus tintoris* L., *Plantago major* L. and *Hippophar rhamnoides* L. are the most popular high ranked medicinal plant species among inhabitants of area while digestive disorders, rheumatic problems, blood pressure and respiratory problems are most common health problem and most of plants are utilized for treatment of these diseases. The traditional knowledge about plant usage is confined to middle age persons. Our present research confirmed that the medicinal plants are severely under threatened, due to lack of knowledge about medicinal plants, easy availability of modern

medicines, extensively enlargement of Karakoram high way, overgrazing and climate change. In situ conservation is suggested to save medicinal flora, which provide baseline information to the students and researcher for identification of plants of Nagar valley.

It is recommended to establish community based companies depend on local biodiversity and can be adopted as a strategy to provide more equitable returns to community groups and hence incentives for conserving the resources. Strategies should also be taken to promote the indigenous and traditional knowledge about uses of medicinal plants. Comprehensive conservation plan shall be developed to save the local medicinal plants.

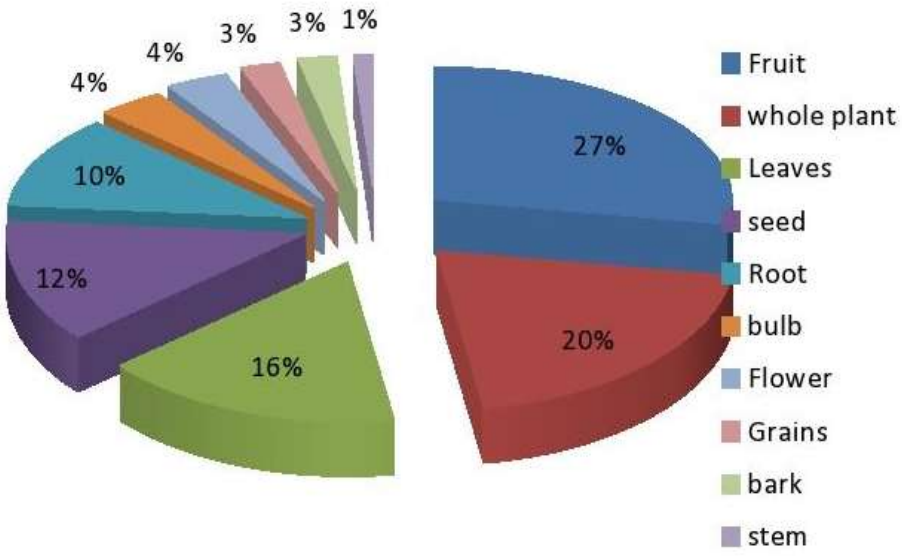


**Figure 7:** Plant species part used by inhabitants of Nagar valley

**Conflict of interest statement**

The authors are not aware of any affiliations with or involvement in any organization or entity with any financial interest (such as honoraria; educational grants; participation in speakers' bureaus; membership, employment, consultancies, stock ownership, or other equity interest; and expert testimony or patent-licensing arrangements), or non-financial interest (such as personal or professional relationships, affiliations, knowledge or beliefs) in the subject matter or materials discussed in this manuscript.

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**Table 1: Importance Value Index based diversity and medicinal importance of plant species in four different zones of Nagar Valley, Gilgit-Baltistan, Pakistan.**

| Sr. No | Species name | Local name | Family name | IVI | Traditional and Medicinal importance |
|---|---|---|---|---|---|
| | **Agro Ecological Zone** | | | | |
| 1 | *Cichorium intybus* | *Eshkinagi* | Compositae | 22.88 | Used to control blood pressure |
| 2 | *Ephedra gerardiana* | Sopat | Ephedraceae | 22.43 | Respiratory tract infection |
| 3 | *Chenopodium album* | *Taghashing* | Chenopodiaceae | 22.06 | Used for blood pressure |
| 4 | *Metha royleana* | Phelaling | Labiatae | 21.31 | Used to relief from motions and stomach disorders |
| 5 | *Datura stramonium* | Datura | Solanaceae | 21.23 | Used to control muscle rigidity and also in treatment of asthma |
| 6 | *Artimisia sieversiana* | *Khakas* | Compositae | 20.31 | Leaves are used for gastro and stomach pain |
| 7 | *Cuscuta europaea* | *Mayon basi* | Cuscutaceae | 20.09 | The whole plant is use for cough and jaundice |
| 8 | *Papaver somniferum* | Mardakhy | Papaveraceae | 19.41 | Used for dysentery, chronic fever |
| 9 | *Artemisia rutifolia* | *Mon* | Compositae | 19.09 | Used for stomach disorder and to control blood pressure |
| 10 | *Taraxacum officinale* | *Tergut* | Compositae | 19.03 | Leaves are used in fever and also for liver problems |
| 11 | *Chenopodium bortys* | *Hamamo* | Chenopodiaceae | 18.53 | Used for abdominal problems, |
| 12 | *Verbascum Thapsus* | Zakon sheka | Scrophulariaceae | 17.76 | Used for treatment of ureic problems |
| 13 | *Plantago major* | Ispaghol | Plantaginaceae | 17.08 | Used for stomach disorders, lower cholesterol level of blood and for constipation |
| | **Desert Zone** | | | | |
| 1 | *Cynodon dactylon* | Jott | Poaceae | 30.96 | N/A |
| 2 | *Bothriochloe bladhii* | Shaqa | Poaceae | 30.62 | N/A |
| 3 | *Digitaria Sanguinalis* | Shaqa | Poaceae | 30.03 | N/A |
| 4 | *Peganum harmala* | Ispandor | Poaceae | 27.25 | Extraction is used for jaundice |
| 5 | *Artemisia scoparia* | Desi phaypus | Compositeae | 27.09 | Used against diabetes and blood pressure |
| 6 | *Capparis spinosa* | kaveer | Capparidaceae | 25.28 | Used for diarrheic and diabetic problems and also for removal of kidney stone |
| 7 | *Daphne mucronata* | Nirk | Thymeiaeaceae | 24.44 | Bark is used in treatment of bones |

| | | | | | |
|---|---|---|---|---|---|
| 8 | *Tribulus terrestris* | Hook gukroz | Zygophyllaceae | 24.25 | Relieves urinary diseases and kidney stone |
| 9 | *Chenopodium botrys* | *Hamamo* | Chenopodiaceae | 23.38 | Used for uterus and menstruation |
| | **Dry-rocky mountainous Zone** | | | | |
| 1 | *Pistacia integerrima* | *Kaavo* | Anacardiaceae | 47.32 | Used for asthama, gastro intestinal problems and also for lleucorrhea |
| 2 | *Urtica hyperborean* | Jami | Urticaceae | 34.95 | Used to remove blockage of blood |
| 3 | *Tribulus terrestris* | Hook gukroz | Zygophyllaceae | 32.68 | Used for urinary diseases |
| 4 | *Isodonrugosus* | Phaypush | Labiatae | 29.63 | Used for toothache, blood pressure and also for microbial infections |
| 5 | *Artemesia scoparia* | Desi phayphus | Compositeae | 29.41 | Used against diabetes and blood pressure |
| 6 | *Ephedra Intermedia* | Sopat | Ephedraceae | 27.90 | Used to control asthama and cough |
| 7 | *Chenopodium botrys* | *Hamamo* | Chenopodiaceae | 27.30 | Used for uterus and menstruation |
| 8 | *Juniperus excelsa* | Chilli | Cupressaceae | 23.95 | Used for kidney stone problem |
| 9 | *Berbaris chitria* | *Eshkeen* | Berberidaceae | 23.97 | Used for healing of broken bones |
| 10 | *Hippophae rhamnoides* | Chashe | Elaeagnaceae | 22.68 | fruit is used for blood pressure and Seed oil is used as anti-cancer |
| | **Sub Alpine Zone** | | | | |
| 1 | *Trifolium repens* | Chita batta | Fabaceae | 30.03 | Used for cough, leucorrhoea and fever |
| 2 | *Pinus wallichiana* | *Chilli* | Pinaceae | 29.23 | Useful to treating respiratory problems, cough, TB and kidney complaints |
| 3 | *Thymus linearis* | Tumoro | Lamiaceae | 28.32 | Used in tea to reduce blood pressure and headache |
| 4 | *Primula macrophylla* | Lelo | Primulaceae | 27.46 | Mature root of plant is used to treat throat infection and tonsil problems. |
| 5 | *Juniperus excels* | *Gall* | Cupressaceae | 26.07 | Used for kidney problem |
| 6 | *Sorbu stianschanica* | Dindesh | Rosaceae | 23.45 | Used in tea to reduce blood pressure and headache |
| 7 | *Fragaria nibicola* | Gruzal | Rosaceae | 23.16 | Used to increase sexual power in man |
| 8 | *Delphinium brunonianum* | Makhooti | Ranunculaceae | 22.11 | Used for dandruff and hair growth |
| 9 | *Juniperus communis* | Cheli | Cupressaceae | 21.49 | They are also used against kidney stone, urine problem |
| 10 | *Saussurea pygmaea* | *Boshi funar* | Compositeae | 19.39 | Used for asthma and chest problem |