

# Exploration of Ethnobotanical and Ethnomedicinal Importance of Naturally Growing Plants of District Neelum From Areas of Dawarian to Ratti Gali, Azad Jammu and Kashmir

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## Research

**Keywords:** Ethnobotanical study, Wild plants, Statistical tools, Spearman's rank correlation, Allium griffithianum, Ethnopharmacological analysis

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# Exploration of ethnobotanical and ethnomedicinal importance of naturally growing plants of District Neelum from areas of Dawarian to Ratti Gali, Azad Jammu and Kashmir

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## Abstract

**Background:** Ethnobotanical study was continued from old civilization to date. Kashmir covered with 46 % vegetation and out of these many are naturally growing plants. Many areas are still unexplored the plants ethnomedicinal importance of wild plants. In this regard, ethnobotanical survey on the unexplored area of District Antheam, Azad Jammu & Kashmir was conducted for identification of wild plants and their ethnomedicinal values.

**Methods:** The current research work was carried out by interviewing the local peoples through a questionnaire method. Data analysis was done by different novel statistical tools such as fidelity level (FL), Spearman's rank correlation (SRC), informant consensus factor (ICF) and direct matrix ranking (DMR) strategies. The ethnobotanical uses of many wild plants were correlated with the plants who already used by societies in some countries of the world. But few plants are used as medicines only indigenous peoples and we recommended these plants for peoples in other parts of country as well as throughout the world in future.

**Results:** Peoples used plants in daily life as in form of vegetables, fodder, fuel, timber as well as for medicinal purposes. Indigenous peoples are using many types of wild plants to cure different diseases like asthma, dysentery, constipation, cold, fever, joint pain, wound healing, kidney

infection and many types of skin diseases. Current study revealed on 103 plants species belonging to 46 plant families from selected area of District Neelum, Azad Jammu and Kashmir. It was observed that Asteraceae with 12 plants species was the the most prominent family occurs in the study area. Out of 103 plants, 75.72% have single-usage, 20.38% have dual-usages and 3.88% have multiple-usage. Among plant partused, leaves having the highest percentage (34 %) that are used by people of the study area for the treatment of different diseases followed by the root 25.2%. Powdered is the dosage form having highest percentage 38% followed by juice and mixture with 29% and 13%, respectively. Some plants used as fodder having highest percentage 37% followed by Food (vegetables and fruits) with 32%. Construction having lowest percentage with 6%. Different statistical tools were applied for more consize results elaboration as mentioned in method section. Data analysis through FL depicted that *Allium griffithianum* and *Adiantum aethiopicum* have highest fidelity level of 75% followed by the *Mentha longifolia* with fedility level of about 72 %. The highest ICF value for recorded for ear-ache and house-thatching (0.91) followed by the construction (0.89) while the lowest ICF value recorded for fodder (0.03) followed by blood purification (0.5). Spearman's rank correlation test confirmed that the number of uses of plants increases with the increase in the number of species.

**Conclusions:** The present research focused to explore the uses of plants in different purposes by experience of old peoples in the study area. Ethnobotanical research focused to explore the uses of plants in different purposes by experience of old peoples in the study area. Young generation of the area did not know ethnobotanical importance of wild plants in the area. So, this study will be useful those peoples and researchers in different fields such as ethnopharmacology, agriculture and biotechnology for future work.

**Keywords:** Ethnobotanical study, Wild plants, Statistical tools, Spearman's rank correlation, *Allium griffithianum*, Ethnopharmacological analysis

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## **Background**

The ethnobotany came into being when earliest man observed animal intake various plants, assembled and alarmed for his food and for fixing his lesion. Ethnobotany plays a significant role between biology, social and traditional system [1, 2]. It was observed that indigenous plants related

knowledge has been continued from one generation to other generation and so on through experience of local peoples. The knowledge of rural areas peoples is best example and key of ethnobotanical study of plants [3]. This study of ethnobotany provides better uses of plants in the field of ethnomedicines as well as it includes use of plants for medicines, food, rituals, social life and others fields of human societies This multi-disciplinary connection between human societies and plants isn't restricted to the utilization of plants for attire, food and asylum yet in addition remembers their utilization for different fields as; strict functions, decorative purposes and medical services [4].

Plants are widely used by every type of community as medicines, whether directly as tribe recipes or medication of different indigenous schemes. There is critical necessity of supporting the medicinal plants that are over collected so that, coming future generations could advantage from these valuable plants that are actual gift of nature for the mankind. The indigenous ethnomedicinal value of plants is helpful to different fields of botany as in the field of Taxonomy, Ecology, Pharmacology and Wildlife in civilizing the prosperity of an area, besides highlighting the traditional uses [5].

The specific plants are used for particular ethnic aims and on particular occasions by cultural groups throughout the existence [6]. It was assessed that 25 % drugs are integrated from restorative plants and right around 80 % people groups of creating nations are still relies upon conventional and local prescriptions to fix ailments as well as fundamental medical services [7].

In our neighbouring country, 27 plant species are used traditionally as ethnomedicinal plants which belong to 18 different taxonomic families for the treatment of different diseases and ailments. The green parts of plants (leaves) are used most frequently and many types of medicines are manufactured in the form of paste and administered orally [8].

The therapeutic uses of plants have been verified by using informant agreement factor (ICF) values and it was explored that some medicinal plants were used to treat jungle fever (0.71), jaundice (0.62), urological issues (0.56), dermatological issues (0.45), torment (0.30) and respiratory turmoil (0.33), and keeping in mind that the overall wellbeing (0.15) and gastrointestinal issues classification (0.28) [9].

Greater part of therapeutic plants might be utilized as a wash to shower the body with less meds being ingested. Before the advancement of current pipes innovation, clean water was not so much accessible but rather more valuable. In such conditions, it might be favorable for washing to happen less as often as possible yet with the utilization of therapeutic plants. Lab testing of a considerable lot of the therapeutic plants utilized by the Tiwi have discovered them to have against microbial properties. Customarily the utilization of such plants are accepted to have happened regularly in a similar way that food plants were gathered.

All necessary requirements of life from medicine to shelter and food to fibre are gained from forests' vegetation. [10]. If the processing of raw woodland material which produce wood, branches, logs and fibres for creating different merchandise that had been useful in every day life for sustainable livelihood [11].

It was estimated that 2500 plant species are recommended internationally as medicinal purpose. The percentage of use value of medicinal plants ranges between 4 - 20 % in different countries of the world. Similarly, it was observed about 6000 higher plant species are used for medicinal purposes in different locations, their falls between 10 – 30 % of the flora of Pakistan. The use of medicinal plants is very important in rural and tribal areas of Pakistan where as it is considered as initial treatment against different diseases remedies [12].

Some therapeutic plants are financial and utilized in treatment of certain sicknesses. An aggregate of 59 plants species were utilized for fourteen distinct classifications of illnesses, for example, skin ailment. Restorative greenery, for example, *Berberis lyceum*, *Ajuga bracteosa*, *Aconitum heterophyllum*, *Bistorta amplexicaule*, *Saussurea lapa* and *Jurinea dolomiaea* are on the edge of eradication due to over misuse [13].

The ethnomedicinal information were accumulated from various region of Punjab Pakistan through polls and broad individual discoursed with local people including 40 guys 20 females of different age bunches between 50 to 80 years and furthermore dark-striped cats and hakims. Around 40 plant species having a place with 22 families were explored which are used by local individuals to fix issues and sicknesses, for example, asthma, ulcer, gonorrhoea, heaps, stomach agony, and skin illnesses. The outcomes exhibited that the zone is wealthy in vegetation yet remained organically unexplored [14].

The ethnobotanical concentrates on trees of region Kotli, Azad Kashmir uncovered conventional use of 50 tree spp., having a place with 39 genera and 24 families with Moraceae, the most well-known family having 9 species. The regular use of tree was restorative, fuel and grain. The phonological examinations uncovered that 65% of the species bloomed from the period of August forward or in winter season [15].

The ethnobotanical assessment on the restorative plants of Darguti, Tehsil Khairatta, Azad Jammu and Kashmir was perceived during 2014-2015 by meeting the neighborhood occupants through a poll. A sum of 100 plant species having a place with 47 families were reported. It was noticed that individuals utilize plants as vegetables and grain, fuel just as therapeutic commitments. Neighborhood individuals use treatment of various ailments like lockjaw, diabetes, looseness of the bowels, asthma, kidney contamination, clogging, gastric ulcer, bronchial illnesses, gonorrhoea, scabies, throat aggravation and numerous sorts of skin maladies with nearby plants [16].

The utilization of customary ethnomedicinal by the nearby seniors of Area Mirpur Azad Jammu and Kashmir saw by mehmood and his partners. Ethnomedicinal information was gathered by mean of poll strategy, meets and direct perception. An aggregate of 38 plant species having a place with 22 families were accounted for of hurling ethnomedicinal use. About 13 hakims and 78 local people were visited to collect ethnomedicinal data [2]. The ethnobotanical estimations of the most normally utilized plants of the Neelum Valley AJ&K, investigated and gives an account of the indigenous information on various networks of the examination zone [17].

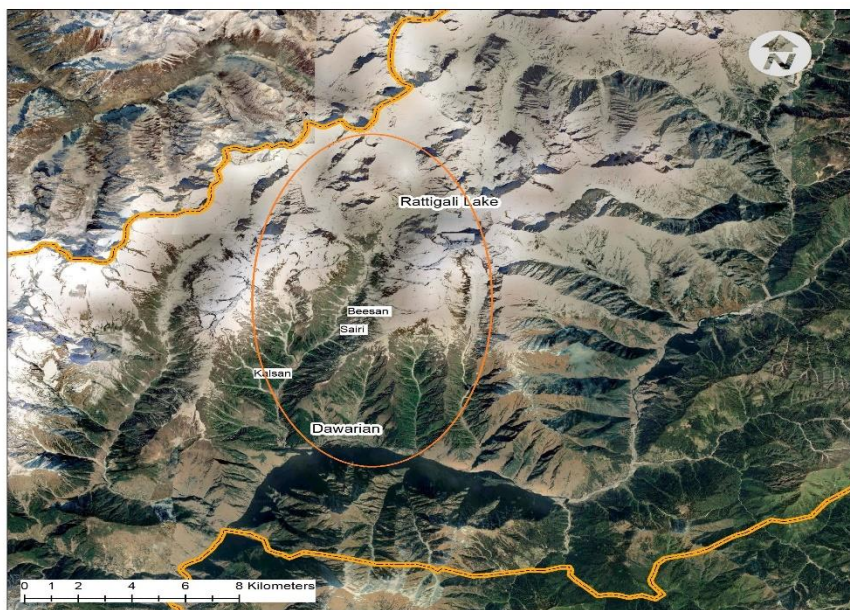
The State of Azad Jammu and Kashmir (AJ&K) is declared as diverse habitats, variable climatic conditions and appropriate fertile soil with rich nutrients [18–19]. It has variety of natural resources particularly rich in medicinal plant flora [20]. The state of AJK has a wide range of mountainous ecosystems which are affluent in flora and fauna. The area of Azad Kashmir has scrub forest, alpine and grasslands ecosystem as vegetational categories. Anthropogenic and other natural hazards depicted a high effect on the ecosystems of the areas [21].

The examination zone "Neelum Valley" is arranged North-East of Muzaffarabad at an elevation of 900-6325 meters above ocean level. It lies between 73°-75° E longitude and 32°-35° N scope [22]. It is the biggest vale of Azad Jammu and Kashmir (AJ&K) covering a territory of 3737 Km. Dawarian town is arranged at 110 km north of the capital Muzaffarabad and is around

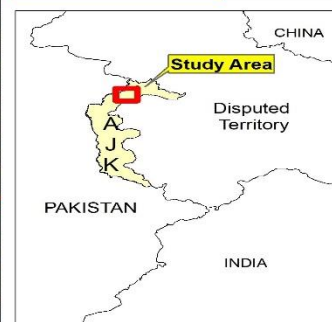
5299 ft over the ocean level. The atmosphere is calm with freezing winters (normal 0-4 °C) and moderate summers (normal temperature 20-30 °C). Normal precipitation is 1650 mm yearly. The territory has different sorts of landforms and little levels. Soil is loamy and sandy topsoil, fit for holding dampness and great development of woodlands. Larger part of the region is secured with thick vegetation and woods trees [23]. The sampling site “Ratti Gali” is situated at 19 km from Dawarian and is about 12130 ft above the sea level. It lies between 74°-76° E longitude and 34°-36° N latitude [22]. Vegetation mainly consist of herbs and shrubs with some tree species. Ratti Gali is famous place because of lake know as Ratti Gali lake which is an alpine glacial lake. The territory has inadequately evolved street and other foundation. Principle crops incorporate corn (*Zea mays* L.), turnip (*Brasica rapa* L.), and bean (*Phaseolus vulgaris* L.) in a coordinated framework. A high extent of nearby individuals are related with animals [24].

Many plant species used as ethomedicines in different areas of AJ&K. The older indigenous peoples of Azad Kashmir have more ethnobotanical knowledge of plant species as comparison to younger ones [24]. However, the current research area is rarely reported except few plant species. Many species of the study were unexplored and reported first time in this paper. Therefore, the present research paper was focused on social and geographical characteristics of different study sites. Then all types of plants were collected for identification, preservation and exposed their ethnobotanical uses. To document the indigenous knowledge of wild plant from Dowariyan and Rati Gali. To explore the indeginous use of plants by local communities. Other key medicinal values and differernt perspectives for better livelihood were also observed and highlighted. Floristic composition of various species compiled for further novel and authentic ethnobotanical exploration. All data was analysed by different statistical tools for more accurate and significant assessment of all identified plant species with special reference to ethnomedicinal importance from the selected study area of District Atmokam, Azad Kashmir, Pakistan and their future perspective as for pharmaceutical analysis. The research will also assist in conservation of the precious medicinal flora of the area.





Overview Maps:



Map of the study area that indicated study sites in circle

## Materials and methods

The current ethnobotanical analysis was conducted during the year 2019 from Dawarian to Rati Gali sites of District Athmaqam Neelum Valley, Azad Jammu and Kashmir.

### *Ethnobotanical information collection*

Ethnobotanical informations were gathered from the local peoples of the study area by random visits with help of local guide or translator. The data collected from the local people indicate local name, local uses, recipe, part used, occurrence, characters involved in the collection, marketing and other related information. The plants of Dawarian and Rati Gali District Athmaqam Neelum valley were categorized according to their economic value such as medicinal, fodder, vegetable, thatching and fuel wood etc. through meeting poll from various individuals however inclination was given to neighborhood senior individuals, who had a ton of data about the plants and their customary employments. Survey and observations added more information in literature [24]. Various age bunches were perceived and organized based on 10 years' age contrast. The 60-70 age bunch was more educated therefore close to home understanding.

### **Data collection by questionnaire method**

For obtaining our concerned objectives questionnaire method using open and close-ended interview was applied to extract useful data from the local people and herbalists. About 40 informants were interviewed of both the genders randomly for obtaining ethnobotanical data. Our informants consist of local people. Informants were asked about the plants they used in the treatment of different ailments. The interviewer also briefed us that how a particular plant is used, its dosage form, its part used and also the recipe of plant used for the treatment of certain diseases [25]. In the open-ended interviews, people were allowed to speak openly about the plants used for the treatment of different diseases. The researcher interviewed the people in their local language so as to extract allmost and reliable information from the people following protocol of Thompson [25] with some modifications.

### ***Plant samples collection and identification***

The plant examples were gathered from the study zone. They were dried, squeezed and mounted appropriately and submitted in Herbarium, (MUH). MUST, Bhimber Campus, AJ&K with voucher numbers for additional reference. They were related to the assistance of vegetation of Pakistan [19] and properly identified plants were kept for future reference.

### ***Data analysis***

Data analysis was conducted by using different quantitative ethnobotanical tools. The dependability and legitimacy of ethnobotanical research work and data was checked and upheld by calculating informant consensus factor (ICF), fidelity level (FL) and Family index (FI) and spearman's rank correlation followed by previous botanists [26, 27].

### ***Fidelity level (FL)***

The fidelity level (FL) is the level of witnesses guaranteeing the utilization of certain plant for a similar object, was determined for the most habitually revealed by usage or ailments as:

$$FL (\%) = N_p / N \times 100$$

Where,  $N_p$  indicated the number of informants that claim a use of plant species used for a particular purpose/ disease, and  $N$  is mentioned the number of informants that use the plant as a medicine to treat any given disease. This statistical tool was also applied by Farooq and his group [26].

### ***Informants consensus factor (ICF)***

ICF identifies the agreement of the informants on the reported medicines for the group of ailments. It was calculated by the following equation:

$$ICF = \frac{n_{ur} - n_t}{n_{ur} - 1}$$

Where  $n_{ur}$  = number of used citation in each category and  $n_t$  = number of specie used. This method is used for further examinations in drug investigation and other exploration ventures [28].

### ***Family index (FI)***

Family index is also calculated to check the member of which family is mostly used to cure against different diseases [13].

### ***Direct Matrix Ranking (DMR)***

Direct matrix ranking was applied which depicts populace thickness of plant species and their protection status in the investigation territory. DMR depicts highest biotic pressure on the plants which are most commonly used by the local people in the investigated area for the treatment of various ailments [24].

### ***Spearman's correlation test***

In spearman's rank correlation, analysis was calculated about indigenous knowledge of male and female to find out the fact that whether male have better knowledge than female or not as well as to explore correlation of number of uses with number of plants. It was proved that the number of uses of plants also increases as the number of plants species increases. It is calculated as:

$$r_s = 1 - 6 \left[ \frac{\sum d^2}{n(n^2 - 1)} \right]$$

Where  $d^2$  is the square of the sum of the ranks and n is the number of informants [29].

## **Results and discussion**

The present ethnobotanical examination persual generated a checklist of plants of Dawarian and Rati Gali, District Athmaqam, Azad Jammu and Kashmir, Pakistan. In this study, some medicinal plants were explored first time from the study area occurring at high elevated sites for detailed phytochemical and ethnopharmaceutical research point of view. Ethnobotanical as well as ethnomedicinal explorations were also elaborated in consise form after identification of each plant species. Individuals of the examination territory generally use plants and trees for different purposes such as fodder, wood, medicine, food and other purposes.

In the recent study it is observed and investigated that the local community of study areas used wild plant species for fulfillment of their daily life needs such as medicines, as food/vegetables, silage for animals, for fuel use and to making household tools and construct their houses. Local people of area collect the medicinal plants and used them for various ailments for human being as well as to cure the many diseases of their domestic animals. *Berberis lycium*, *Oxyria digyna*, *Aconogonon alpinum* were most important plants in the study area. Local community of study areas 90% depends on the livestock as the source of income. Similar studies on the plant species of Neelum Valley, Azad Jammu and Kashmir, Pakistan were documented by

Mahmood and his research group [17]. In which 40 plant species having a place with 31 families were discovered to be important for therapeutic, food, grain/scavenge, fuel, lumber, cover and farming purposes. Neighborhood individuals utilized indigenous plants for their basic ailments. e.g., *Berberis lycium*, *Podophyllum hexandrum*, *Oxyria digyna*, *Rheum austral*, *Aconogonon alpinum*, *Angelica cyclocarpa* and *Geranium wallichianum* were most important plants from the study area.

The Table 1 indicated 6 social comparisons between two observed sites names as Dawarian and Rati Gali prior to plants collection and identification for ethnomedicinal study. These characters' observation directly correlates with plants distribution in the study area. It was observed that more families (52), number of informants (12), average number of families (15-8) and livestock dependence (90%) maximum in Dawarian site as comparison to Rati Gali. These findings were indicated that less number of plants and their minimum diversity appeared Dawarian site. These findings were strongly supported by some ethnobotanist who conducted research on this and orther allied areas of AJK [24, 28].

Table 1: Social characteristics of the variable samples between two study sites: Ratia Galli and Dewarian of Dist. Atmaqam of Azad Jammu and Kashmir

S.No	Social characteristics	Dawarian	Rati Gali
1	number of families	52	8
2	number of informants	12	5
3	Reliance on livestock as an income source	90%	30%
4	Average age of informants	70-50	40-30
5	Average number of family members	15-8	10-3
6	Migration ratio	70%	100%

Different geographic characteristics like topography, area climates, population size, altitude/elevation and vegetation size were measured in Table 2. It was observed that Dawarian has 1615 feet altitude while Rati Gali present at 3700 feet high. This huge elevation difference showed diversity in geographic characteristics [22].

**Table 2** Geographical characteristics observation of the two study sites: Ratia Galli and Dewarian of Dist. Atmaqam of Azad Jammu and Kashmir

S. No.	Sites	Elevation (m)	Geographical characteristics
1	Dawarian	1,615	The village has very fertile soil and thick vegetation. Village has ever green thick forest of <i>Pinus wallichiana</i> . It is mountainous area. Population of the village is small sized but the area is huge.
2	Rati Gali	3,700	This area is located at high altitude. Vegetation mainly consist of herbs or shrubs. There is very low population but area is huge. People migrates here with their domestic animals in summers from different areas.

### ***Plants collection, identification and preservation***

The plants were gathered from the selected towns of District Atmakam, AJK. The plants were identified mainly with the help of Flora of Pakistan. The specimens were submitted in Herbarium, Department of Botany, MUST, Bhimber Campus with voucher numbers for further reference. Family-wise inventory of the plants was given in Table 3. Total 103 plants were identified from the study area with their family names, habit observed (herb, shrub or tree) and local name of each plant elaborated in the Table 3. Similar findings were counted by other taxonomists in other countries [30].

**Table 3** Family-wise Inventory of some plants of Dawarian to Ratti Gali, District Athmaqam Azad Jammu and Kashmir

Sr. No.	Family	Sr. No.	Species	Habit	Local name
1	Astraceae	1	<i>Achillea millefolium</i> L.	Herb	Gandana
		2	<i>Artemisia japonica</i> Thunb.	Herb	Chaou
		3	<i>Anaphalis triplinervis</i> Clarke	Herb	Butt mehndi
		4	<i>Artemisia macrophylla</i> Fisch. ex Besser	Herb	Chita chaou
		5	<i>Gerbera gossypina</i> (Royle) Beauverd	Herb	Kofe
		6	<i>Ligularia thomsonii</i> (Clarke) Pojark.	Herb	Jungli surajmukh
		7	<i>Matricaria chamomilla</i> L.	Herb	Tamak boti
		8	<i>Saussurea lappa</i> (Decne.) Sch.Bip.	Herb	Khut
		9	<i>Cirsium arvense</i> (L.) Scop.	Herb	Jungli kandyara
		10	<i>Sonchus asper</i> (L.) Hill	Herb	Dhodol
		11	<i>Senecio chrysanthemoides</i> DC.	Herb	Chir hand
		12	<i>Solidago virgaurea</i> L.	Herb	Pinja phool
2	Amaryllidaceae	13	<i>Allium griffithianum</i> Boiss.	Herb	Jungli pyaz
3	Araceae	14	<i>Arisaema tortuosum</i> (Wall.) Schott	Herb	Sanp ki boti
4	Aquifoliaceae	15	<i>Ilex dipyrena</i> Wall.	Tree	Kandaro
5	Anacardiaceae	16	<i>Rhus succedanea</i> L.	Tree	Alkhal

6	Berberidaceae	17	<i>Berberis lycium</i> Royle	Shrub	Sumbal
		18	<i>Podophyllum hexandrum</i> Royle	Shrub	Ban kukri
		19	<i>Podophyllum emodi</i> Wall. ex Hook.f. & Thomson	Shrub	Tra patra
7	Buddlejaceae	20	<i>Buddleja crispa</i> Benth.	Shrub	Gansu
8	Buxaceae	21	<i>Buxus wallichiana</i> Baill.	Herb	Chiriri
		22	<i>Sarcococca saligna</i> Müll.Arg.	Shrub	Shangal
9	Boraginaceae	23	<i>Cynoglossum lanceolatum</i> Forssk.	Herb	Chiro
		24	<i>Onosma bracteata</i> Wall.	Herb	Gao zuban
10	Betulaceae	25	<i>Corylus colurna</i> L.	Tree	Aurni
11	Brassicaceae	26	<i>Erysimum hieraciifolium</i> L. f.	Herb	Mirchi
		27	<i>Erysimum hedgeanum</i> Al-Shehbaz	Herb	Maneera
12	Convolvulaceae	28	<i>Convolvulus arvensis</i> L.	Herb	Berrhi
		29	<i>Cuscuta reflexa</i> Roxb.	Herb	Neela tari
13	Campanulaceae	30	<i>Campanula pallida</i> Wall.	Herb	Bikh
14	Colchicaceae	31	<i>Colchicum luteum</i> Baker	Herb	Sorinjan
15	Celastraceae	32	<i>Euonymus hemsleyanus</i> Loes.	Tree	Seeki
16	Crassulaceae	33	<i>Hylotelephium ewersii</i> (Ledeb.) H.Ohba	Herb	Loon salooni
17	Cupressaceae	34	<i>Juniperus communis</i> L.	Tree	Bentheri
18	Caprifoliaceae	35	<i>Morina persica</i> L.	Herb	Bekh-e-Akwar
		36	<i>Valeriana jatamansi</i> Jones	Herb	Panchi hola
		37	<i>Viburnum cotinifolium</i> D. Don	Shrub	Ukloo
19	Caryophyllaceae	38	<i>Silene vulgaris</i> (Moench) Garcke	Herb	Murkun
20	Fumariaceae	39	<i>Corydalis govaniana</i> Wall.	Herb	Bhutkas
		40	<i>Corydalis vaginans</i> Royle	Herb	Mameri
21	Geraniaceae	41	<i>Geranium rotundifolium</i> L.	Herb	Ratan jut
		42	<i>Geranium villosum</i> Ten.	Herb	Gull-e-attar
22	Gentianaceae	43	<i>Swertia paniculata</i> Wall.	Herb	Charyta

23	Juncaceae	44	<i>Juncus articulatus</i> L.	Herb	Jungli ghash
24	Lamiaceae	45	<i>Ajuga parviflora</i> Benth.	Herb	Chita chaou
		46	<i>Ajuga bracteosa</i> Wall	Herb	Janeadam
		47	<i>Clinopodium vulgare</i> L.	Herb	Asaba-el-fetiyal
		48	<i>Elsholtzia strobilifera</i> Benth.	Herb	Perilla
		49	<i>Isodon rugosus</i> Codd.	Shrub	Pemar
		50	<i>Mentha longifolia</i> L.	Herb	Pahari podina
		51	<i>Origanum vulgare</i> L.	Herb	Nazbu
		52	<i>Phlomis bracteosa</i> Royle.	Shrub	Kukarjari
		53	<i>Scutellaria linearis</i> Benth.	Herb	Birch
		54	<i>Thymus linearis</i> Benth.	Herb	Ban jamani
25	Oxalidaceae	55	<i>Oxalis corniculata</i> L.	Herb	Khatimili
26	Orobanchaceae	56	<i>Pedicularis brevifolia</i> D.Don	Herb	Khasturi
27	Orchidaceae	57	<i>Satyrium nepalense</i> D.Don	Herb	Gagun
28	Papilionaceae	58	<i>Astragalus graveolens</i> Benth.	Herb	Ban phali
		59	<i>Astragalus heratensis</i> Bunge	Shrub	Phut Kanda
		60	<i>Indigofera heterantha</i> Brandis	Shrub	Kanthi
		61	<i>Lespedeza juncea</i> (L.f.) Pers.	Herb	Kanthi ranga
		62	<i>Vicia sativa</i> L.	Herb	Chiri panja
		63	<i>Trifolium repens</i> L.	Herb	Sinja
29	Pteridaceae	64	<i>Adiantum aethiopicum</i> L.	Herb	Kahkawa
		65	<i>Onychium japonicum</i> (Thunb.) Kunze	Herb	Kangu
30	Polygonaceae	66	<i>Aconogonon alpinum</i> (All.) Schur	Herb	Chikro
		67	<i>Bistorta amplexicaulis</i> (D.Don) Greene	Herb	Masloon
		68	<i>Oxyria digyna</i> (L.) Hill	Herb	Kakri
		69	<i>Persicaria mitis</i> (Schrank) Holub	Herb	Pahari masloon



		70	<i>Rheum emodi</i> Wall.	Herb	Chit patra
		71	<i>Rheum australe</i> D. Don	Herb	Chutyal
31	Polygalaceae	72	<i>Polygala chinensis</i> L.	Herb	Sanp ki jari
32	Pinaceae	73	<i>Abies pindrow</i> Royle	Tree	Partal
		74	<i>Cedrus deodara</i> Don	Tree	Davdaar
		75	<i>Pinus wallichiana</i> Jacks.	Tree	Kayal
		76	<i>Pinus roxburghii</i> Sarg.	Tree	Cheer
		77	<i>Picea smithiana</i> (Wall.) Boiss.	Tree	Kachal
33	Poaceae	78	<i>Bromus pectinatus</i> Thunb.	Herb	Pero
		79	<i>Cenchrus pennisetiformis</i> Steud.	Herb	Lidder
		80	<i>Digitaria cruciata</i> (Nees) A.Camus	Herb	Ghaa
		81	<i>Sorghum halepense</i> (L.) Pers.	Herb	Baru
34	Primulaceae	82	<i>Primula denticulata</i> Sm.	Herb	Mamera
35	Plantaginaceae	83	<i>Plantago lanceolata</i> L.	Herb	Kala chamchi part
		84	<i>Wulfenia amherstiana</i> Benth.	Herb	-----
36	Ranunculacea	85	<i>Actaea spicata</i> L.	Herb	Moneeri
		86	<i>Aconitum heterophyllum</i> Wall. ex Royle	Herb	Ptrees
		87	<i>Caltha alba</i> Cambess.	Herb	Makanpath
37	Rosaceae	88	<i>Cotoneaster microphyllus</i> Wall. ex Lindl.	Herb	Loni
		89	<i>Rosa microphylla</i> Roxb. ex Lindl.	Shrub	Shigari
		90	<i>Rubus niveus</i> subsp. <i>horsfieldii</i> (Miq.) Focke	Shrub	Pakana
		91	<i>Fragaria nubicola</i> (Lindl.) Lacaita	Herb	Mehwa
38	Rutaceae	92	<i>Skimmia laureola</i> Franch.	Shrub	Neri
39	Sapindaceae	93	<i>Acer cappadocicum</i> Gled.	Tree	Tera Kanna
		94	<i>Aesculus indica</i> Hook.	Tree	Ban khaur

40	Saxifragaceae	95	<i>Bergenia ciliata</i> Sternb.	Herb	Betbewa
41	Sabiaceae	96	<i>Meliosma simplicifolia</i> Walp.	Shrub	Bakhaish
42	Salicaceae	97	<i>Populus alba</i> L.	Tree	Sufaida
		98	<i>Salix tetrasperma</i> Roxb.	Tree	Bheens
43	Symplocaceae	99	<i>Symplocos paniculata</i> (Thunb.) Miq.	Shrub	Ludder
44	Taxaceae	100	<i>Taxus baccata</i> L.	Tree	Thuni
45	Violaceae	101	<i>Viola biflora</i> L.	Herb	Phul naqsh
		102	<i>Viola canescens</i> Wall.	Herb	Thandi jari
46	Viscaceae	103	<i>Viscum album</i> L.	Shrub	Purakh

### ***Ethnobotanical data of wild plants***

Ethnobotanical data of wild plants including voucher number, local names, botanical family, parts used, gathering period and traditional uses were compiled in Table 4. Among them Asteraceae having 12 (11.65%) species, Lamiaceae having 9 (8.73%) whereas Polygonaceae having 7 (6.79%) species, respectively. Papilionaceae having 6 (5.82%) species. Poaceae and Rosaceae each having 4 (3.88%) species while Berberidaceae, Caprifoliaceae and Ranunculaceae each having 3 (2.91%) species. Buxaceae, Boraginaceae, Brassicaceae, Convolvulaceae, Fumariaceae, Geraniaceae, Pteridaceae, Plantaginaceae, Spindaceae, Salicaceae and Violaceae each having 2 (1.94%) species., Amaryllidaceae, Araceae, Aquifoliaceae, Buddlejaceae, Butelaceae, Campanulaceae, Colchicaceae, Celastraceae, Crassulaceae, Cupressaceae, Caryophyllaceae, Gentianaceae, Juncaceae, Oxalidaceae, Orobanchaceae, Orchidaceae, Primulaceae, Rutaceae, Saxifragaceae, Sabiaceae, Symplocaceae, Taxaceae and Viscaceae each having 1 (0.97%) species. A pie-chart of all families having number of species given in (Fig.1).

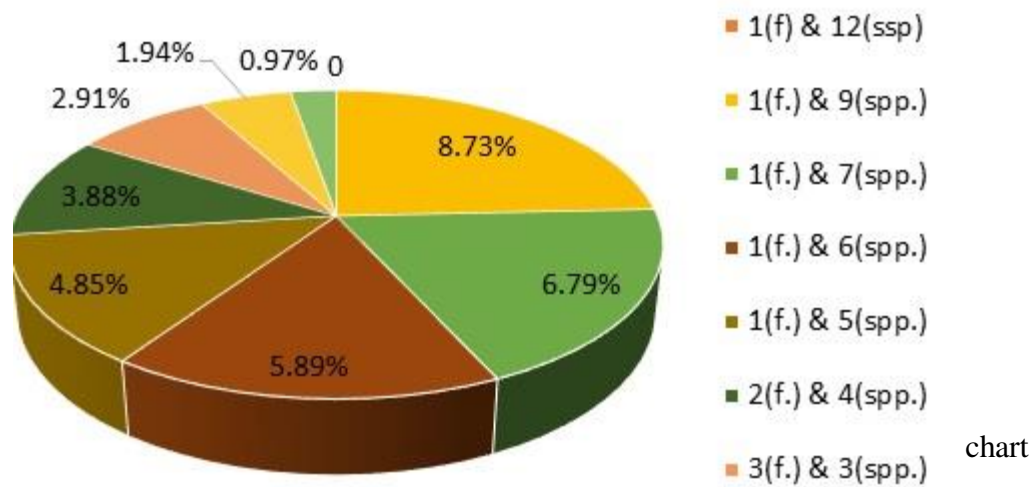


Fig. 1 A pie of species

contribution in each family from study area, Azad Jammu and Kashmir

In the investigated area total 103 plant species belonging to 37 families were recorded. Asteraceae was the dominant family of study area with 12 plant species. Somewhat similar ethnomedicinal study was conducted by many researchers on 59 plant species belonging to 35 families being used by local people District Athmaqam, Neelum valley, Azad Jammu and Kashmir [13]. In which Asteraceae was the dominant family of the study area with 8 plant species. These previous findings were strongly correlated and supported our study.

The present study provides information about different uses of 103 plant species belonging to 46 families. We found that 78 species (75%) had single use, 21 species (20%) had dual uses and 4 species (3%) had multi uses. Single usage plants have been categorized into medicinal, fodder, food and fuel. Among 78 single usage plant species 45 species (58%) had medicinal uses, 15 species had food and fodder values each and 3 species (3%) had fuel values. Double usage plant species had been classified into six different categories. Among 21 species, (33%) had medicinal and food, fodder and food uses. While (14%) had medicinal plus fodder values, (9%) had fodder and fuel uses, (4%) had medicinal plus fuel and medicinal plus condiments values. Multi usage plants have classified into three categories. Among 4 plant species (50%) were used as medicinal, furniture, fuel and house thatching, (25%) were used as fodder, ropes, fuel and medicinal, food and fodder. Similar study was conducted on the plants of District Kotli, Azad Jammu and Kashmir, Pakistan [6]. They investigated 93 plants species belonging to 46 families in which 49 (52.68%) plants for single usage, 35 (37.63%) for double purposes and 7 (7.52) for three purposes and 2

(2.15%) for multi purposes. Some other researchers were also explored ethnobotanical importance and use of medicinal plants from Khyber Pakhtoonkwa province of Pakistan [31].

**Table 4** Traditional ethnobotanical uses of wild plant species recorded from Dawarian to Ratti Gali, District Atmakam, Azad Jammu and Kashmir

S. No.	Species name	Family	Collecting Period	Part used	Traditional uses
1	<i>Acer cappadocicum</i> Gled.	Sapindaceae	Summer	Leaves, Wood	Leaves are used as fodder. Wood is used as fuel for domestic.
2	<i>Ajuga bracteosa</i> Wall.	Lamiaceae	Summer	Whole plant	Root extracts are used for purification of blood. Paste of leaves helpful to cure headache while powder of whole plant is given to treat abdominal pain.
	<i>Ajuga parviflora</i> Benth.	Lamiaceae	Summer	Whole plant	It is used as fermifuged. It is used as fodder.
3	<i>Allium griffithianum</i> Boiss.	Amaryllidaceae	Summer	Leaves	It is used to cure fever and cough. It is used as food.
4	<i>Aconogonon alpinum</i> (All.) Schur	Polygonaceae	Summer	Whole plant	Leaves are used as food. Root is used for the treatment of joints pain.
5	<i>Actaea spicata</i> L.	Ranunculaceae	Summer	Roots	Juice of roots is used to kill lice.
6	<i>Aesculus indica</i> (Wall. ex Cambess.) Hook.	Spindaceae	Summer	Whole plant	Leaves are used as fodder. Wood and stem is used as fuel.
7	<i>Aconitum heterophyllum</i> Wall. ex Royle	Ranunculaceae	Summer	Root	Roots are used for the treatment of fever, vomiting, dysentery, flu cough and abdominal pain with boiled milk.
8	<i>Abies pindrow</i> Royle.	Pinaceae	Summer	Leaves	The paste of the leaves apply on cuts wounds bruises to get rid of bacteria and germs.
9	<i>Achillea millefolium</i> L.	Asteraceae	Summer	Whole plant	Paste prepared from this plant is used in stanching the flow of blood from wounds. Leaves are chewed to treat teeth pain. Leaves juice is poured in ear to treat ear pain. plant is also used to treat T.B., stomach disorder and fever in form of Tea.
10	<i>Artemisia japonica</i> Thunb.	Asteraceae	Summer	Leaves	The juice of leaves is used for cough and asthma.
11	<i>Anaphalis triplinervis</i> Clarke	Asteraceae	Summer	Whole plant	The paste of whole plant is used as tonic for animals.
12	<i>Artemisia macrophylla</i> Fisch. ex Besser	Asteraceae	Summer	Leaves, Shoot	Leaves are used for cough and asthma. Shoot is used for fodder.
13	<i>Astragalus graveolens</i> Benth.	Papilionaceae	Summer	Fruit	Fruit is eatable.
14	<i>Ajuga parviflora</i> Benth	Lamiaceae	Summer	Whole plant	It is used as fodder.

15	<i>Adiantum aethiopicum</i> L.	Pteridaceae	Summer	Leaves	Juice of leaves is used for the treatment of chest burning, stomachache and blood purification.
16	<i>Arisaema tortuosum</i> (Wall.) Schott	Araceae	Summer	Whole plant	The roots are used as wormicide. The extract of leaf is used to cure cattle worms and stomach issues. The dried tubers are used as cure of snake poison.
17	<i>Astragalus chlorostachys</i> Bunge	Papilionaceae	Summer	Whole plant	The plant is used as fodder for the livestock and cattle.
18	<i>Bergenia ciliata</i> (Haw.) Sternb.	Saxifragaceae	Summer	Whole plant	Extracts of leaves is used as earaches relieve while roots are used as a tonic in treatment of fevers, diarrhoea and pulmonary affections.
19	<i>Bromus pectinatus</i> Thunb.	Poaceae	Summer	Whole plant	It is used as fodder.
20	<i>Berberis lycium</i> Royle	Berberidaceae	Summer	Leaves	Dried leaves are used for the treatment of headache, stomachache, joints pain and toothache. Boiled water of roots is used to treat internal wounds, especially bone fracture.
21	<i>Bistorta amplexicaulis</i> (D. Don) Greene	Polygonaceae	Summer	Root, Leaves	Dried roots are used in making tea. The herbaceous roots are also used as fodder or cattle.
22	<i>Buddleja crispa</i> Benth.	Buddlejaceae	Summer	Whole plant	It is used as fodder.
23	<i>Buxus wallichiana</i> Baill.	Buxaceae	Summer	Leaves	Dried leaves are used in the treatment of joints pain and muscles pain.
24	<i>Convolvulus arvensis</i> L.	Convolvulaceae	Summer	Leaves	Leaves are used as vegetable. It is also used as fodder.
25	<i>Cirsium arvense</i> (L.) Scop.	Astraceae	Summer	Whole plant	Powdered form mix with water is used as tonic.
26	<i>Campanula pallida</i> Wall.	Campanulaceae	Summer	Whole plant	It is used as fodder.
27	<i>Cynoglossum lanceolatum</i> Forssk.	Boraginaceae	Summer	Whole plant	The foliar past is applied on abscess to remove pus. It is also used in asthma.
28	<i>Cuscuta reflexa</i> Roxb.	Convolvulaceae	Summer	Whole plant	Juice of the whole plant used to increase the length of hairs and make strong. It is also used as fodder.
29	<i>Cedrus deodara</i> (Roxb. ex D. Don) G. Don	Pinaceae	Summer	Wood	Oil of wood is used for toothache, applied to skin for skin problems. Wood is also used as fuel.
30	<i>Colchicum luteum</i> Baker	Colchicaceae	Summer	Whole plant	Juice of plant is used for purification of blood.
31	<i>Corylus colurna</i> L.	Butalaceae	Summer	Fruit	Fruit is eatable.
32	<i>Corydalis vaginans</i> Royle	Fumariaceae	Summer	Sap	The sap of the plant is used in the treatment of eye diseases.

33	<i>Cotoneaster microphyllus</i> Wall. ex Lindl.	Rosaceae	Summer	Whole plant	It is used as fodder for cattle and goats.
34	<i>Corydalis govaniiana</i> Wall.	Fumariaceae	Summer	Leaves	Juice of leaves is used for the treatment of fever and skin problem.
35	<i>Caltha alba</i> Cambess.	Ranunculaceae	Summer	Whole plant	Dried powdered or juice of this plant is used to reduce muscle pain and sedative.
36	<i>Cenchrus pennisetiformis</i> Steud.	Poaceae	Summer	Whole plant	It is used as fodder for cattle and rodents.
37	<i>Clinopodium vulgare</i> L.	Lamiaceae	Summer	Leaves	A sweet and aromatic herb tea is made from the fresh leaves.
38	<i>Digitaria cruciata</i> (Nees) A.Camus	Poaceae	Summer	Whole plant	It is used as fodder for cattle and goats.
39	<i>Erysimum hieracifolium</i> L. f.	Brassicaceae	Summer	Whole plant	It is used as food and source of vegetable.
40	<i>Erysimum hedgeanum</i> Al-Shehbaz	Brassicaceae	Summer	Whole plant	This is poisonous herb. The juice of whole plant is use to kill lices in animals.
41	<i>Euonymus hemsleyanus</i> Loes.	Calastraceae	Summer	Whole plant	It is used as fodder cattle and rodents.
42	<i>Elsholtzia strobilifera</i> (Benth.) Benth.	Lamiaceae	Summer	Whole plant	It is used as fodder cattle and rodents.
43	<i>Fragaria nubicola</i> Lacaita	Rosaceae	Summer	Fruit	Fruit is eatable and used as antioxidant agent.
44	<i>Geranium rotundifolium</i> L.	Geraniaceae	Summer	Root, Leaves	Dried root powder is doted on wounds. The dried roots were grinded, sugar and milk are added in it, and then used for pain relief of joints.
45	<i>Geranium villosum</i> Ten.	Geraniaceae	Summer	Whole plant	It is used as food for cure of edema.
46	<i>Gerbera gossypina</i> (Royle) Beauverd	Asteraceae	Summer	Whole plant	It is used as fodder cattle and rodents.
47	<i>Hylotheplium ewersii</i> (Ledeb.) H.Ohba	Crassulaceae	Summer	Leaves	It is believed to be having cooling effect if the juice of the leaves mix with water and drink.
48	<i>Ilex dipyrena</i> Wall.	Aquifoliaceae	Summer	Leaves	It is used as fodder. It is also the source of fuel and wood.
49	<i>Indigofera heterantha</i> Brandis	Papilionaceae	Summer	Shoots	Shoots are used as fodder, branches as ropes, brooms and fuel.
50	<i>Isodon rugosus</i> (Wall.) Codd	Lamiaceae	Summer	Leaves	Juice of the leaves is used for stomachache.

51	<i>Juncus arcuatus</i> Wahlenb.	Juncaceae	Summer	Whole plant	It is used as fodder cattle and rodents.
52	<i>Juniperus communis</i> Brand.	Cupressaceae	summer	Wood	It is the source of fuel and commercial wood.
53	<i>Lespedeza juncea</i> (L.f.) Pers.	Papilionaceae	Summer	Leaves	It is used as fodder cattle and rodents.
54	<i>Ligularia thomsonii</i> Clarke.	Asteraceae	Summer	Root	Dried root or powdered of root is used in the treatment of asthma, stimulate blood flow, reduce inflammation and stopping cough.
55	<i>Mentha longifolia</i> L.	Lamiaceae	Summer	Whole plant	Shoot is used for stomachache and gas trouble. Juice of leaves expels worms from the stomach. It is also as condiment.
56	<i>Matricaria chamomilla</i> L.	Asteraceae	Summer	Root	Root is used for toothache.
57	<i>Morina persica</i> L.	Caprifoliaceae	Summer	Aerial parts	It is used for treatment of cold.
58	<i>Meliosma simplicifolia</i> (Roxb.) Walp.	Sabiaceae	Summer	Leaves, Wood	Leaves are used as fodder. It is also source of fuel.
59	<i>Oxalis corniculata</i> L.	Oxalidaceae	Summer	Leaves, Flowers	Juice of leaves and flowers mixed together is used for the treatment of eyes.
60	<i>Onychium japonicum</i> (Thunb.) Kunze	Pteridaceae	Summer	Whole plant	It is used as vegetable. Dried root or powdered root is used for the treatment of asthma and flu.
61	<i>Oxyria digyna</i> (L.) Hill	Polygonaceae	Summer	Shoot	Shoot extracts are used for constipation, liver disorders and stomachache.
62	<i>Onosma bracteata</i> Wall.	Boraginaceae	Summer	Whole plant	Powder of dry root is used against asthma and bronchitis. Decoction of leaves is given in stomach and bladder irritation.
63	<i>Origanum vulgare</i> L.	Lamiaceae	Summer	Whole plant	It is used for muscles pain, cold and toothache. It is also as vegetable and fodder.
64	<i>Polygala chinensis</i> L.	Polygalaceae	Summer	Whole plant	This plant is used for treatment of snake bites.
65	<i>Phlomis bracteosa</i> Royle ex Benth.	Lamiaceae	Summer	Leaves, Flowers	Powdered leaves are mixed in tea and used against cough and cold. Flowers are crushed and used against toothache.
66	<i>Pedicularis brevifolia</i> D. Don	Orobanchaceae	Summer	Leaver, Root	Powdered leaves is used for the treatment of cough, fever, asthma and skin disease. Dried or powdered root is used for the treatment of stomachache.
67	<i>Primula denticulata</i> Sm.	Primalaceae	Summer	Stem	Juice of stem is used for eye diseases.



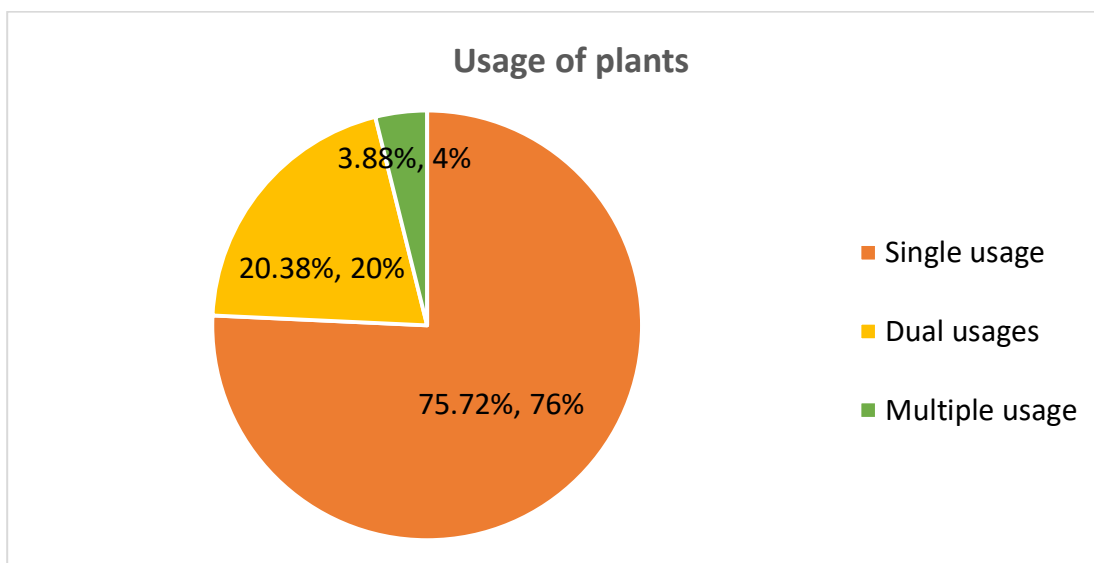
68	<i>Podophyllum hexandrum</i> Royle	Barberidaceae	Summer	Leaves	Powdered leaves is used in the treatment of asthma. It is also used to reduce bulb in throat.
69	<i>Populus alba</i> L.	Salicaceae	Summer	Whole plant	Leaves are used as fodder. Wood is used as fuel.
70	<i>Plantago lanceolata</i> L.	Plantaginaceae	Summer	Whole plant	It is used as vegetable and laxative.
71	<i>Persicaria mitis</i> (Schrank) Holub	Polygonaceae	Summer	Root	Tea is made by root which help to reduce the joints pain.
72	<i>Picea smithiana</i> (Wall.) Boiss.	Pinaceae	Summer	Wood	Wood is the source of fuel.
73	<i>Podophyllum emodi</i> Wall. ex Hook.f. & Thomson	Barberidaceae	Summer	Whole	It is used as fodder cattle and rodents.
74	<i>Pinus wallichiana</i> A.B.Jacks.	Pinaceae	Summer	Whole plant	Smell of resin reduce severe cough. Powder of leaves and bark used with cold water useful for dysentery. Wood is used to make house thatching. Cones are used for fuel purposes and seeds are edible.
75	<i>Pinus roxburghii</i> Sarg.	Pinaceae	Summer	Whole plant	Powder of leaves and bark used with cold water for dysentery. Wood is used for furniture and fire purpose. Smoke is used to repel the mosquitoes and other insects.
76	<i>Rosa macrophylla</i> Lindl.	Rosaceae	Summer	Fruit	Fruit is used in fever to cure from it.
77	<i>Rheum emodi</i> Wall.	Polygonaceae	Summer	Whole plant	Leaves are used as vegetable. The powdered root and stem mix together with hot water to relieve constipation.
78	<i>Rubus niveus</i> subsp. <i>horsfieldii</i> (Miq.) Focke	Rosaceae	Summer	Fruit	Fruit is eatable.
79	<i>Rheum australe</i> D. Don	Polygonaceae	Summer	Root, Leaves	Leaves are used as vegetable. Paste of root is used for wound healing.
80	<i>Rhus succedanea</i> L.	Anacardiaceae	Summer	Whole plant	It is used as fodder. It is also source of fuel.
81	<i>Saussurea lappa</i> (Decne.) Sch.Bip.	Asteraceae	Summer	Root	Powder of root is used for cough and toothache, also as vermifusefor intestinal worm. Juice of root is used with a sweetner to cure rheumatism and pneumonia.
82	<i>Silene vulgaris</i> Garcke.	Caryophyllaceae	Summer	Whole plant	It is used as vegetable.

83	<i>Sonchus asper</i> Hill.	Asteraceae	Summer	Whole plant	Young leaves and stem is cooked as vegetable.
84	<i>Sorghum halepense</i> Pers.	Poaceae	Summer	Whole plant	Juice of root is used for the asthma. It is also used for fodder.
85	<i>Senecio chrysanthemoides</i> DC.	Asteraceae	Summer	Whole plant	It is used as vegetable.
86	<i>Skimmia laureola</i> Franch.	Rutaceae	Summer	Leaves	Tea is made by dry leaves which is very effective in joints pain, muscles pain, stomach pain and bone pain. Powdered leaves also used in deserts.
87	<i>Salix tetrasperma</i> Roxb.	Salicaceae	Summer	Whole plant	It is used as fodder. Wood is used as fuel.
88	<i>Symplocos paniculata</i> (Thunb.) Miq.	Symplocaceae	Summer	Leaves	Powdered leaves is used in the treatment of menorrhagia, eye disease.
89	<i>Sarcococca saligna</i> Müll.Arg.	Buxaceae	Summer	Leaves	Powdered leaves is used in constipation, blood purification and muscles relaxation.
90	<i>Satyrium nepalense</i> D.Don	Orchidaceae	Summer	Tuber	Tubers are used as tonic and to cure dysentery and malaria fever.
91	<i>Scutellaria linearis</i> Benth.	Lamiaceae	Summer	Leaves	Powdered leaves is used to reduce inflammation and diarrhea.
92	<i>Swertia paniculata</i> Wall.	Gentianaceae	Summer	Whole plant	Powdered plant is used to cure from fever.
93	<i>Solidago capitata</i> Fisch. ex Herder	Asteraceae	Summer	Whole plant	Powdered plant is used to heal wounds.
94	<i>Thymus linearis</i> Benth.	Lamiaceae	Summer	Whole plant	Tea is made by this plant which help to reduce fats in body, abdominal pain and gas trouble.
95	<i>Taxus baccata</i> L.	Taxaceae	Summer	wood	It is used as fuel.

96	<i>Trifolium repens</i> L.	Papilionaceae	Summer	Leaves	Used as vegetables.
97	<i>Viola biflora</i> L.	Violaceae	Summer	Leaves	Leaves are used as vegetables. Tea is made by dry leaves which helps in cough headache and flu.
98	<i>Vicia sativa</i> L.	Papilionaceae	Summer	Leaves	Leaves are used as vegetable.
99	<i>Viburnum cotinifolium</i> Don.	Caprifoliaceae	Summer	Fruit	Fruit is eatable.
100	<i>Viscum album</i> L.	Viscaceae	Summer	Leaves	Powdered leaves are used in the treatment of cough and asthma.
101	<i>Valeriana jatamansi</i> Jones	Caprifoliaceae	Summer	Root	Powdered root is used for the treatment of joints pain. It is also used in sweet dishes.
102	<i>Viola canescens</i> Wall.	Violaceae	Summer	Leaves, Flowers	Powder of leaves and flowers is given internally in the treatment of coughs and asthma.
103	<i>Wulfenia amherstiana</i> Benth.	Plantaginaceae	Summer	Whole plant	It is used as fodder cattle and rodents.

### ***Summary of ethnobotanical investigation***

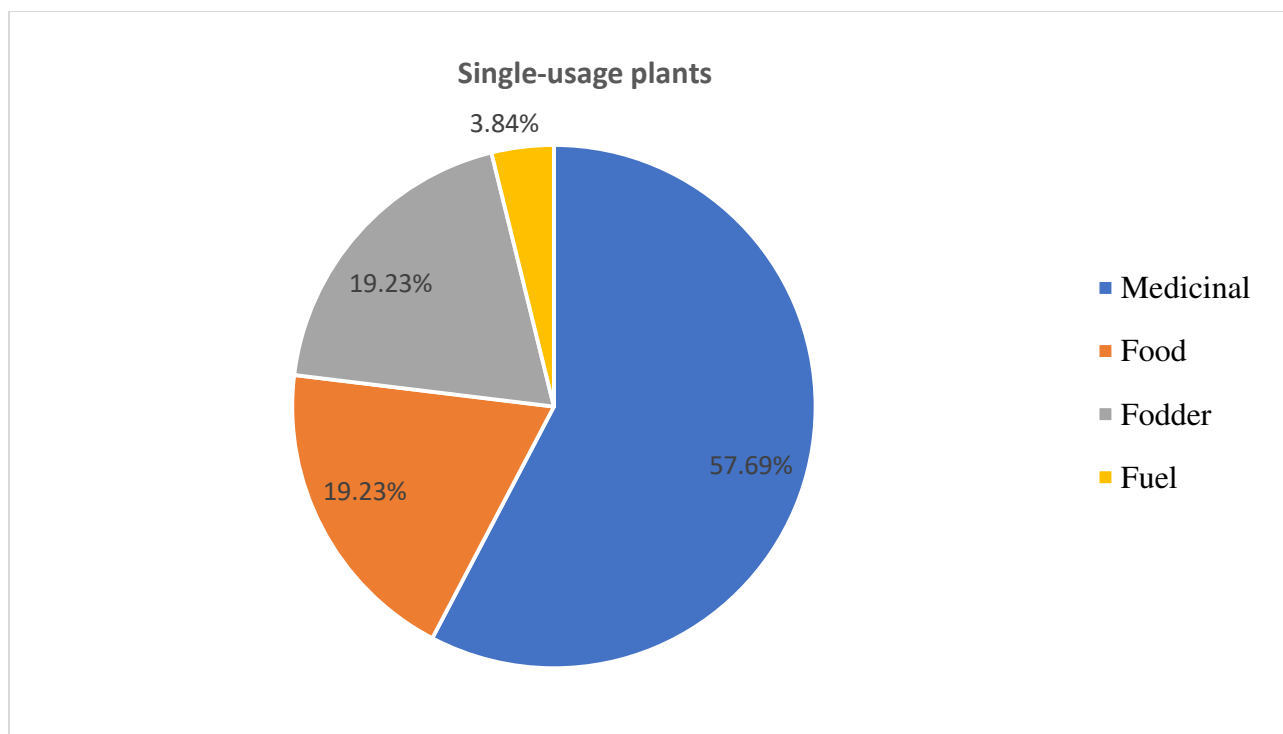
To summarize the identified (103 plants) species in pie-chart as; out of which 75.72% were single usage, 20.38% were dual usages and 3.88% were multiple usages. A pie-chart of all plants uses is given in Fig. 2.



**Fig. 2** Graphical presentation of plants on the basis of their usage

#### **Single-usage plants**

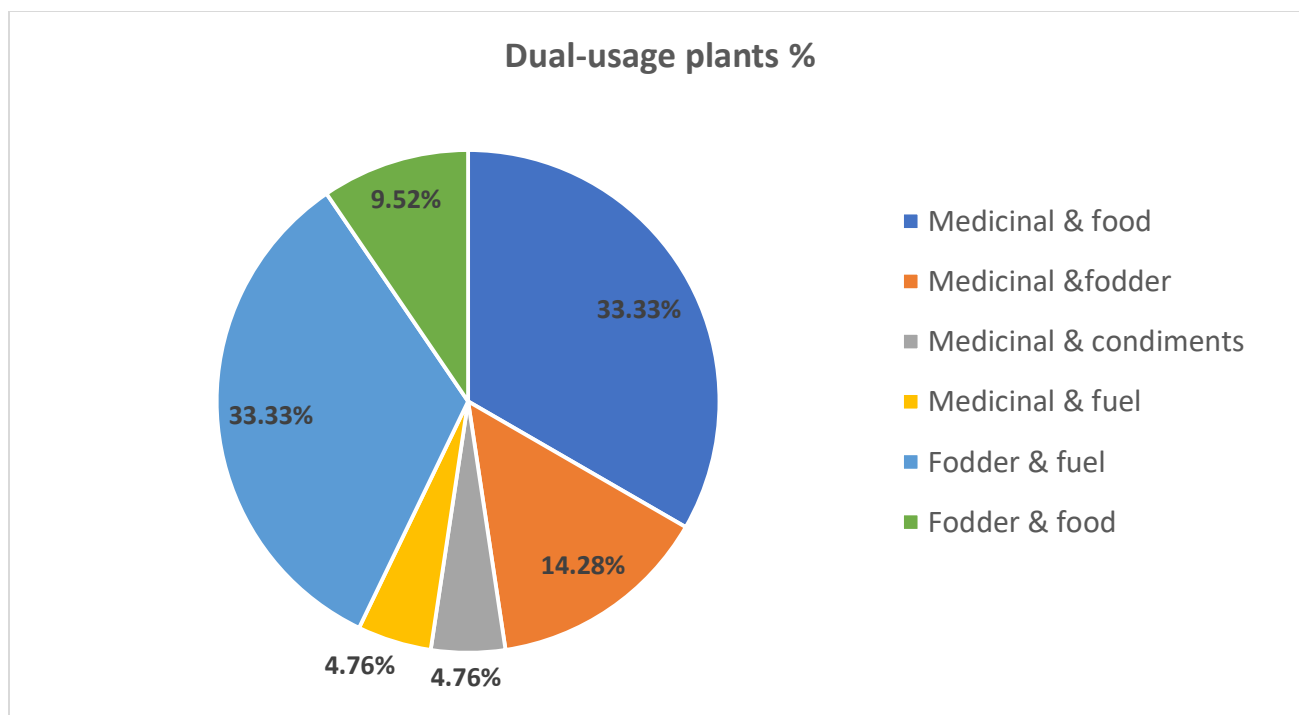
The plants which are used for only one purpose are called single-usage plant, e.g. *Solidago capitata* used as a medicinal purpose. Out of 103 plant species reported from the study area (Dowariya and Rati Gali), 78 were single usage. Out of 78 plants, medicinal plants were 45 (57.69%), whereas food, fodder and fuel were 15 (19.23%), 15 (19.23%) and 3 (3.84%) respectively. A pie-chart of all single-usage plants is given in Fig. 3. These findings were strongly correlated with Uniyal medicinal practices in Kangra district of Himachal Pradesh, Western Himalaya [32].



**Fig. 3** A pie-chart of single-usage plants

### ***Dual-usage plants***

The plants that used for two key purposes, are called dual-usage plants. For example, *Artemisia macrophylla* is used for medicinal as well as fodder. Out of 103 plants species, 21 (20.38%) were representing dual-usage plants. There were 6 categories of dual-usage of plants representing 21 species, i.e. medicinal & food and fodder & fuel were 7 (33.33%) while medicinal & fodder and food & fodder were 3 (14.28%) and 2 (9.52%) respectively. Medicinal & condiments and medicinal & fuel were 1 (4.76%). A pie-chart of all dual-usage plants is given in (Fig. 4). Many researchers positively correlate with our findings as Polat and his co-researchers discussed an ethnobotanical use of medicinal plants in Espiye and its surroundings in 2015 [33].

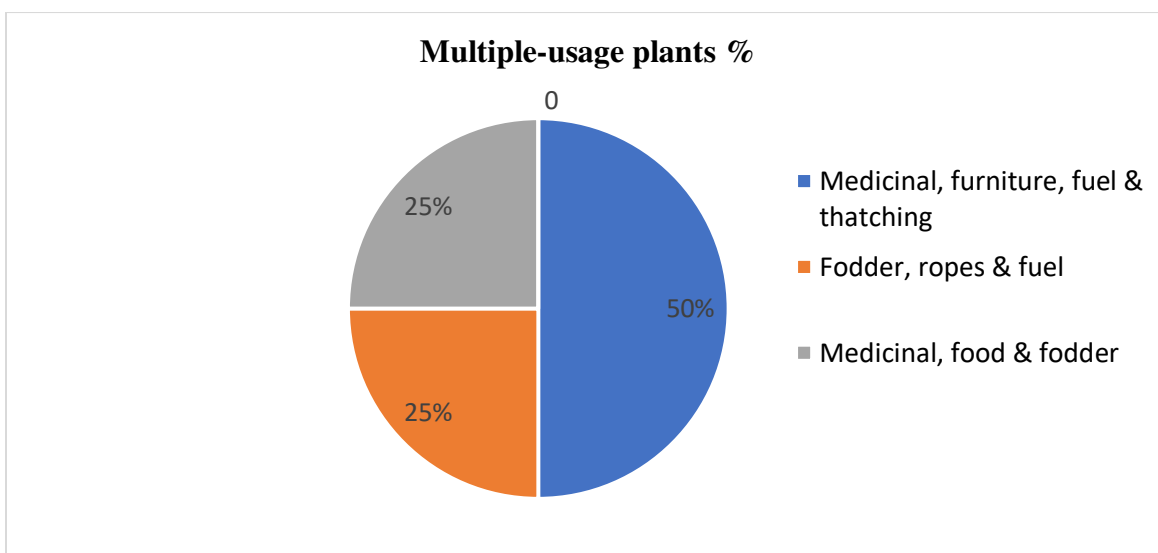


**Fig. 4** A pie-chart of dual usage plants

Dosage form such as powdered, juice, mixture and decoction were frequently used for the treatment of different diseases in the study area. Powdered is the dosage form having the highest percentage 38 % used among the local people, after that juice is widely used by the local people having the percentage of about 29 % while the least administrated form is oil 1.61 %. Other purposes such as fodder, food, fuel and construction were used by local people. Mostly plants frequently used for domestic animals as fodder having the highest percentage 37%, and after that as food is widely used by the local people having percentage of about 32%. Similar studies were conducted on the plants of Kel village, Neelum Valley, Azad Jammu and Kashmir. They investigated 50 plants belonging to 33 families from the study area [24]. Among plant part utilized, Leaves (30%) and the entire plant (23%) were the most much of the time utilized plant parts followed by roots (14%), bark (11%), seeds (8%), natural products (6%) elevated parts and stem (3%) and blossoms (2%) while the most widely recognized strategies for readiness was decoction (20%), extricate (17%), mixture (15%), powder and squeeze (13% each), glue (11%), poultice (7%), and oil (8%). Comparative traditional employments of therapeutic plants were additionally investigated by Oliver in 2013 [34].

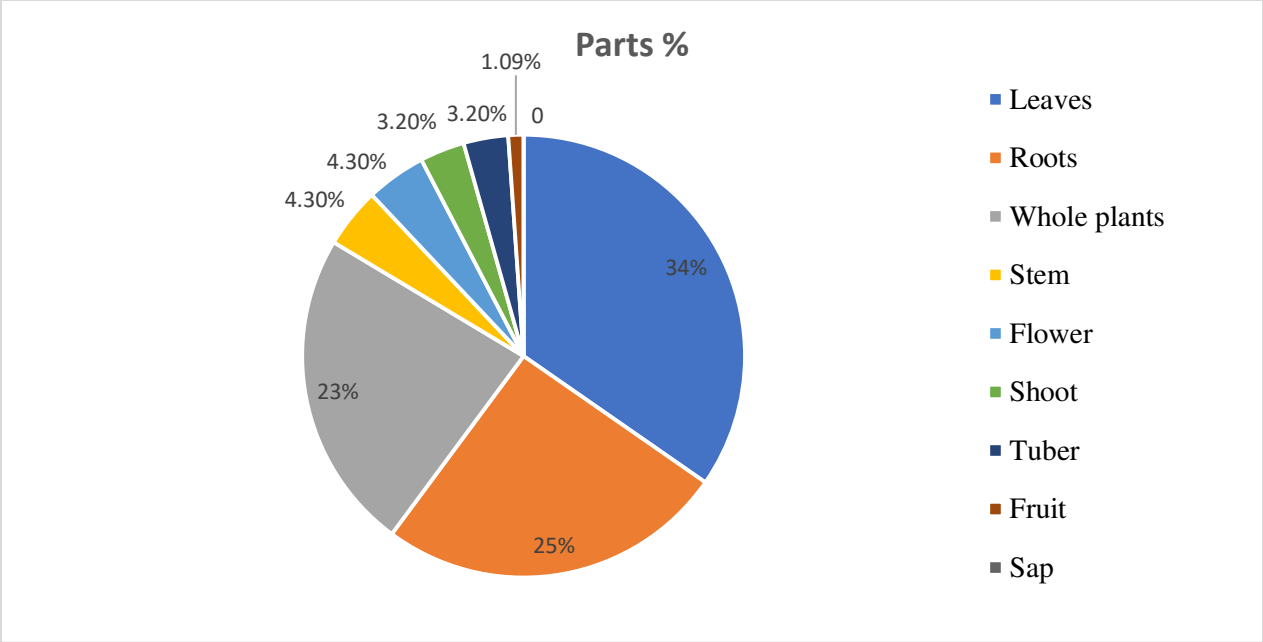
### ***Multiple-usage plants***

The plants which are used for multiple purposes, are called multiple-usage, e.g. *Pinus wallichiana* A.B.Jacks. is used for fuel, furniture, medicinal and thatching. Out of 103 plant species, 4 were representing multi-usage plants. There were 3 categories of multi-usage plants representing 4 plant species. Out of 4 plants, fodder, ropes and fuel were 1(25%), medicinal, furniture, fuel and thatching were 2(50%) while Medicinal, food and fodder were 1(25%). A list of all the multiple-usage plants, their local names and families is given in (Table 6). While a pie-chart of all multiple-usage plants is given in (Fig.5). Similar multiple Traditional use of medicinal plants among Kalasha, Ismaeli and Sunni groups in Chitral District, Khyber Pakhtunkhwa province Pakistan were documented in year 2016 [31].

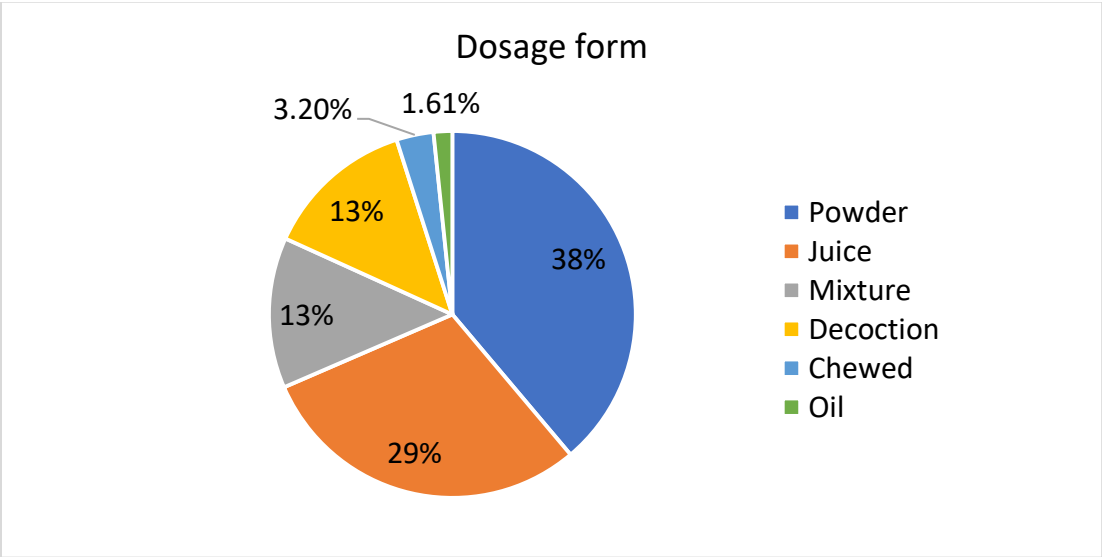


**Fig. 5** A pie chart of multiple-usage plants

Similar research was conducted on the plants of Darguti, Tehsil Khuiratta, AJK, Pakistan were being used by the local population of the area [16]. The plants species have single, double and multiple usages. 12 plant species have single uses, 24 have double uses and 64 species have multiple uses which is quite match with our findings. This district falls in subtropic region but my study area occurs in temperate region. Therefore, few plants species were grown different from our research area.

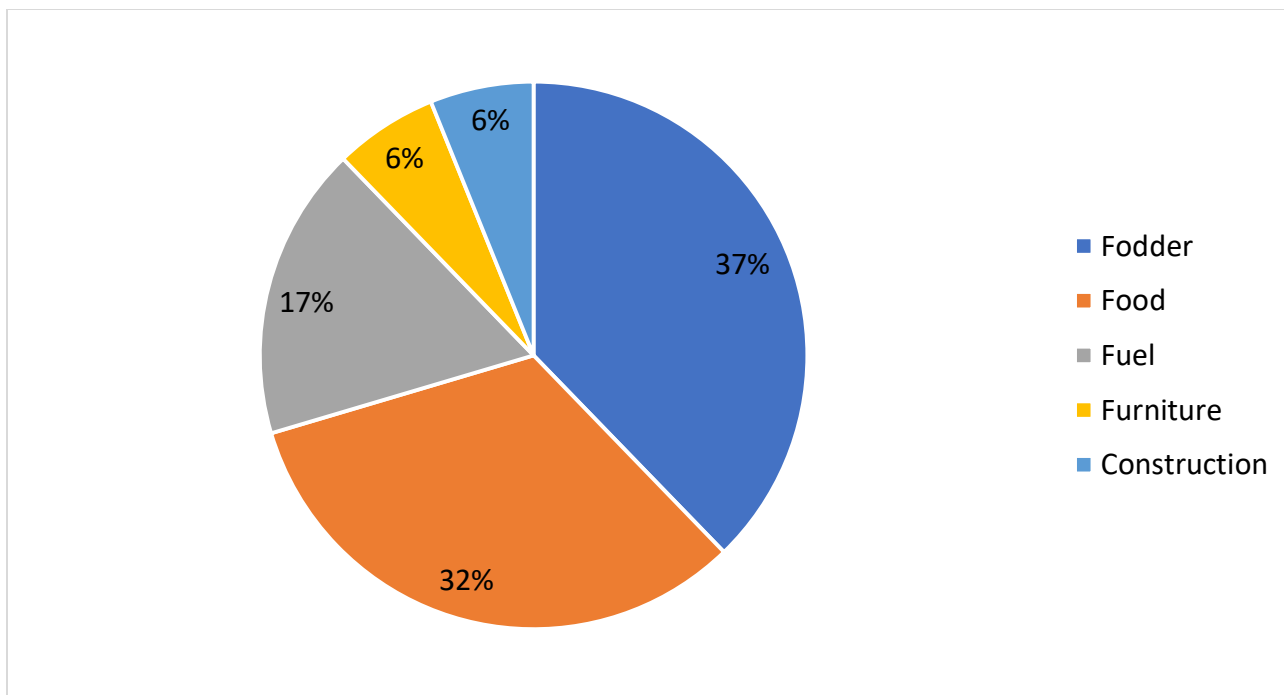


**Fig. 6** A pie-chat of different parts of plants used for the treatment of different diseases



**Fig.7** A pie chart of Dosage form used against diseases





**Fig. 8** A Pie chart of different plants used by local people in different categories

Fidelity level of the data depicts that *Allium griffithianum* (Jungli pyaz) and *Fragaria nubicola* (Mehwa) is the leading species with 75% value which is frequently used by local people of Dawarian. Second most important plant with respect to fidelity level of about is the *Mentha longifolia* (Pahari podina) with 72%. Whole plant is used for stomachache and gas trouble. Juice of the leaves expel worm from the stomach. It is also used as condiments. Third plant with respect to fidelity level is *Abies pindrow* (Partel), the paste of the leaves applied on cuts wounds bruises to get rid of bacteria and germs (Table 8). It is also the source of fuel. Ahmad and his colleagues conducted similar studies on the plants of Kel village, Neelum Valley, Azad Jammu and Kashmir [24]. They researched that the species having the most elevated FL esteem were *Berberis lyceum* (95%) utilized in jaundice, hepatitis, typhoid, fever, and tuberculosis issues, trailed by *Dioscorea bulbifera*, *Impatiens glandulifera* (90%) utilized in stiffness, joint torment and *Artemisia vulgaris* (90%) utilized in liver issues. Additionally, FL level was likewise seen by Farooq and his exploration bunch [26]. Five plant species including *Berberis lyceum*, *Mentha arvensis*, *Pyrus malus*, *Taraxacum officinale*, and *Viola canescens* had 100% loyalty level.

**Table 8** Fidelity level of plants in study area of Dawarian to Ratti Gali, AJK

Sr. No.	Species name	Local name	FL	F.L% $\frac{NP}{N} \times 100$
1	<i>Acer cappadocicum</i>	Tra kanna	20	50%
2	<i>Ajua bracteosa</i>	Jan-e-Adam	15	37%
	<i>Ajuga parviflora</i>	Chita chaou	24	60%
3	<i>Allium griffithianum</i>	Jungli pyaz	30	75%
4	<i>Aconogonon alpinum</i>	Chikro	25	62%
5	<i>Actaea spicata</i>	Moneeri	20	50%
6	<i>Aesculus indica</i>	Ban khaur	10	25%
7	<i>Aconitum heterophyllum</i>	Ptrees	18	45%
8	<i>Abies pindrow</i>	Partal	28	70%
9	<i>Achillea millefolium</i>	Gandana	10	25%
10	<i>Artemisia japonica</i>	Chaou	10	25%
11	<i>Anaphalis triplinervis</i>	But mehndi	5	12%
12	<i>Artemisia macrophylla</i>	Chita chaou	17	42%
13	<i>Astragalus graveolens</i>	Ban phali	21	52%
15	<i>Adiantum aethiopicum</i>	Kahkawa	30	75%
16	<i>Arisaema tortuosum</i>	Sanp ki jari	9	22%
17	<i>Astragalus chlorostachys</i>	Phut kanda	12	30%
18	<i>Bergenia ciliata</i>	Betbewa	25	62%
19	<i>Bromus pectinatus</i>	Pero	5	12%
20	<i>Berberis lycium</i>	Sumbal	19	47%
21	<i>Bistorta amplexicaulis</i>	Masloon	18	45%
22	<i>Buddleja crispa</i>	Gansu	10	25%
23	<i>Buxus wallichiana</i>	Chiriri	17	42%
24	<i>Convolvulus arvensis</i>	Berrhi	14	35
25	<i>Cirsium arvense</i>	Jungli kandyara	8	20%
26	<i>Campanula pallida</i>	Bikh	10	25%
27	<i>Cynoglossum lanceolatum</i>	Chiro	12	30%
28	<i>Cuscuta reflexa</i>	Neela tari	3	7%

29	<i>Cedrus deodara</i>	Devdaar	16	40%
30	<i>Colchicum luteum</i>	Sorinjan	11	27%
31	<i>Corylus colurna</i>	Aurni	25	62%
32	<i>Corydalis vaginans</i>	Mameeri	9	22%
33	<i>Cotoneaster microphyllus</i>	Loni	12	30%
34	<i>Corydalis govaniana</i>	Bhutkas	15	37%
35	<i>Caltha alba</i>	Makanpath	7	17%
36	<i>Cenchrus pennisetiformis</i>	Lidder	6	15%
37	<i>Clinopodium vulgare</i>	Asaba-el-fetiyal	23	57%
38	<i>Digitaria cruciata</i>	Ghaa	4	10%
39	<i>Erysimum hieraciifolium</i>	Mirchi	11	27%
40	<i>Erysimum hedgeanum</i>	Maneera	20	50%
41	<i>Euonymus hemsleyanus</i>	Seeki	3	7%
42	<i>Elsholtzia strobilifera</i>	Perilla	10	25%
43	<i>Fragaria nubicola</i>	Mehwa	30	75%
44	<i>Geranium rotundifolium</i>	Ratan jut	11	27%
45	<i>Geranium villosum</i>	Gull-e-attar	8	20%
46	<i>Gerbera gossypina</i>	Kofe	10	25%
47	<i>Hylotelephium ewersii</i>	Loon salooni	6	15%
48	<i>Ilex dipyreana</i>	Kandaro	2	5%
49	<i>Indigofera heterantha</i>	Kanthi	13	32%
50	<i>Isodon rugosus</i>	Pemar	21	52%
51	<i>Juncus arcuatus</i>	Jungli ghass	11	27%
52	<i>Juniperus communis</i>	Bentheri	4	10%
53	<i>Lespedeza juncea</i>	Kanthi ranga	9	22%

54	<i>Ligularia thomsonii</i>	Jungli surajmuk	14	35%
55	<i>Mentha longifolia</i>	Pahari podina	29	72%
56	<i>Matricaria chamomilla</i>	Tamak boti	20	50%
57	<i>Morina persica</i>	Bekh-e-Akwar	8	20%
58	<i>Meliosma simplicifolia</i>	Bakhaish	5	12%
59	<i>Oxalis corniculata</i>	Khatimli	24	60%
60	<i>Onychium japonicum</i>	Kangu	2	5%
61	<i>Oxyria digyna</i>	Kakri	10	25%
62	<i>Onosma bracteata</i>	Gao zuban	4	10%
63	<i>Origanum vulgare</i>	Nazbu	9	22%
64	<i>Polygala chinensis</i>	Sanp ki jari	10	25%
65	<i>Phlomis bracteosa</i>	Kukarjari	16	40%
66	<i>Pedicularis brevifolia</i>	Khasturi	14	35%
67	<i>Primula denticulata</i>	Mamera	3	7%
68	<i>Podophyllum hexandrum</i>	Ban kukri	12	30%
69	<i>Populus alba</i>	Sufaida	18	45%
70	<i>Plantago lanceolata</i>	Kala chamchi patr	25	62%
71	<i>Persicaria mitis</i>	Pahari masloon	13	32%
72	<i>Picea smithiana</i>	Kachal	10	25%
73	<i>Podophyllum emodi</i>	Tra patra	10	25%
74	<i>Pinus wallichiana</i>	Kayal	23	57%
75	<i>Pinus roxburghii</i>	Cheer	23	57%
76	<i>Rosa macrophylla</i>	Shigari	29	72%
77	<i>Rheum emodi</i>	Chit patra	7	17%
78	<i>Rubus niveus</i>	Pakana	18	45%
79	<i>Rheum australe</i>	Chutyal	11	27%
80	<i>Rhus succedanea</i>	Alkhal	7	17%

81	<i>Saussurea lappa</i> .	Kuth	20	50%
82	<i>Silene vulgaris</i>	Murkun	24	60%
83	<i>Sonchus asper</i>	Dhodai	20	50%
84	<i>Sorghum halepense</i>	Baru	1	2%
85	<i>Senecio chrysanthemoides</i>	Chir hand	14	35%
86	<i>Skimmia laureola</i>	Neri	21	52%
87	<i>Salix tetrasperma</i>	Bheens	4	10%
88	<i>Symplocos paniculata</i>	Ludder	1	2%
89	<i>Sarcococca saligna</i>	Shangal	5	12%
90	<i>Satyrium nepalense</i>	Tera Kanna	4	10%
91	<i>Scutellaria linearis</i>	Birch	9	22%
92	<i>Swertia paniculata</i>	Charyta	2	5%
93	<i>Solidago capitata</i>	Pinja phool	7	17%
94	<i>Thymus linearis</i>	Ban jamani	19	47%
95	<i>Taxus baccata</i>	Thuni	6	15%
96	<i>Trifolium repens</i>	Sinja	21	52%
97	<i>Viola biflora</i>	Phul naqsh	12	30%
98	<i>Vicia sativa</i>	Chiri pancha	17	42%
99	<i>Viburnum cotinifolium</i>	Ukloo	14	35%
100	<i>Viscum album</i>	-----	11	27%
101	<i>Valeriana jatamansi</i>	Panchi hola	16	40%
102	<i>Viola canescens</i>	Thandi jari	15	37%
103	<i>Wulfenia amherstiana</i>	-----	3	7%

Family with highest number of plant species, number of species contained in each family and family ranking (FR) explored from the study area (Table 9). It was observed that highest FR was shown Asteraceae and lowest FR indicated by Rosaceae. These findings were very closely supported by Maqbool and his colleagues [30].

**Table 9** Measurement of Family index (with highest number of species) in the study area

S. No.	Family	Number of species	Ranking
1	Asteraceae	12	1st
2	Lamiaceae	10	2nd
3	Polygonaceae	7	3rd
4	Papilionaceae	6	4th
5	Pinaceae	5	5th
6	Poaceae	4	6th
7	Rosaceae	4	7th

Spearman's rank correlation test confirmed that the number of uses of plants increases with increases in the number of species. In spearman's correlation, we correlated the indigenous knowledge of males and females to find out the facts that either the females have better knowledge as compared to males or not as well as we also correlated the number of uses with the number of plants (Table 10, 11, 12). Similar studies were conducted by Ahmad and his colleagues [24] in Kel, Neelum Valley Azad Jammu and Kashmir and Amjad and his colleagues were also done work in Toli Peer National Park, Azad Jammu and Kashmir. They were investigated plant species from their respected areas and applied statistical tools such as FL, ICF, DMR and FI [28]. Similar statistical tools were also applied by Maqbool et al., 2019 on ethnobotanical data compiled from district Bhimber, Azad Jammu and Kashmir, Pakistan [30].

**Table 10** Spearman's rank correlation and data analysis from Dawarian to Rati Gali, AJK

Age range	Number of interviews	Male informants	Female informants
20-29	13	2	11
30-39	2	1	1
40-49	8	6	2
50-59	4	3	1
60-69	5	1	4
70-79	3	0	3
80-89	3	2	1
90-99	2	1	0

**Table 11** Spearman correlation for male informants in study area

Age	Number of species	d 1	Number of uses	d 2	d = d 2-d 1	d <sup>2</sup>
25	14	5	16	5	0	0
35	9	2	4	1	-1	1
44	16	6	28	7	1	1
55	12	4	11	3	-1	1
66	7	1	10	2	1	1
85	18	7	20	6	-1	1
94	10	3	13	4	1	1

Sum of value of  $d^2 = 6$

$$r_s = 1 - 6 \left[ \frac{\sum d^2}{n(n^2-1)} \right]; r_s = 1 - 6 \left[ \frac{6}{7(7^2-1)} \right]; r_s = 1 - 6 \left[ \frac{6}{7(49-1)} \right]; r_s = 1 - 6 \left[ \frac{6}{7(48)} \right]; r_s = 1 - 6 \left[ \frac{6}{336} \right]; r_s = 1 - 6 [0.01]; r_s = 1 - 0.06; r_s = 0.9$$

**Table 12** Spearman correlation for female informants in study area

Age	Number of species	d 1	Number of uses	d 2	d = d 2-d 1	d <sup>2</sup>
24	11	2	13	1	-1	1
35	14	5	18	4	-1	1
45	18	7	20	6	-1	1
54	10	1	15	2	1	1
65	12	3	16	3	0	0
75	13	4	19	5	1	1
84	15	6	22	7	1	1

Sum of value of  $d^2 = 6$

$$r_s = 1 - 6 \left[ \frac{\sum d^2}{n(n^2-1)} \right]; r_s = 1 - 6 \left[ \frac{6}{7(7^2-1)} \right]; r_s = 1 - 6 \left[ \frac{6}{7(49-1)} \right]; r_s = 1 - 6 \left[ \frac{6}{7(48)} \right]; r_s = 1 - 6 \left[ \frac{6}{336} \right]; r_s = 1 - 6 [0.01]; r_s = 1 - 0.06; r_s = 0.9$$

Informant consensus factor (ICF) was used to support the data and to see the degree of agreement on each plant reported by informants (Table 13A). The highest value of ICF is 0.91 for earache who depict prevalence of diseases mostly in children in the area and for construction houses because people in study area only depends on tree for construction their houses. The lowest

value is for fodder 0.03 (Table 13B). Similar findings were correlated and strongly supported by Farooq and his colleagues [26]. Maximum informant consensus factor (0.88) was calculated for digestive and liver disorders (Table 13B). According to diseases wise ICF was also measured by different scientists in rest of the world [30].

**Table 13A** Informant consensus factor (ICF) for different categories (For diseases)

Diseases	Species (nt)	All spp. %	Used citation (nur)	All citation %	$ICF = \frac{(nur-nt)}{(nur-1)}$
Cough	13	12.7%	26	65%	0.52
Stomachache	11	10.6%	30	75%	0.65
Asthma	10	9.70%	20	50%	0.52
Wounds healing	9	8.73%	14	35%	0.33
Joint pain	7	6.79%	22	55%	0.71
Toothache	7	6.79%	25	62%	0.75
Fever	5	4.85%	19	47%	0.77
Chest burning	5	4.85%	10	25%	0.55
Dysentery	4	3.88%	5	12%	0.25
Muscle pain	4	3.88%	12	30%	0.72
Eye allergy	4	3.88%	15	37%	0.78
Blood purification	4	3.88%	7	17%	0.5
Constipation	3	2.91%	6	15%	0.6
Headache	3	2.91%	18	45%	0.88
Flu	3	2.91%	11	27%	0.8
Skin allergy	3	2.91%	2	5%	0.25
Cold	2	1.94%	9	22%	0.87
Earache	2	1.94%	13	32%	0.91
Diarrhea	2	1.94%	6	15%	0.8

**Table 13B** Informant consensus factor (ICF) for different categories (For other purposes)



<b>Category</b>	<b>Species (nt)</b>	<b>All spp. %</b>	<b>Used citation (nur)</b>	<b>All citation %</b>	<b>ICF = <math>\frac{(nur-nt)}{(nur-1)}</math></b>
Fodder	28	27.9%	29	72%	0.03
Food	24	23.3%	35	87%	0.32
Fuel	13	12.6%	32	80%	0.61
Furniture	5	4.94%	34	85%	0.87
Construction	5	4.94%	39	97%	0.89
House Thatching	4	3.88%	36	90%	0.91

**Table 14** Direct matrix ranking (DMR) of tree species with different uses other than medicinal value in the study area (AJK)

Uses	<i>P. wallichiana</i>	<i>P. roxburghii</i>	<i>P. smithiana</i>	<i>C. deodara</i>	<i>A. pindrow</i>	<i>A. cappadocicum</i>	<i>P. alba</i>	<i>S. tetrasperma</i>
Construction	40	40	35	36	30	0	0	0
Hedge, Fencing	20	18	15	10	15	14	20	22
Fire wood	25	29	35	38	30	32	28	19
Cash income	40	38	30	35	20	0	2	0
Fodder	5	2	8	4	10	20	22	29
Fruit, Food	0	0	0	5	0	0	0	0
Total	130	127	123	128	105	66	72	70
Rank	1 <sup>st</sup>	3 <sup>rd</sup>	4 <sup>th</sup>	2 <sup>nd</sup>	5 <sup>th</sup>	8 <sup>th</sup>	6 <sup>th</sup>	7 <sup>th</sup>

According to Direct matrix ranking (DMR), plant species were also used for other purposes than medicinal values as indicated in Table 14. These results indicated that the plant species *P. wallichiana* top of the list with DMR 1<sup>st</sup> (130). While *S. tetrasperma* indicated 2<sup>nd</sup> position according to other use value. These findings were strongly justified by different taxonomists. They calculated DMR from various regions of the world as strongly correlated with our studies [35-40].

Thus, the study is very useful as it provide baseline data compilation about traditional ethnomedicinal uses of wild plants of the area and it also describes the biotic threats to the flora of the area. Through this study important and unique medicinal plants are selected for further studies to confirm their ethnopharmacological analysis and drug discovery.

## Conclusion

The present research focused to explore the uses of plants in different purposes by experience of old peoples in the study area. ethnobotanical research focused to explore the uses of plants in different purposes by experience of old peoples in the study area. Ethnobotanical survey on the unexplored areas of District Antheam, Azad Jammu & Kashmir were selected for identification of wild plants and their ethnomedical impacts exploration. This research was carried out by interviewing the local peoples through a questionnaire method. Data analysis was done by different novel statistical tools such as fidelity level (FL), informant consensus factor (ICF), direct matrix ranking (DMR) strategies. Some plants were used as medicines only for indigenous peoples continuously and we recommended these plants for peoples in other parts of country as well as throughout the world in future. It was observed that peoples used plants as vegetables, fodder, fuel, timber and as well as for medicinal purposes. Local peoples are using many types of indigenous wild plants to cure different diseases like asthma, dysentery, constipation, cold, fever, joint pain, wound healing, kidney infection and many types of skin diseases. A total of 103 plants species belonging to 46 families were recorded. The most dominant family of that area was Asteraceae having 12 species. Among 103 plants 75.72% have single-usage, 20.38% have dual-usages and 3.88% have multiple-usage. Among plant parts, leaves having the highest percentage 34 % which are commonly used by local people for the treatment of various diseases followed by the root 25.2%. Some plants used as fodder having highest percentage 37% followed by Food (vegetables and fruits) with 32%. Data analysis through FL depicted that *Allium griffithianum* and *Adiantum aethiopicum* have highest fidelity level of 75% followed by the *Mentha longifolia* with fidelity level of about 72 %. The highest ICF value for recorded for ear-ache and house-thatching (0.91) followed by the construction (0.89) while the lowest ICF value recorded for fodder (0.03) followed by blood purification (0.5). Spearman's rank correlation test confirmed that the number of uses of plants increases with the increase in the number of species. So, this study will be useful those peoples and researchers in different fields such as ethnopharmacology, agriculture and biotechnology for future work.

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## **Declaration**

An ethnobotanical exploration of naturally growing plants of District Athmaqam from Dawarian to Ratti Gali, Azad Jammu and Kashmir.

## **Authors' contributions**

MA supervised the project, TH designed the study, conducted field survey and data analysis, MI helped in data interpretation and correction of the final draft of the paper. All the authors critically read this article and approved it as the final manuscript.

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This paper is a part of a MPhil thesis of a student. However, no funding was provided by any source to conduct this research project.

## **Availability of data and materials**

The data and materials already included in this manuscript.

## **Ethics approval and consent to participate**

The present ethnomedicinal research is purely based on a field survey instead of human or animal trials. Therefore, ethical approval and consent to participate is not applicable.

## **Consent of publication**

This manuscript data related to ethnobotanical research is sharing to the journal of ethnobiology and ethnomedicine after consent of all author/coauthor.

## **Competing interests**

The authors declare that they have no competing interests.

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# Figures

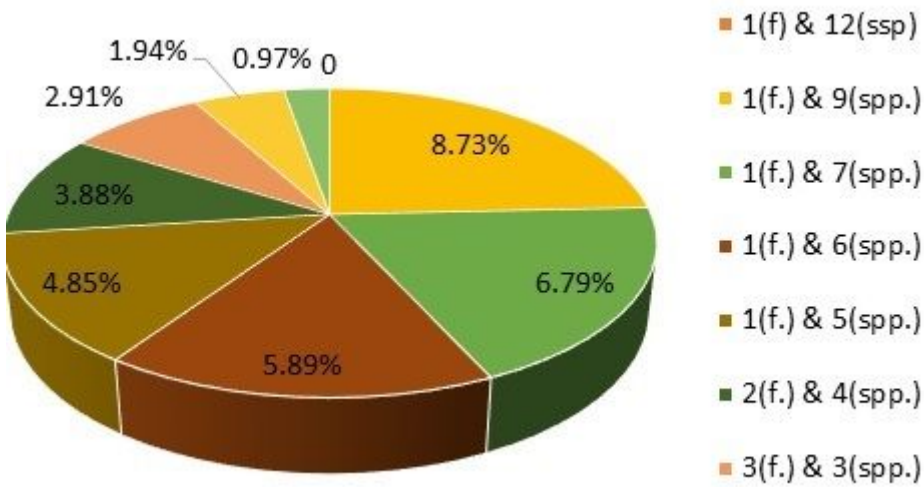


Figure 1

A pie chart of species contribution in each family from study area, Azad Jammu and Kashmir

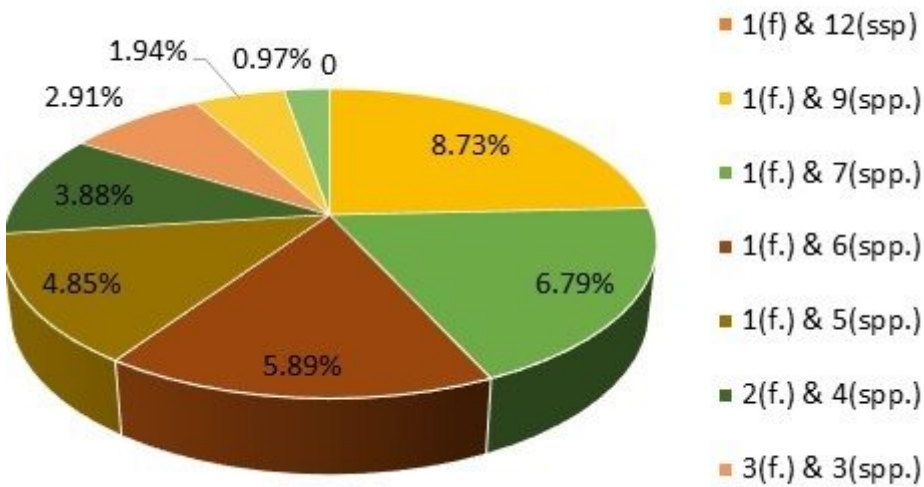
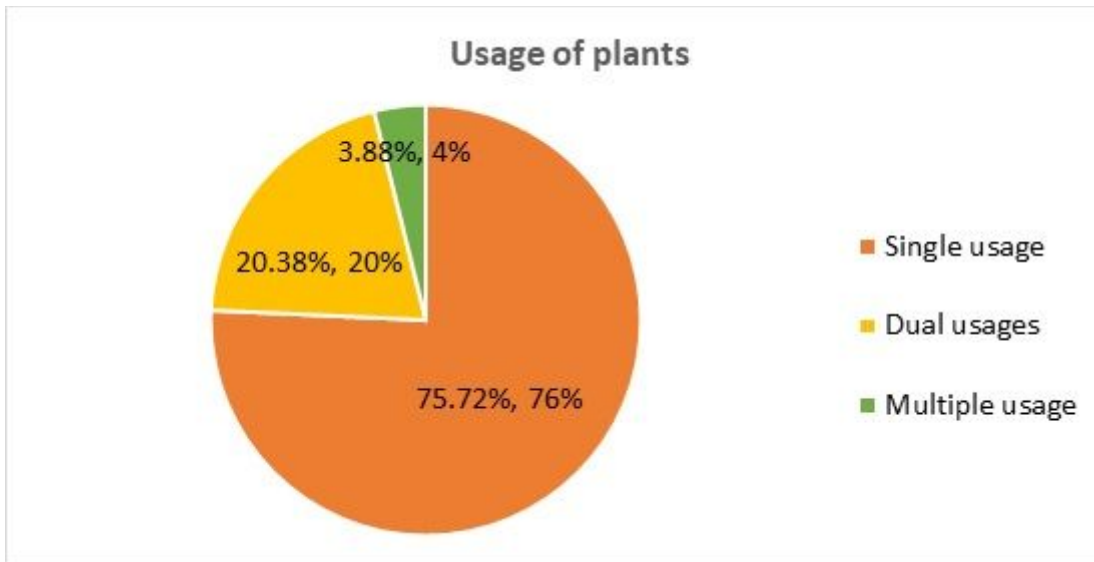


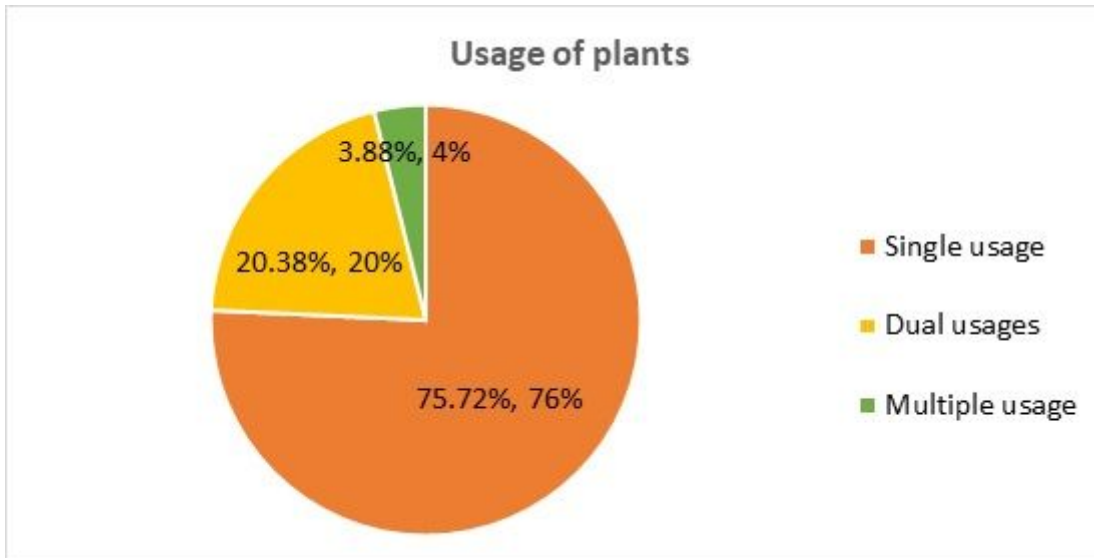
Figure 1

A pie chart of species contribution in each family from study area, Azad Jammu and Kashmir



**Figure 2**

Graphical presentation of plants on the basis of their usage



**Figure 2**

Graphical presentation of plants on the basis of their usage

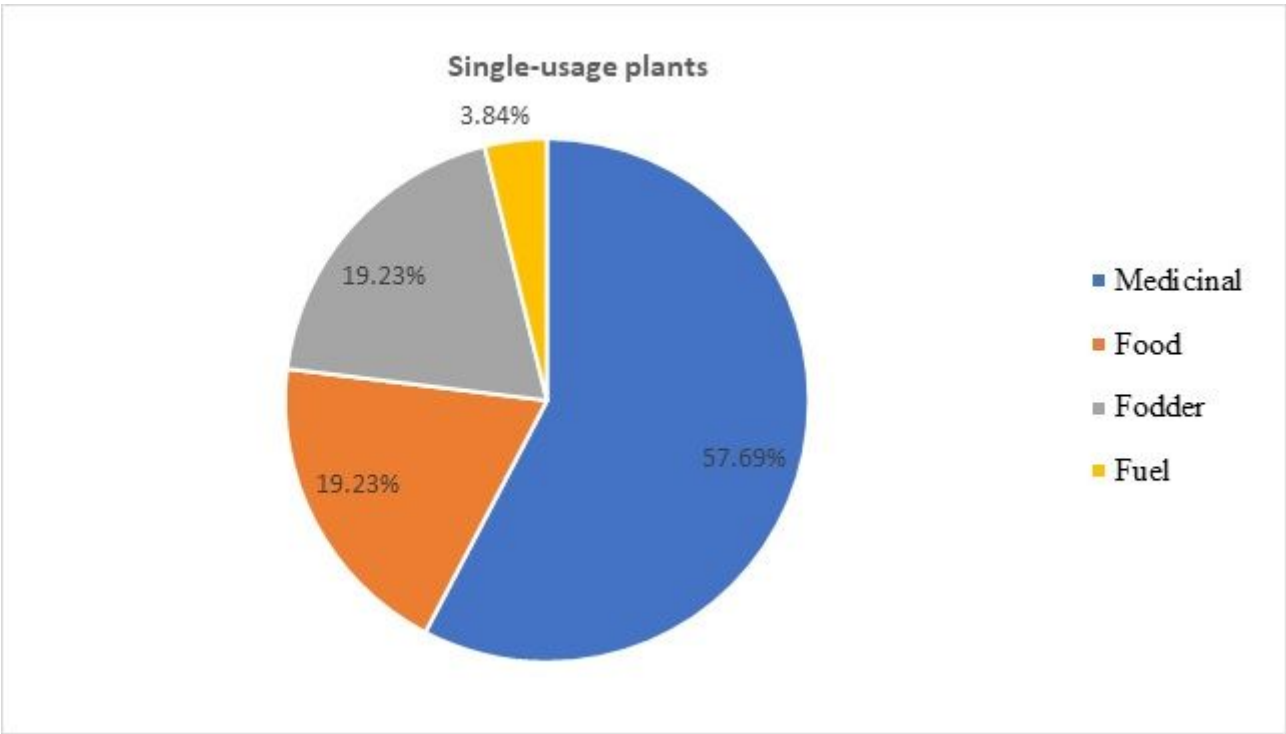


Figure 3

A pie-chart of single-usage plants

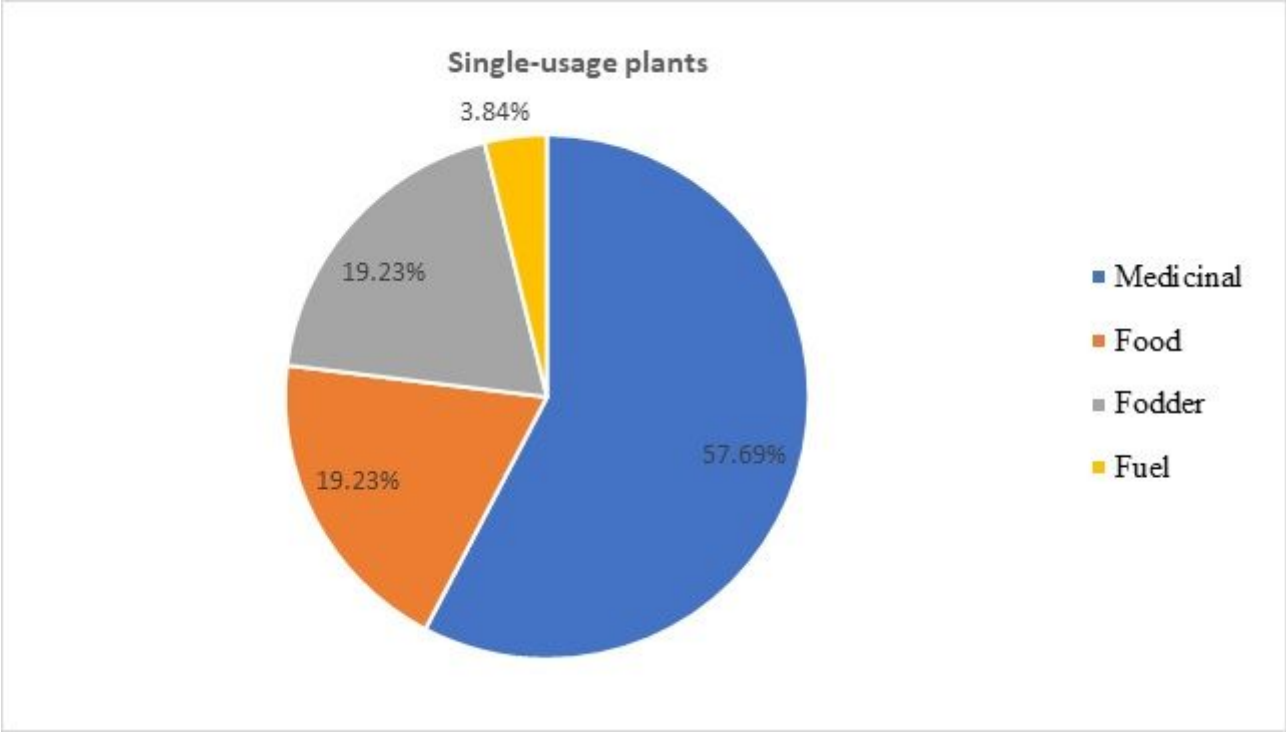
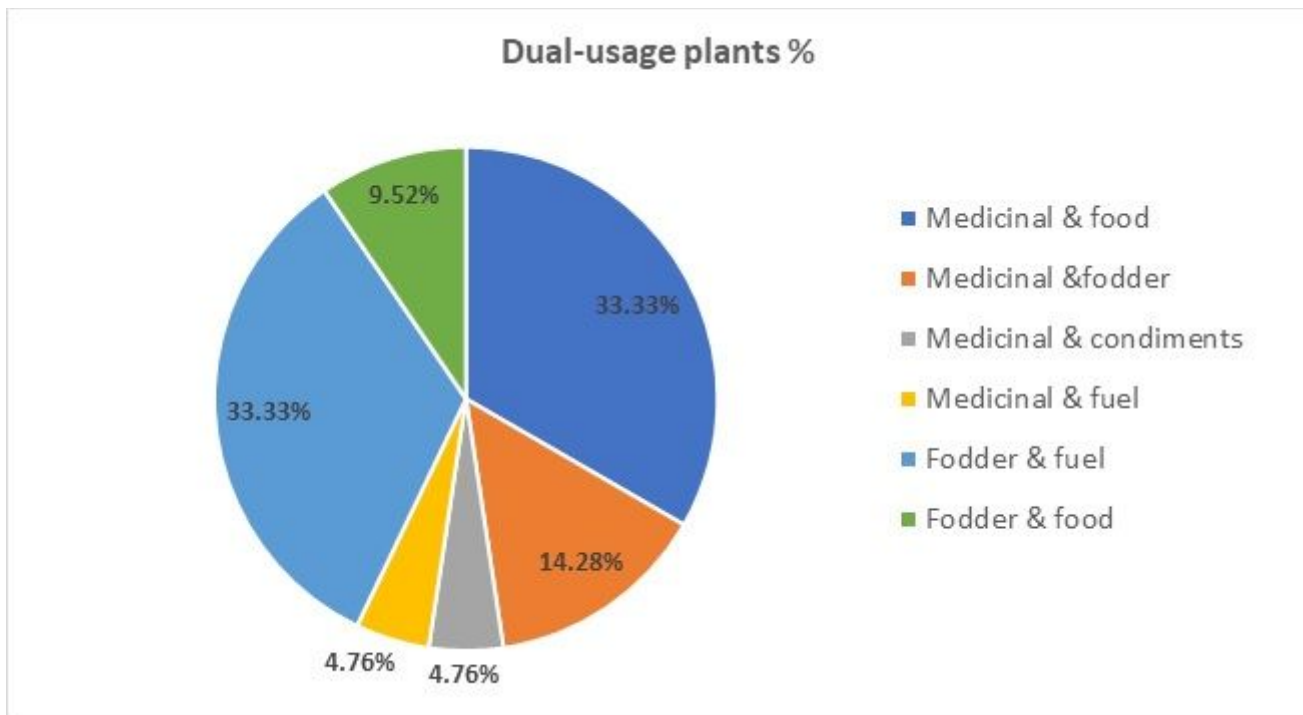


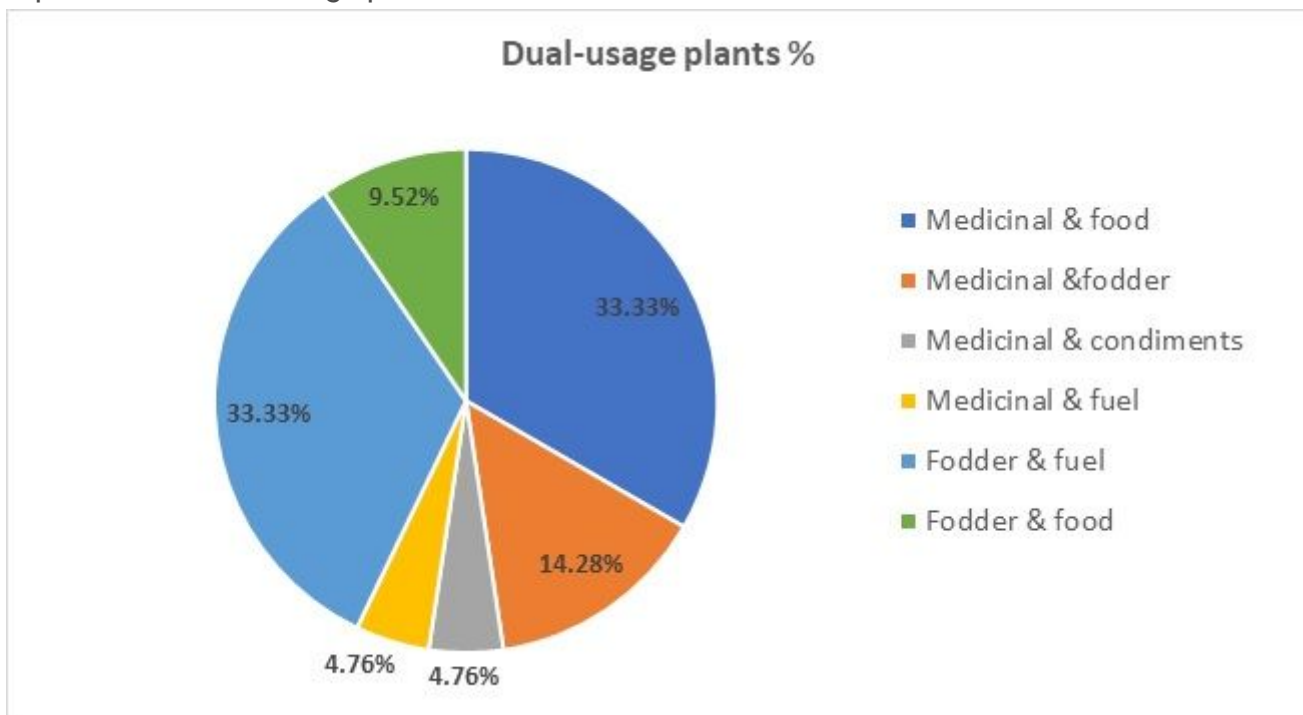
Figure 3

A pie-chart of single-usage plants



**Figure 4**

A pie-chart of dual usage plants



**Figure 4**

A pie-chart of dual usage plants

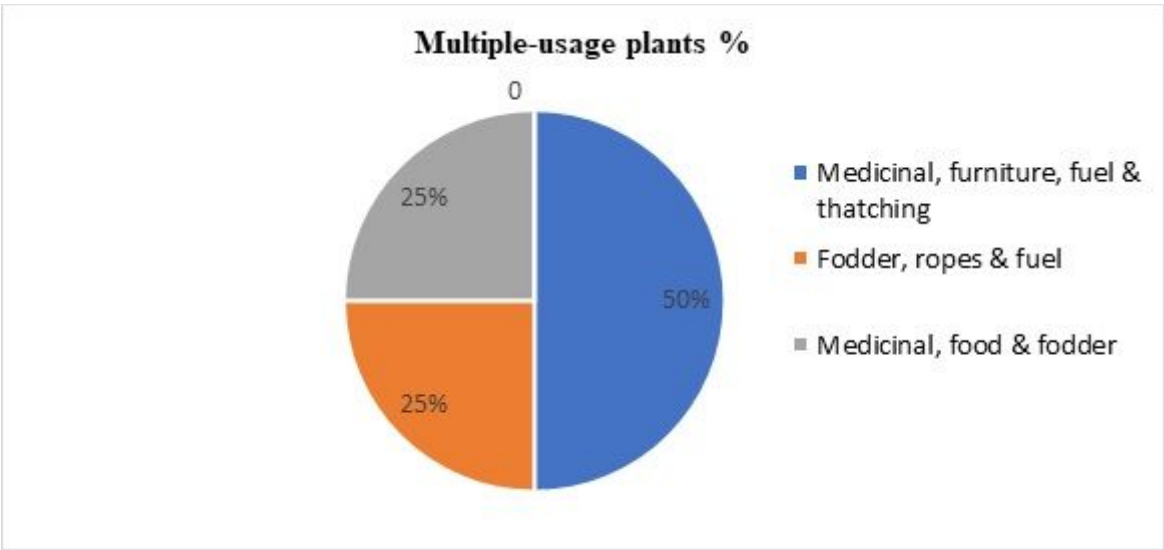


Figure 5

A pie chart of multiple-usage plants

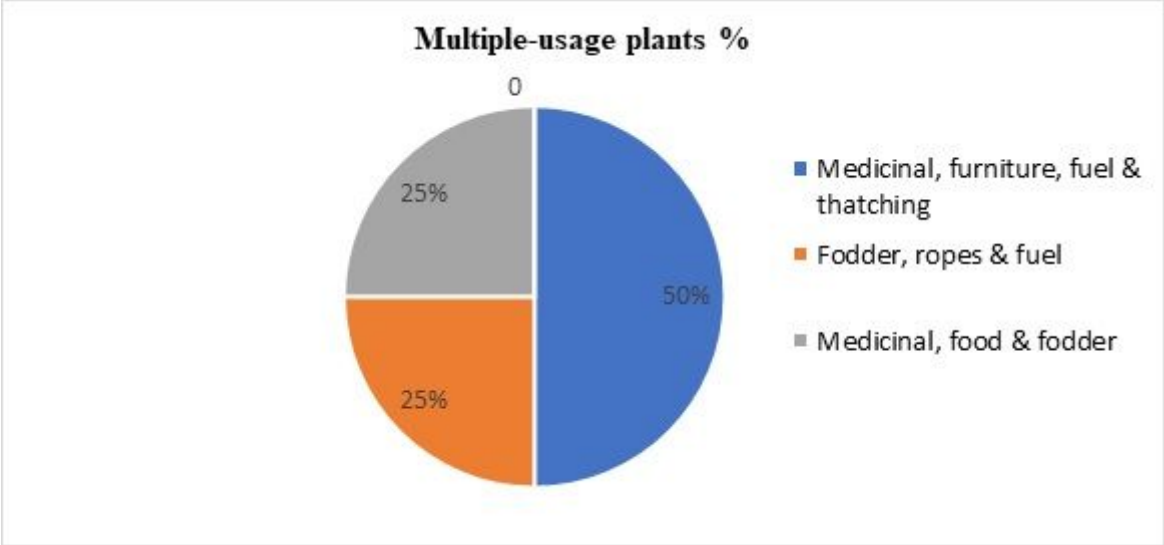
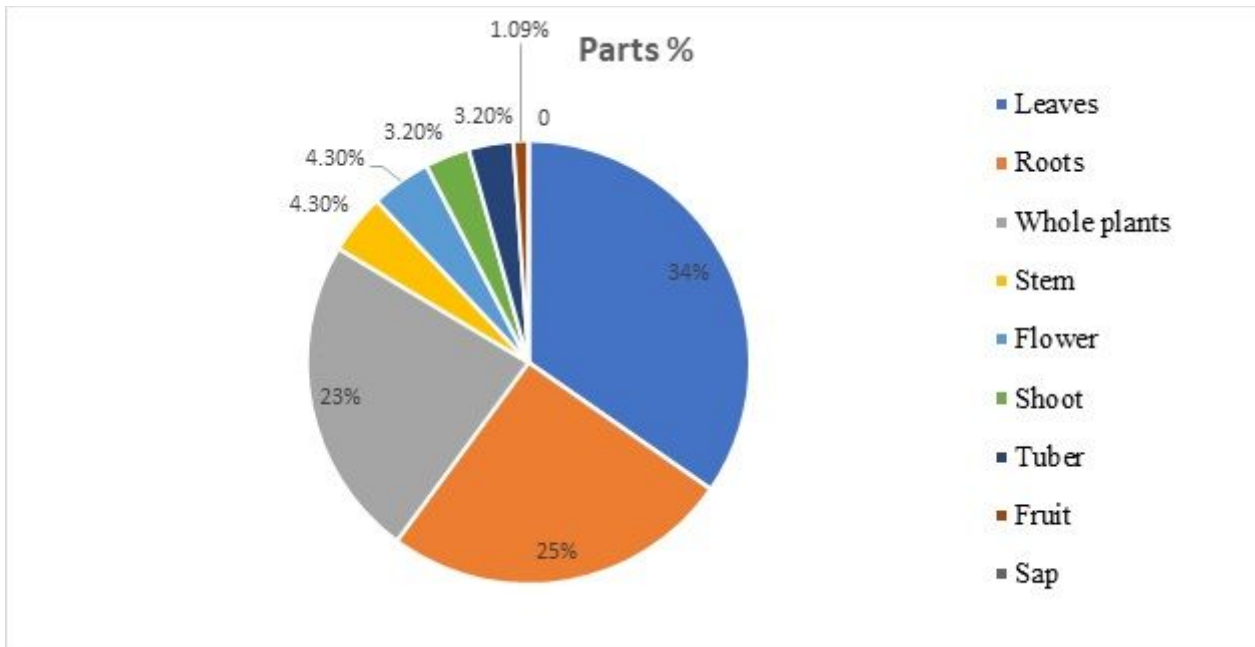


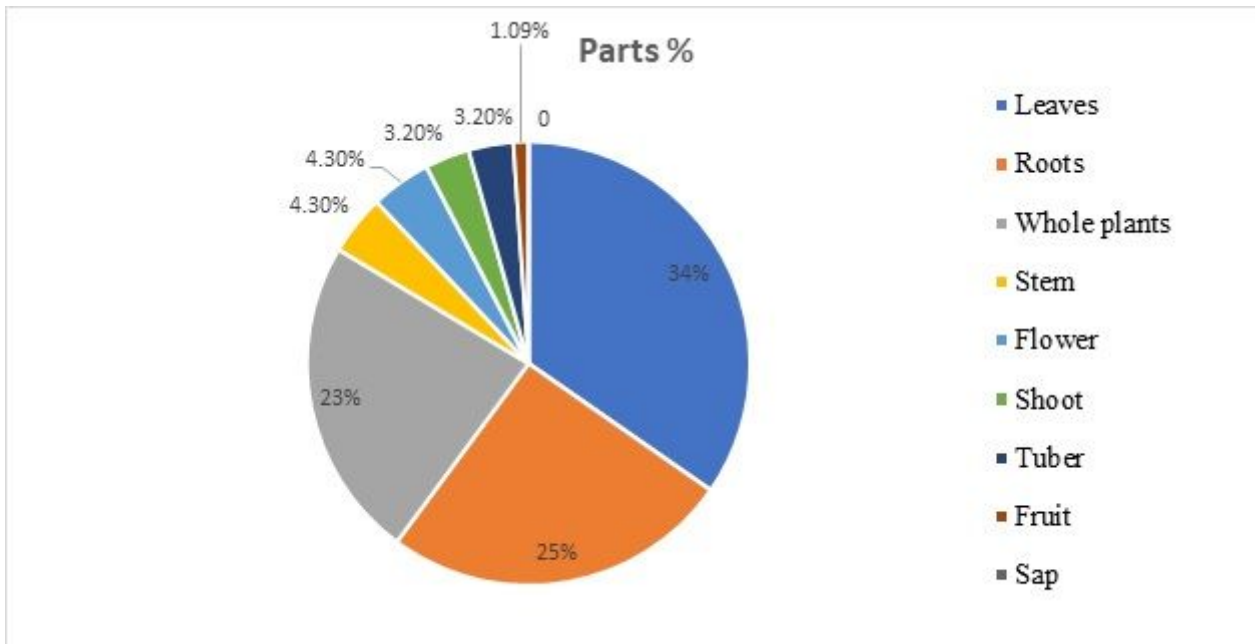
Figure 5

A pie chart of multiple-usage plants



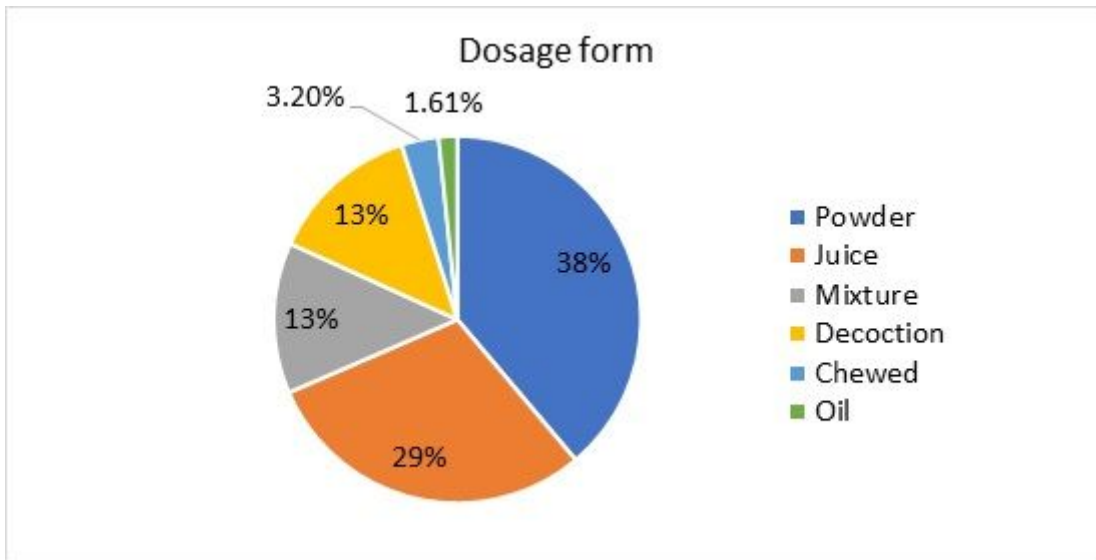
**Figure 6**

A pie-chart of different parts of plants used for the treatment of different diseases



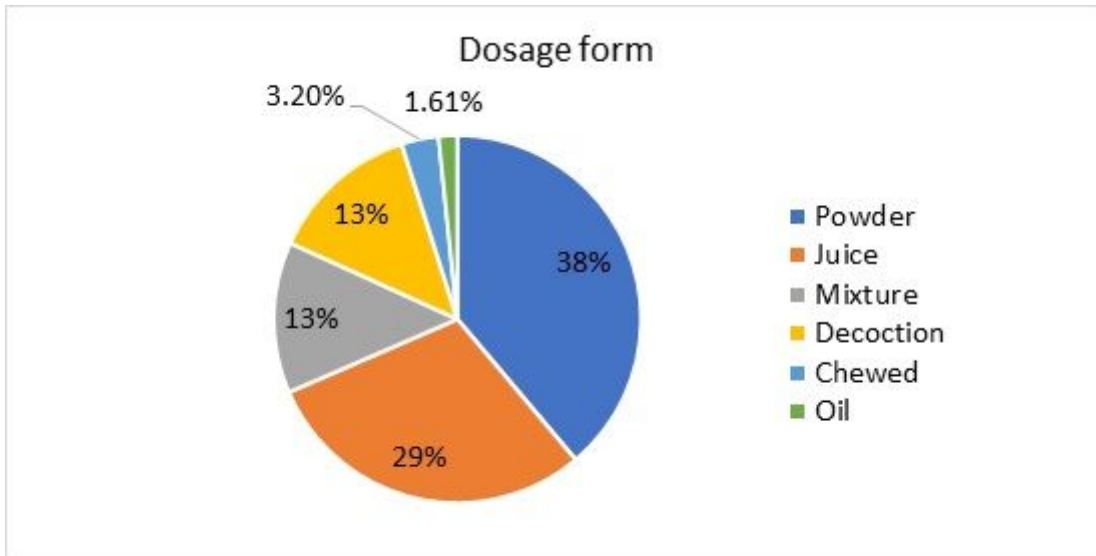
**Figure 6**

A pie-chart of different parts of plants used for the treatment of different diseases



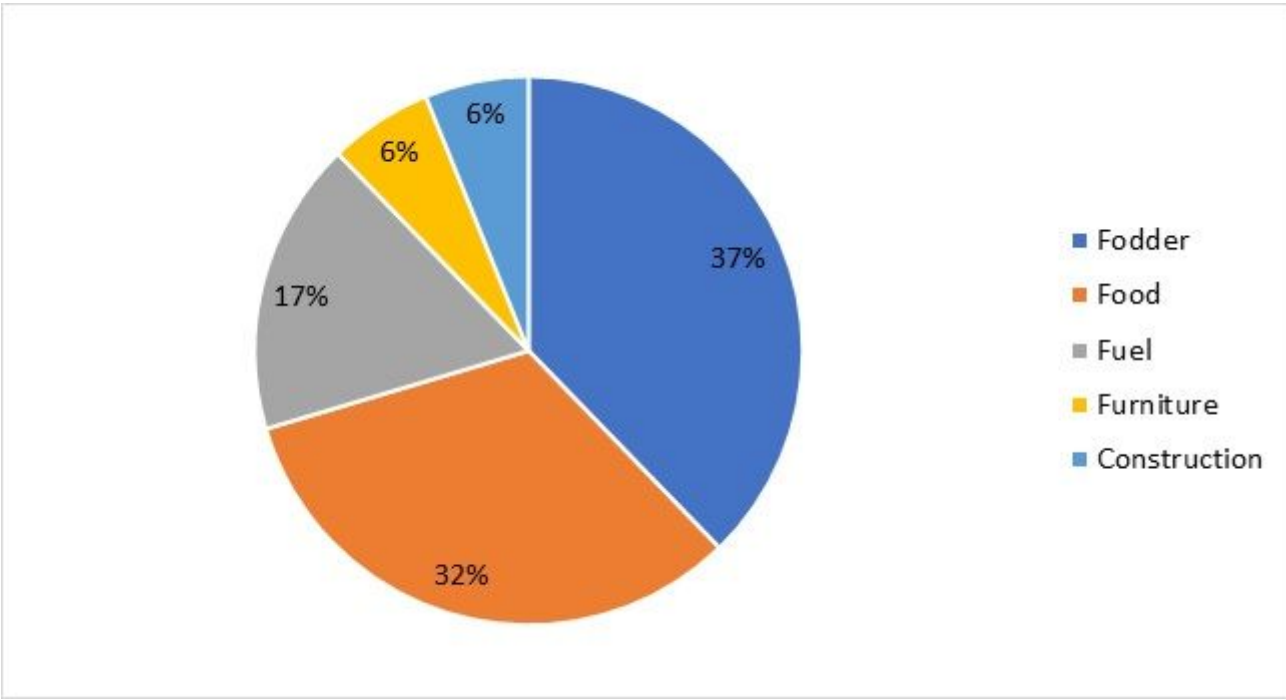
**Figure 7**

A pie chart of Dosage form used against diseases



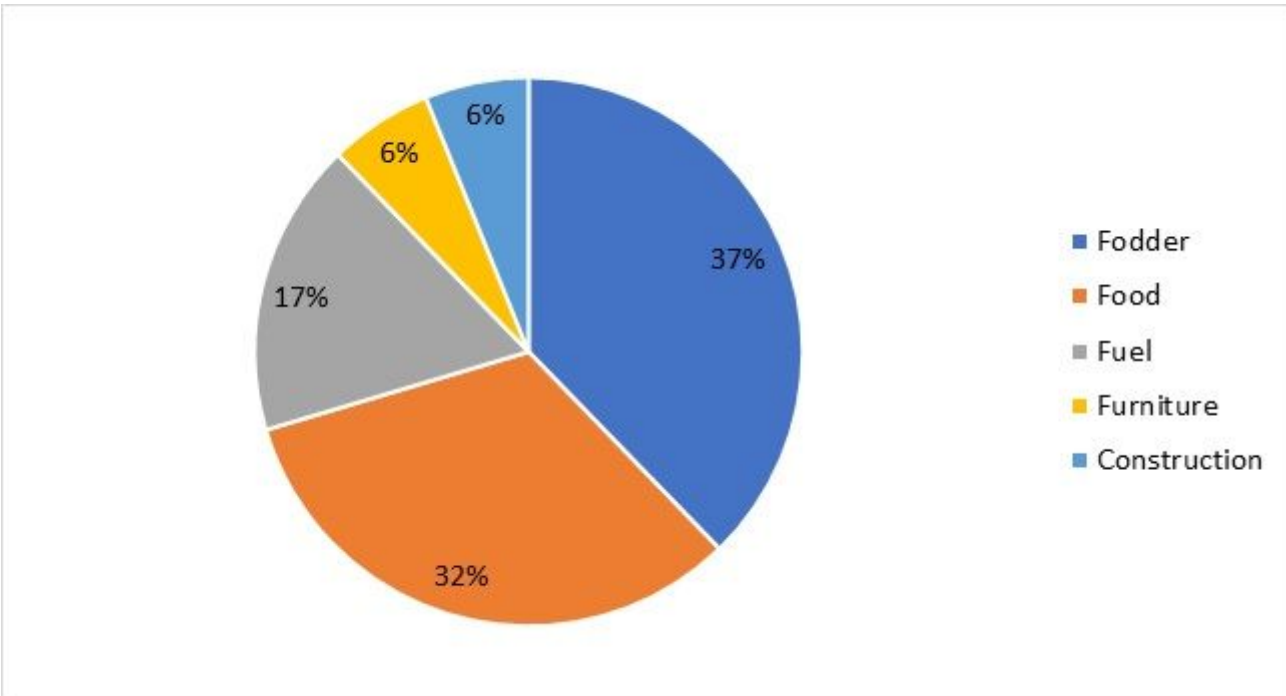
**Figure 7**

A pie chart of Dosage form used against diseases



**Figure 8**

A Pie chart of different plants used by local people in different categories



**Figure 8**

A Pie chart of different plants used by local people in different categories

## Supplementary Files



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