



Quantitative analysis of ethnomedicinal plants of Tehsil Khuiratta, Azad Jammu & Kashmir, Pakistan

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Research

Abstract:

Background: This study was aimed at documenting quantitative ethnobotanical information of important medicinal plants which are being used by the local communities of Khuiratta, District Kotli, Azad Jammu & Kashmir (AJK), Pakistan.

Methodology: Using semi-structured questionnaires, 80 local residents of the study area were interviewed. The collected data was examined by using quantitative indices of ethnobotany such as Use Value (UV), Frequency of Citation (FC), Relative Frequency of Citation (RFC), Informant Consensus Factor (ICF), and Jaccard Similarity Index (JI).

Results: A total of 65 useful species of plants belonging to 36 families were collected from the study area. Of them, 13 plants were not reported in previous studies; while some plant species showed new uses which were not mentioned in previous investigations. The Asteraceae was the most dominant family that contributed 8 medicinal plants in the research area. Major life form of plants inhabiting in the area was herb (61%); while leaves (35%) were highly used in preparing recipes and most common mode of preparations were decoction and powder form (12% each). RFC was ranged from 0.11 to 0.78; while UV was ranged from 0.10 to 0.82. Higher ICF was recorded for kidney and urinary tract infection (0.86). The JI was ranged from 2.28 to 19.56.

Conclusion: The primary objective of this research was to provide and conserve useful information about the therapeutic use of the native plant species of Khuiratta, AJK. This research appraisal provides some additional and novel uses along with higher RFCs and UVs which may serve as benchmark for phytochemical analysis and novel therapeutic properties.

Keywords: Khuiratta, Quantitative ethnobotany, Ethnomedicinal plants, Therapeutic properties.

Background

Ethnobotany is a living science that deals with documenting traditional knowledge of plants which can be used in different needs of human being (Qureshi *et al.* 2016). In this era, ethnobotany plays a major part in the global economy, which is not used only in our daily lives, but also imparts significant contributions in the modern agriculture sector and pharmaceutical industry (Oliver 2013). Plants with medicinal properties are essential for the survival of underdeveloped cultures (Qureshi *et al.* 2016; Munawar *et al.* 2022). Herbal medicines are also widely utilized in developed countries. China is leading country in which 40–50% of the population use herbal medicine as supplemental healthcare, followed by Germany (40–50%), France (49%), Australia (48%) and US (42%) as reported by Kassaye *et al.* (2006) and Bibi *et al.* (2014). Out of the 422,000 angiosperms, 50,000 plants are being exploited for medicinal purpose. According to the World Health Organization (WHO), most of drugs are of from plant origins (Rates 2001). Plants have been used in herbal formulations, resulting in effective medicines that have been studied for decades and cannot be substituted with new allopathic preparations (Ahmad 1998). Plant-based drugs are highly effective and have fewer side effects as compared to the modern synthetic drugs (Mahdi 2010).

Most of the information about the utilization of the plant is typically retained to the traditional healers (*Hakeems*) and aged people, and it is passed on verbally to the next generation (Qureshi & Bhatti, 2008; Qureshi *et al.* 2010). Most of the native women of the rural communities have very diverse information about the usage of medicinal plants (Mahmood *et al.* 2012; Rehman *et al.* 2022a). There is a great risk of information loss due to advanced healthcare system, population growth, and poor interactions between the new and old generations. Knowledge from the native people of an area is now being critically depleted due to certain factors like urbanization, long-term drought, deforestation, migration of local people, and less information about the importance of flora of an area (Vitalini *et al.* 2013).

Pakistan is endowed with diverse medicinal plants because it has a variety of climates, ecological zones, soil types, and diverse habitats (Hussain *et al.* 2010). There are 400–600 plants that have been recognized and are being utilized in the customary healthcare system (Hamayun 2005, Shinwari & Qaiser 2011; Rehman *et al.* 2023). Most of the north and west regions of Pakistan are enriched with medicinal plants. Azad Jammu and Kashmir (AJK) has rich biodiversity and most of the area is comprised on hilly area that contains diverse medicinal plants. It is situated in the western Himalayan foothills between 73–751° East longitude and 33–351° North latitude and occupies an area of 13,269 km². The main rivers of AJK are Poonch, Neelum and Jehlum. District Muzaffarabad, Bagh, Poonch, Sudhanoti, etc. situated towards the north; while, districts Mirpur, Kotli, Bhimber, etc. are located to the south having rolling plains (Anonymous 2006).

Some ethnomedical research has been published from various areas of AJK, including District Neelum, AJK (Mahmood *et al.* 2011), District Poonch, AJK (Khan *et al.* 2012), District Kotli, AJK (Ajaiib *et al.* 2010; Amjad *et al.* 2015, Amjad & Arshad 2014) and Sudhanoti (Ishtiaq *et al.* 2015). However, Tehsil Khuiratta of district Kotli AJK is still unexplored in terms of quantitative ethnobotanical data. Therefore the main objectives of the study were (i) to record ethnobotanical knowledge of medicinal plants (ii) to find novelty by comparing the collected data with already published work (iii) and to analyze the data by using various quantitative indices.

Materials and Methods

Study area

The study was conducted in Khuiratta is one of the largest Tehsil of district Kotli AJK. It lies 29 km southeast to Kotli and 165 km to the east of Islamabad. It covers an area of 46559 canals and 3 marlas. The Line Of Control (LOC) is about 7 kilometers away from Khuiratta. It lies between 33° N, 74° E. Khuiratta is a humid subtropical in nature without any dry seasonal climate. It is located at an elevation of 801 meters above sea. The average temperature in winter is 22°C; while the average temperature during summer is 41°C. There is about 376 mm of rain per year with a humidity of 46.47%. (Fig. 2).

Map of Khuiratta AJK

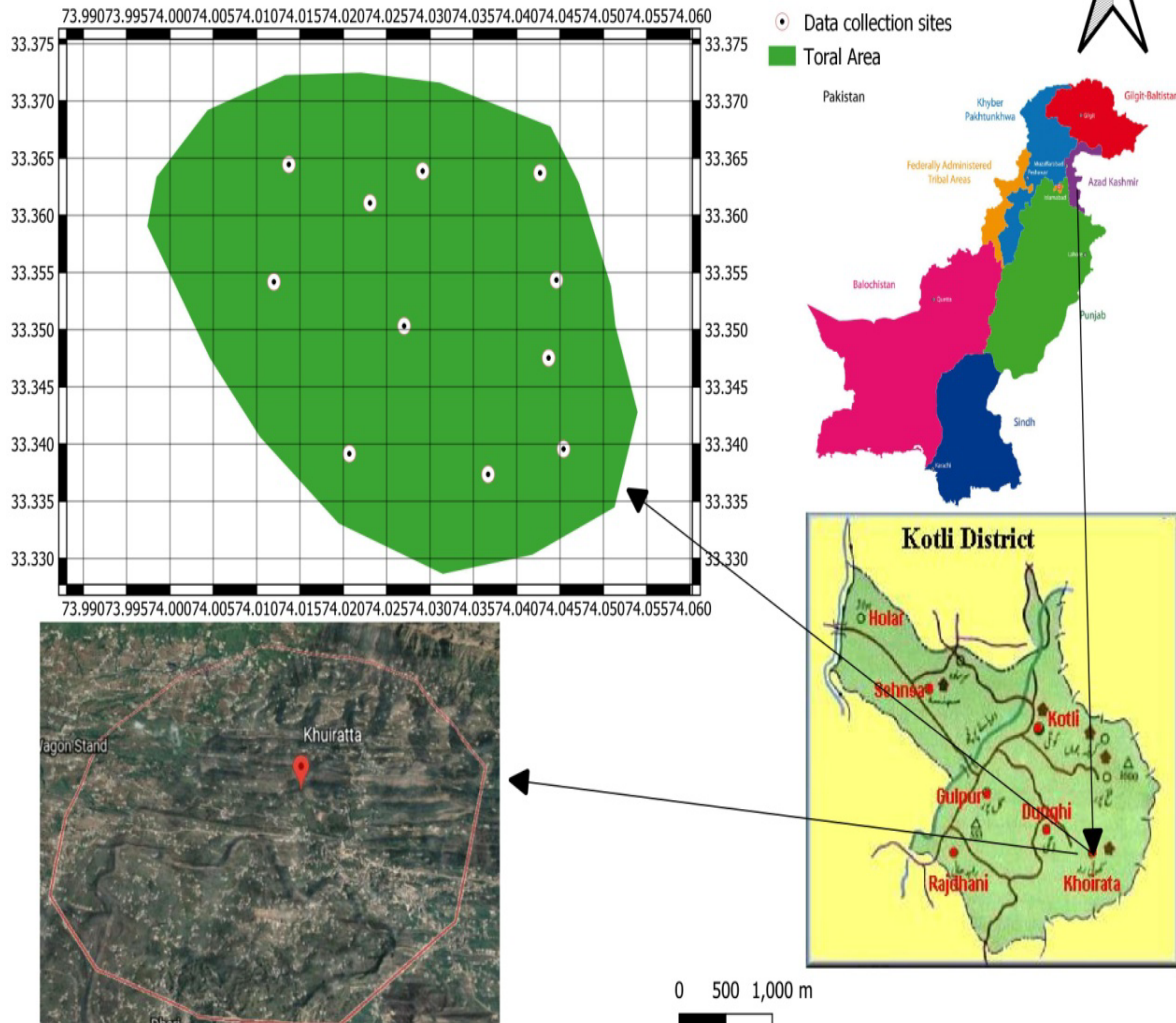


Figure 1. Map of the study area

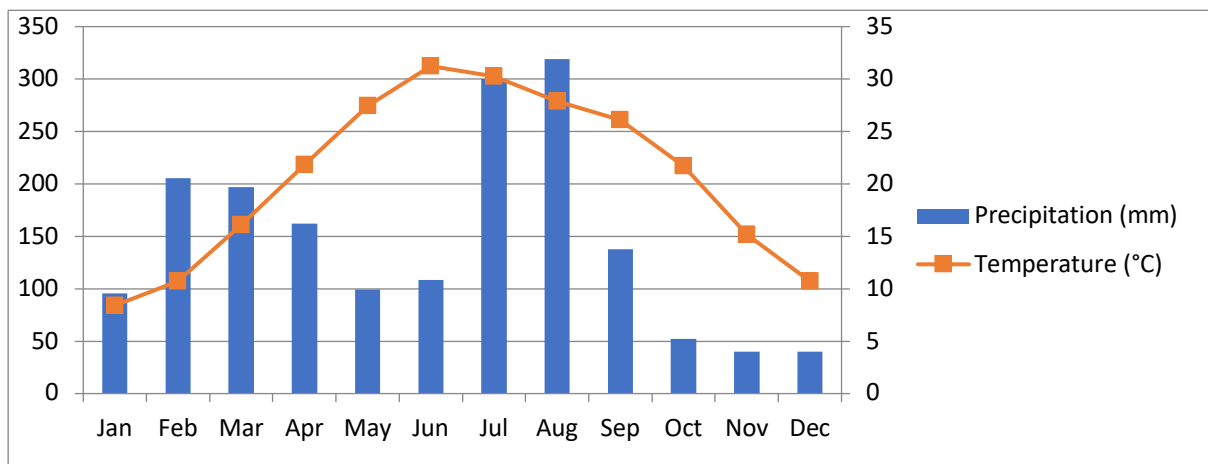


Figure 2. Climate of the study area

Qualitative data collection

The ethnobotanical survey was carried the month of September 2020 to August 2022. A total of 80 informants were interviewed. Data were collected by using field interviews with shepherds, housewives, local herbalists (*Hakeems*), local medicinal plants merchants (*Pansaries*), and other pure cultured persons. The participant's demographics (gender, age, and occupation) were also recorded. The interviews were conducted in the local language (*Pahari*) as

well as in Urdu. All the collected data were written on a questionnaire designed for ethnobotanical data documentation. At the site, ethnobotanical data such as common name, part utilized, recipe, medicinal applications, and ethnographic data of the people were documented. The obtained data were further cross-checked at several villages to ensure the validity of the ethnobotanical knowledge by displaying fresh specimens, stating local names, and showing field images to respondents.

Plant collection, identification and preservation

Plant specimens were collected with all available parts (roots, stem leaf, and flower). These were properly pressed, dried and then mounted on herbarium sheets. Identification of plant species was made by taxonomist/experts, and further verified through the Flora of Pakistan (<http://www.efloras.org/flora>) and The Plant List. The final herbarium sheets were then deposited at PMAS herbarium of the Arid Agriculture University, Rawalpindi.

Quantitative data analysis

The following quantitative indices were used to verify the homogeneity and validity of collected ethnobotanical data.

Informant Consensus Factor (ICF)

The ICF was utilized to compare the respondent's information for each use category and to verify the work's legitimacy and calculated by using following formula (Heinrich *et al.* 2009).

$$ICF = \frac{Nur - Nt}{Nur - 1}$$

Where *Nur* denotes to the total number of utilization records for each cluster of diseases and *Nt* denotes to the total number of plant species used.

Use Value (UV)

Use value (UV) is a frequently used index to measure the relative significance of valuable plants (Phillips & Gentry, 1993). It was calculated by using following formula:

$$UV = \frac{\sum U_i}{N}$$

Where, $\sum U_i$ denotes the number of uses reported by the local people for a particularly given species and *N* denotes to the total number of interviewed informants.

Jaccard Similarity Index or Jaccard index (JI)

This index is used to compare the data examined with that of other ethnobotanical studies carried out in other countries around the world, as well as among the indigenous communities in the areas studied and was calculated by using following formula (Gonza *et al.* 2008):

$$JI = \frac{C \times 100}{(a + b + c)}$$

Where "a" is the recorded number of plant species in our study area where "b" is the recorded number of species in other neighboring area and "c" is the common number of species in both areas

Relative Frequency of Citation (RFC)

The relative frequency of the citation indicates the local significance of each medicinal plant species used in the region by the indigenous people (Ouelbani *et al.* 2016). It was calculated by using following protocol:

$$RFC = \frac{FC}{N (0 < RFC >)}$$

Where, FC denotes number of informants who reported particular species usage while *N* denotes total number of informants who took part in the study.

Results and Discussion

Demographic data of informants:

During the field survey from 2021 to 2022, demographic characters of informants were determined and documented through face-to-face conversation. In all, 80 informants were interviewed in which, 19 informants were women, 61 men, 21 herbal practitioners and 17 were shepherds.

The shepherds mostly rely on plants as they continuously migrate from one area to another. They are also quite knowledgeable on how to use plants.

Most of the informants interviewed (62) were above 40 years of age; while rest of the 18 informants were under 40 years of age. Old-aged informants are well versed on indigenous information about the local plants.

The demographic data is provided in Table 1. By considering their educational background 23 Informants (15 men and 8 women) were illiterate while 8 informants had only primary education, 16 middle (12 men and 4 women), 14 secondary (11 men and 3 women), 16 graduates(13 men and 3 women); while rest of 6 were M.Phil. scholars (5 men and 1 woman). Most illiterate people rely on herbaceous plants for different purposes. Some M. Phil. scholars also have useful indigenous knowledge about the plants.

Table 1. Demographic data of informants of study area.

Age group	10-20	20-30	30-40	40-50	50-60	Above 60>	Total
Male	3	7	8	16	14	13	61
Female	---	---	---	4	9	6	19
Total	3	7	11	20	28	18	80
Educational background	Illiterate	Primary	Middle	Secondary	Graduate	Post graduate	
Male	15	8	12	11	13	5	64
Female	5	---	4	3	3	1	16
Total	20	8	16	14	16	6	80
Profession	Herbal practitioners	Shepherds	Local people	Shopkeepers	Pansaries		
Male	18	17	16	13	9	---	73
Female	3	---	4	---	---	---	7
Total	21	17	20	13	9	---	80

Medicinal plant diversity

A total of 65 plant species belonging to 33 families recorded as medicinal, in which Asteraceae was the most dominant plant family that contributed 8 plant species (Fig. 3). Asteraceae was also dominant in previous findings (Shaheen *et al.* 2017). Table 2 shows the findings of the field survey as well as the ethnomedicinal plants found in the research region.

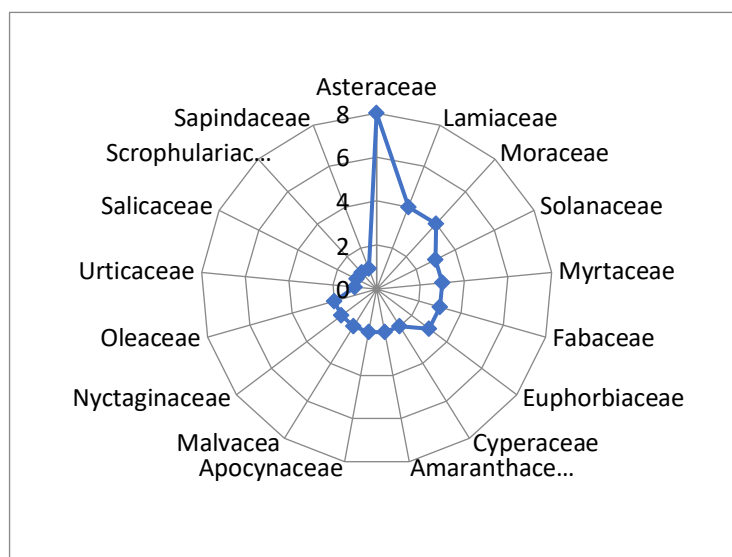


Figure 3. Contribution of plants by major families.

Table 2. Ethnomedicinal plants found in the research region.

Plant families and scientific name	Common name	Habitat	Parts used	Mode of preparation	Route of administration	Ethnobotanical data	Previous Report	RFC	UV
Asteraceae									
<i>Artemisia vulgaris</i> L.	Gajjar booti	Herb	Leaves	Extract	Oral	Leaves extract used in chest inflammation and chronic fever. It is also used to kill abdominal worms. Extract with almond oil used to treat ear ache and ear wounds . It is used as fodder.	1□,2□,3◇,4□,5◇,6□,7□,8□,9□,10□,11□,12□,13□,14□,15□	0.23	0.15
<i>Cirsium arvense</i> (L.) Scop.	Kandaal	Herb	Leaves	Extract	Oral	Extract from leaves mixed with honey helps in treatment of catarrh and chest inflammation .	1□,2□,3□,4□,5□,6□,7□,8□,9□,10□,11□,12□,13□,14□,15□	0.13	0.32
<i>Eclipta alba</i> (L.) Hassk.	Sofed banghara	Herb	Leaves	Decoction	Oral	Boiled in water helps in treatment of leprosy. Leaves extract helps to reduce fever. Its leave extract mixed with gooseberry oil helps to stop premature hair whitening . It is used as fodder.	1□,2□,3□,4□,5□,6□,7□,8□,9◇,10□,11□,12□,13□,14□,15□	0.11	0.13
<i>Taraxacum officinale</i> (L.) Weber ex F.H.Wigg.	Khali Hand	Herb	Flower	Decoction(tea)	Oral	It is used in treatment of Hepatitis	1□,2□,3•,4•,5◇,6•,7□,8□,9□,10◇,11□,12□,13□,14□,15□	0.20	0.11
<i>Vernonia cinerea</i> (L.) Less.	Booti	Herb	Leaves	Poultice	Topical	Leaves used in treatment of skin problems(Abscesses)	1□,2□,3□,4□,5□,6□,7□,8□,9□,10□,11□,12□,13□,14□,15□	0.15	0.10
<i>Xanthium strumarium</i> L.	Sarkandy	Herb	Seeds	Poultice	Topical	Paste of seed used to treat inflamed skin(Abscesses)	1□,2□,3□,4□,5◇,6◇,7□,8□,9□,10◇,11□,12□,13◇,14□,15□	0.35	0.25
				Infusion	Oral	It is used Treatment of dysentery			
			Whole plant	Juice	Oral	Whole plant juice mixed with carrot act as Antirheumatic.it is also used as fodder.			

<i>Tagetes erecta</i> L.	Booti	Herb	Leaves	Poultice(paste)	Topical	Paste of leaves applied on body which helps in proper flow of bloodstream	1□,2□,3□,4□,5□,6□,7□,8□,9□,10□,11□,12□,13□,14□,15□	0.21	0.28
				Vegetable	Oral	Leaves used as vegetable in treatment of Tonsillitis .			
			Flowers	Poultice(paste)	Topical	Flower paste is helpful for eyes infection.			
<i>Helianthus annuus</i> L.	Soraj Mukhi	Herb	Leaves	Decoction (extract)	Oral	Leaves extract helps to cure earache.	1□,2□,3□,4□,5□,6□,7□,8□,9□,10□,11□,12□,13□,14□,15□	0.42	0.5
			Seeds	Powder	Oral	Seeds powder mixed with water used to kill abdominal worms (vermicide) . It is used as fodder.			
Acanthaceae									
<i>Justicia adhatoda</i> L.	Bakhar	Herb	Leafs	Infusion	Oral	It acts as Blood purifier. It is used reduce Inflammation in stomach .	1•,2◇,3□,4□,5•6□,7◇,8□,9□,10◇,11□,12□,13□,14□,15□	0.18	0.42
Asclepiadiaceae									
<i>Calotropis procera</i> (Aiton) Dryand.	Akk	Herb	Latex,	Poultice	Topical	Latex is used to kill abdominal worms (vermicide). It is also used to heal wounds of diabetic patients . Antinflammatory, vermicide, Leaves act as painkiller. Latex applied on skin is beneficial for sting of honey bee and scorpion.	1◇,2◇,3□,4◇,5□,6□,7◇,8□,9◇,10◇,11□,12□,13□,14□,15□	0.48	0.62
			Leaves	Paste of leaves mixed with oil	Topical	Paste of leaves heat in oil applied on body helps to relief inflamed joints (Antirheumatic). It is also used as painkiller.			
Apocynaceae									
<i>Catharanthus roseus</i> (L.) G.Don	Sadda bahar	Herb	Leaves	Infusion	Oral	Extract of leaves helps to remove itchiness. It is also in treatment of chest and lung infection.	1□,2□,3□,4□,5□,6□,7□,8□,9□,10□,11□,12□,13□,14□,15□	0.2	0.25
<i>Nerium oleander</i> L.	<i>Gandeera</i>	Shrub	Flower	Juice	Oral	Dried powder of flower mixed in milk used to stop vomiting (nausea).	1•,2◇,3□,4□,5◇,6□,7□,8□,9□,10◇,11□,12□,13□,14□,15□	0.32	0.2
			Leaves	Extract	Oral	Extract of leaves is expectorant .			
			Roots	Poultice	Topical	Poultice applied on body to heal wounds and skin infection (leprosy).			

Amaranthaceae									
<i>Achyranthes aspera</i> L.	Puthkanda	Herb	Whole plant,	Boiled	Oral	Whole plant boiled in water given for the treatment of piles, Abdominal pain, asthma and cough	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15	0.38	0.35
			Leaves	Poultice	Topical	Grind fresh leaves mixed with honey beneficial for, snake and scorpion bitten areas.			
				Paste	Topical	Paste of leaves used in treatment of asthma.			
<i>Chenopodium album</i> L.	Bathwa	Herb	Seeds	Extract(oil)	Oral	Oil from seeds helps kill abdomen insects. Oil from seeds helps to cure dysentery . It is also used as fodder.	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15	0.48	0.55
Asparagaceae									
<i>Asparagus setaceus</i> (Kunth) Jessop	Asparagus	Herb	Roots	Powder	Oral	Powder form roots helps in treatment of spermatorea . Helps to increase milk in womens and sperms in male.	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15	0.18	0.1
Boraginaceae									
<i>Cynoglossum lanceolatum</i> Forssk.	Churoun	Herb	Areal part	Extract	Oral	Helps to treat dysentery, helps to treat skin allergies . Helps to remove any kind of inflammation. It is used as a Blood purifier. It is used as fodder.	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15	0.21	0.27
Cactaceae									
<i>Opuntia ficus-indica</i> (L.) Mill.	Thor	Herb	Fruit	Eaten	Oral	Ripened fruit is used to kill bacteria that are cause Gonorrhoea . It is used in treatment of rabies	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15	0.28	0.41
			Latex	Syrup	Oral	Latex is beneficial for digestion and expectorant and skin infection.			
			Root	Crushed in water	Topical	Roots are used to treat snake bite			

Cannabaceae									
<i>Cannabis sativa</i> L.	Bhang	Herb	Leaves	Extract	Oral	Grind leaves helps to cure Hemorrhoids caused by piles. Helps in reducing whooping cough and chronic headache Leaves are painkiller.	1□,2□,3□,4◇,5◇,6◇,7◇,8◇,9◇,10◇,11□,12□,13□,14□,15□	0.51	0.47
			Seeds	Powder	Oral				
Cyperaceae									
<i>Cyperus scariosus</i> R.Br.	Ghass	Herb	Leaves	Extract	Oral	It is used in making Perfume It act as Brain tonic	1□,2□,3□,4□,5□,6□,7□,8□,9□,10□,11□,12□,13□,14□,15□	0.31	0.23
			Roots	Powder	Oral				
<i>Cyperus rotundus</i> L.	Kah	Herb	Leaves	Decoction (Tea)	Oral	Tea of Cyprus with mint helps in treatment of cholera.	1□,2□,3□,4□,5◇,6□,7□,8□,9◇,10◇,11□,12□,13□,14□,15□	0.35	0.38
Cucurbitaceae									
<i>Luffa acutangula</i> (L.) Roxb.	Ghai toori	Herb	Fruit	Extract	Oral	2 – 3 drops of extract of fruit helps treatment of epilepsy (brain disorder) . It is also used as vegetable. Its leaves are used as fodder.	1◇,2□,3□,4□,5□,6□,7□,8□,9□,10□,11□,12□,13□,14□,15□	0.56	0.66
Convolvulaceae									
<i>Ipomoea hederacea</i> (L.) Jacq.	Kala dana	Herb	Seeds	Powder	Oral	Grind Seeds used in treatment of dysentery and loose motion . It is used as expectorant	1□,2□,3□,4□,5□,6□,7□,8□,9□,10□,11□,12□,13□,14□,15□	0.30	0.38
Euphorbiaceae									
<i>Euphorbia hirta</i> L.	Booti	Herb	Areal part	Decoction	Oral	It is used to treat Cough. It is also used to maintain blood pressure .	1□,2□,3□,4□,5□,6□,7◇,8□,9□,10◇,11◇,12□,13□,14□,15□	0.45	0.40
<i>Mallotus philippensis</i> (Lam.) Müll.Arg.	Kamila	Tree	Fruit	Infusion	Oral	It is used to expel parasitic worms from body (Anthelmintics) and helps in treatment of skin infection due to fungus (ringworm) . The wood is often used as fuel wood.	1◇,2•,3□,4◇,5□,6□,7◇,8□,9□,10□,11□,12□,13□,14□,15□,15◇,	0.53	0.82

<i>Ricinus communis</i> L.	Harnoli	Shrub	Fruit	Paste	Topical	Its paste when applied on breast of mother which helps to increase flow of milk.	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15	0.71	0.50
				Juice	Oral	Paralysis, Bell's palsy and cough. Oil is immunity. It is also used as fooder.			
Fabaceae									
<i>Acacia arabica</i> (Lam.) Willd.	Kikar	Tree	Stem	Toothbrush	Topical	Fresh stem is used for teeth whitening.	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15	0.48	0.63
			Leaves	Infusion(tea)	Oral	Leaves are used to relief abdominal pain. Its wood is used as fuel wood			
<i>Cassia angustifolia</i> Vahl.	Amaltas	Shrub	Leaves	Juice	Oral	Leaves are used to kill stomach worms. Dried leaves mixed with lemon waters beneficial for skin.	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15	0.36	0.23
<i>Dalbergia sissoo</i> DC.	Tali	Tree	Leaves,	Extract (Tea)	Oral	Shampoo of leaves helps in hair growth. Boiled leaves extract helps to reduce the inflammation of breast and Urethral Infection.	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15	0.75	0.60
			Wood		Topical	Its oil obtained from wood is beneficial for skin infection (Pruritus). Its wood is used as fuel wood			
Lamiaceae									
<i>Clerodendrum bungei</i> Steud.	Guldasta booti	Shrub	Roots	Extract	Oral	Roots extract mixed with ginger powder helps in treatment of paralysis.	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15	0.16	0.22
<i>Mentha spicata</i> L.	Podina	Herb	Leaves	Juice (extract)	Oral	Beneficial for Belly Ache. Leaves extract drops are used to kill ear worms. Juice of mint used to stop Singultus. Best for heart and stomach Jaundice vomiting, Catarrh. It is used to treat obesity.	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15	0.62	0.80
<i>Origanum vulgare</i> L.	Jangali majorum	Herb	Leafs	Decoction (tea)	Oral	Tea of leaves helps in treatment of nousia. Its also act as blood purifier.	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15	0.41	0.51
				Poultice	Topical	Paste of leaves beneficial for sore eyes.			

<i>Ocimum basilicum</i> L.	Niazboo	Herb	Leaves	Extract	Oral	Leaves extract mixed with honey act as flum expectorant.	1□,2□,3□,4□,5□,6□,7□,8□,9□, 10□,11□,12□,13□,14□,15□	0.48	0.50
			Flower	Syrup	Oral	Flowers act as diuretics (difficulty in passing urine) and skin emollient.			
			Seed	Powder	Oral	Seeds used in treatment of Spermatorrhoea.			
			Root	Poultice(paste)	Topical	Roots used in treatment of skin problems (Abscesses).			
<i>Vitex negundo</i> L.	Bannna	Shrub	Leaves	Poultice	Topical	Crushed leaves applied on body used to treat inflamed joint (Antirheumatic)	1□,2□,3□,4□,5□,6□,7□,8□,9□, 10□,11□,12□,13□,14□,15□	0.33	0.28
				Extract	Oral	Boiled leaves in hot water helps in treatment of skin infection(leprosy). Its leaves used as fodder.			
			Flowers	Extract	Oral	Flowers are used to treat fever, eyes infection and womb infection.			
Malvaceae									
<i>Abutilon frutescens</i> Medik.	Jai	Herb	Leaves	Decoction(tea)	Oral	Leaves tea gargling helps to relief teeth pain and make gums healthy.	1□,2□,3□,4□,5□,6□,7□,8□,9□, 10□,11□,12□,13□,14□,15□	0.15	0.11
<i>Abelmoschus esculentus</i> (L.) Moench	Bhindi	Herb	Fruit	Cooked	Oral	Best for male fertility . Best of gastric ulcer. Best of urinary tract infection. It also used as vegetable.	1□,2□,3□,4□,5□,6□,7□,8□,9□, 10□,11□,12□,13□,14□,15□	0.66	0.61
			Seed	Dry powder	Oral	Powder of dry seeds helpful to control excessive nocturnal emission.			
			Root	Paste	Topical	Paste of roots best wound healer.			
Moraceae									
<i>Ficus palmata</i> Forssk.	Phagwara	Tree	Fruit	Eaten	Oral	It is used in treatment Constipation, asthma and cough. Its wood is used as fuel food. Leaves are used as fodder.	1□,2□,3□,4□,5□,6□,7□,8□,9□, 10□,11□,12□,13□,14□,15□	0.78	0.67

Ethnobotany Research and Applications

<i>Ficus religiosa</i> L.	Peepal	Tree	Leaves	Tea	Oral	Boiled dried leaves help in preventing vomiting and nausea . Leaves are used as fodder.	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15	0.60	0.46
				Paste	Oral	Paste of leaves to make tablets helps in piles.			
			Fruit	Powder	Oral	Powder of dried fruit given for 15 days to treat asthma.			
			Bark	Paste	Topical	Paste of bark helps to cure wounds. Its wood acts as fuel wood.			
<i>Ficus benghalensis</i> L.	Bohar	Tree	Fruit	Eaten	Oral	It is used in treatment of infection transmitted due to sexual contact (Gonorrhoea). It is also used to reduce the swelling of gall bladder (Cholecystitis) and used to control involuntary emission of semen (Spermatorrhoea). Leaves are used as fodder.	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15	0.76	0.70
				Latex	Poultice	Topical			
			Bark	Decoction	Oral	Bark boiled in water act as antidiabetics.			
			Root	Paste	Topical	Column roots paste used in treatment of infertility.			
<i>Morus alba</i> L.	Shah toot	Tree	Flower	Powder	Oral	Powder of dried flower used in treatment of piles . The grind leaves paste applied on skin for treatment of Abscesses.	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15	0.71	0.73
				Leaves	Paste	Topical			
			Seeds	Powder	oral	Seed are best for immunity. It is used in therapy of inflamed joints(Antirheumatic).			
			Roots	Decoction		Roots used as blood purifier. Its wood acts as fuel wood.			

Myrtaceae									
<i>Melia azadarch</i> L.	Driek	Tree	Leaves	Extract	Oral	Leaves extract is blood purifier. Leaves are used as fodder.	1□,2□,3□,4◇,5◇,6□,7◇,8◇,9◇, 10◇,11◇,12□,13◇,14□,15◇,	0.70	0.60
			Fruit	Extract, wash hairs with extracts	Oral	Fruits extract is for hair growth and kill lice . Seeds help to treat constipation and piles.			
<i>Psidium guajava</i> L.	Amrood	Tree	Fruit	Eaten	Oral	Fruit is best for stomach and heart. Helps in digestion. Leaves are used as fodder.	1□,2□,3□,4◇,5□,6□,7□,8□,9◇, 10□,11◇,12□,13□,14□,15□	0.75	0.66
			Seed	Eaten	Oral	Seeds used to kill abdominal worms (vermicide) .			
			Flower	Paste	Topical	flowers paste is used for eyes infection			
<i>Syzygium cumini</i> (L.) Skeels	Jaman	Tree	Seeds	Powder	Oral	Seeds powder mixed in milk acts as Antidiabetic	1□,2□,3□,4□,5□,6□,7□,8□,9□, 10•,11□,12□,13□,14□,15•,	0.73	0.70
			Fruit	Eaten	Oral	It helps to reduce burning sensation (prickely heat), ulcer and pimples			
Nyctaginaceae									
<i>Boerhavia procumbens</i> Banks ex Roxb.	Santhi	Herb	Leaves	Extract	Oral	Extract from leaf applied on infected areas, expectorant, stomachic, treatment of jaundice .	1□,2□,3□,4□,5□,6□,7◇,8□,9◇, 10□,11□,12□,13□,14□,15□	0.18	0.12
<i>Mirabilis jalapa</i> L.	Gul e abbasi	Herb	Flower	Powder	Oral	Powder of dried flower used in treatment of piles.	1□,2□,3□,4□,5□,6□,7◇,8◇,9□, 10◇,11□,12□,13□,14□,15□	0.40	0.46
			Seeds	Powder	Oral	Antirheumatic, seeds are used for immunity			
			Leaves	Paste	Topical	The grind leaves paste applied on skin for treatment of skin diseases (Abscesses).			
			Roots	Decoction	Oral	Roots used as a blood purifier.			
Oleaceae									
<i>Jasminum grandiflorum</i> L.	Jasminium	Shrub	Flower	Extract(oil)		Oil from flowers are helpful in wound healing .	1□,2◇,3□,4□,5◇,6□,7◇,8□,9□, 10◇,11□,12□,13◇,14□,15□	0.38	0.43
			Leaf	Extract(oil)		Its oil is used to treat chronic fever and act as heart tonic.			

<i>Olea ferruginea</i> Wall. ex Aitch.	Kahu	Tree	Leaves	Juice		It is used in treatment of cough and Lungs infection	1,2,3,4,5,6,7,8 9,10,11,12,13,14,15	0.61	0.62
			Stem	Toothbrush	Oral	It is best for bleeding gums and helps to reduce toothache.			
			Bark	Extract	Oral	It is used to treat fever and helps to relief the pain inflamed joint			
Oxalidaceae									
<i>Oxalis corniculata</i> L.	Jandouro	Herb	Leaves	Poultice	Topical	Grind leaves applied on skin to treat scorpion bite area.	1,2,3,4,5,6,7,8 9,10,11,12,13,14,15	0.52	0.43
				Juice	Oral	Helps in treatment of jaundice. It is best Liver and stomach tonic. It also act as Appetizer			
Poaceae									
<i>Cynodon dactylon</i> (L.) Pers.	Ghass	Herb	Leaf	Poultice	Topical	It helps in wound healing when poultice applied on body	1,2,3,4,5,6,7,8 9,10,11,13,14,15	0.30	0.22
				Infusion	Oral	Helps to treat lungs infection			
Punicaceae									
<i>Punica granatum</i> L.	Daruni	Shrub	Flower,	Powder	Oral	Flower powder orally used to treat cough and fever. Prevent vomiting. Diuretics. Helps to cure jaundice	1,2,3,4,5,6,7,8 9,10,11,12,13,14,15	0.40	0.57
			Seeds	Paste	Oral	Seeds are used as heart and liver tonic			
			Stem	Toothbrush	Oral	Best for bleeding gums and teeth's			
Papveracea									
<i>Fumaria indica</i> (Hauskn.) Pugsley	Shahteera	Herb	Seed	Powder	Oral	Seed act as blood purifier and helps in treatment of jaundice	1,2,3,4,5,6,7,8 9,10,11,12,13,14,15	0.22	0.17
			Leave	Infusion	Oral	Leaves extract helps in treatment of skin diseases (Psoriasis) and chronic fever			
Pteridaceae									
<i>Adiantum incisum</i> Forssk.	Moor pankh	Herb	Leaf	Decoction(tea)	Oral	It is used in treatment of snake poisoning and rabies.	1,2,3,4,5,6,7,8 9,10,11,12,13,14,15	0.12	0.13
Polygonaceae									
<i>Rumex obtusifolius</i> L.	Unknown	Herb	Leaves	Extract	Oral	It is used to treat constipation and helps prevent vomiting	1,2,3,4,5,6,7,8 9,10,11,12,13,14,15	0.18	0.23

Pinaceae									
<i>Pinus roxburghii</i> Sarg.	Cheer	Tree	Leaves	Decoction	Oral	Boiled leaves used in treatment of Throat and lungs infection . It also helps to relief tooth pain	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15	0.27	0.18
Rutaceae.									
<i>Zanthoxylum armatum</i> DC.	Timber	Shrub	Seed	Paste	Oral	It is used as Sputum expectorant. It is used to treat Obesity and gastric problems .	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15	0.70	0.68
			Stem	Toothbrush	Topical	It stem is used reduce Toothache and stops bleeding from gums.			
Rhamnaceae									
<i>Ziziphus nummularia</i> (Burm.f.) Wight & Arn.	Jhandi	Shrub	Fruit	Eaten	Oral	Fruit used to treat teeth problems and acts as stomach tonic.	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15	0.45	0.50
			Root	Powder	Oral	Grind roots with black paper boiled in water and given 3 times a day helps in treatment of dysentery .			
Rosaceae									
<i>Rosa damascena</i> mill L.	Rosa damacina	Shrub	Flowers	Extract	Oral	Extract of flower used in treatment of piles . Extract of flower used in medicines for eyes. Gargling with its tea use to treat throat problems. Extract also used to treat juindice.	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15	0.37	0.32
Smilacaceae									
<i>Hemidesmus indicus</i> (L.) R. Br. ex Schult.	Kapati	Herb	Roots	Decoction	Oral	Roots are helpful for skin diseases especial for infection on skin (leprosy). It acts as blood purifier .	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15	0.13	0.20
				Powder	Oral	Boiled roots in milk helps to get rid of chronic cough			
Solanaceae									
<i>Solanum surattense</i> Burm. f.	Mohkari	Herb	Roots	Decoction	Oral	Its roots boiled with honey to treat excessive discharge of mucus in the nose or throat (catarrh). It is used for treatment of Skin diseases. It acts as blood purifier	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15	0.16	0.12

<i>Solanum nigrum</i> Mill.	Kachach	Herb	Leaf	Decoction	Oral	Boiled Extract of leaves used for the treatment inflammation of liver and stomach. It also acts as diuretics.	1□,2□,3□,4•,5□,6•,7◇,8◇,9◇,10◇,11□,12□,13□,14◇,15□	0.21	0.16
			Stem	Infusion	Oral	Extract from stem and leaves used to remove excess fluid from body tissues (Hydropsy)			
<i>Datura innoxia</i> Mill.	Siah Dahtora	Herb	Seeds	Powder (tablets)	Oral	Powder of seeds helps in treatment of abnormally excessive sweating from hands (hyperhidrosis). Tablets from powder of datura helps to reduce body weakness and Maintain pregnancy	1□,2□,3□,4□,5□,6□,7◇,8□,9◇,10◇,11□,12□,13□,14□,15□		
Sapindaceae									
<i>Cardiospermum halicacabum</i> L.	Ballon wine	Herb	Leaf	Poultice	Topical	It is used to relief joint pain.	1□,2□,3□,4□,5□,6□,7□,8□,9□,10□,11□,12□,13□,14□,15□	0.15	0.18
				Extract	Oral	Leaves extract helps to relief ear pain.			
			whole plant	Decoction(tea)	Oral	Whole plant tea used in treatment of asthma.			
Scrophulariaceae									
<i>Verbascum thapsus</i> L.	Gidar tambako	Herb	Inflorescence areal part	Extract	Oral	It is used to relief facial pain (prosopagia) . It is used to treat involuntary urination that happens at night while sleeping (nocturnal enuresis) and piles.	1□,2□,3◇,4◇,5◇,6◇,7◇,8□,9□,10□,11□,12□,13□,14◇,15□	0.21	0.13
Salicaceae									
<i>Salix caroliniana</i> Michx.	Wangera	Herb	Leaf	Extract	Topical	Leaf extract used to treat ear pain, headache. Helps to treat influenza .	1□,2□,3□,4□,5□,6□,7□,8□,9□,10□,11□,12□,13□,14□,15□	0.13	0.10
Urticaceae									
<i>Urtica dioica</i> L.	Bichoo booti	Herb	Leaf	Paste (poultice)	Topical	It is used in treatment of skin diseases (Abscesses) and swelling of skin.	1□,2□,3◇,4□,5◇,6◇,7□,8□,9□,10□,11□,12□,13□,14◇,15□	0.35	0.26
			Seed	Powder mixed in milk	Oral	It is used to control involuntary emission of semen (spermatorrhoe) without orgasm. it is also used increase lactation in breastfeeding mothers and as expectorant.			

Zygophyllaceae									
Tribulus terrestris L.	Gurgunduk	Herb	Leaf,	Paste	Topical	It's used for Skin diseases	1□,2□,3□,4□,5□,6□,7◇,8 •9◇, 10□,11□,12□,13□,14□,1 5□	0.55	0.37
			Seed	Powder	Oral	It is used to remove Kidney stones			
			Roots	Decoction	Oral	body weakness			
			Flower	Extract	Oral	It is used in treatment of dengue fever			
RFC = Relative frequency of citation; UV = use value; (●) = similar use to previous report; (◇) = dissimilar use to previous reports; (□) = Not reported in previous study; Bold text represents the most preferred use of plant species ; 1 = (Azeem et al.,2020); 2 =(Hussain et al., 2019); 3 = (Ahmad et al., 2017); 4 = (Qaseem et al., 2018); 5 = (Amjad et al., 2020); 6 = (Ullah et al., 2013); 7 =(Ibrar et al., 2015); 8 = (Bibi et al., 20114); 9 = (Umair et al., 2017); 10 = (Iqbal et al., 2020); 11 = (Malla & Chhetri, 2009); 12 = (Napagoda et al., 2019); 13 = (Kefalew et al ., 2015); 14 = (Ugulu et al., 2009); 15 = (Chellappandian et al., 2012)									

Life forms of plants

In this study area, annual herbs (61%) were mostly used for the treatment of different medicines, followed by trees (19%), shrubs (15%), and climbers (5%). Access to herbaceous plants is easy as compared to trees and shrubs because they grow freely along the roadside gardens and wild in nature. Most traditional healers prefer herbs for different purposes because they can easily be collected (Rana *et al.* 2015; Rehman *et al.* 2022b).

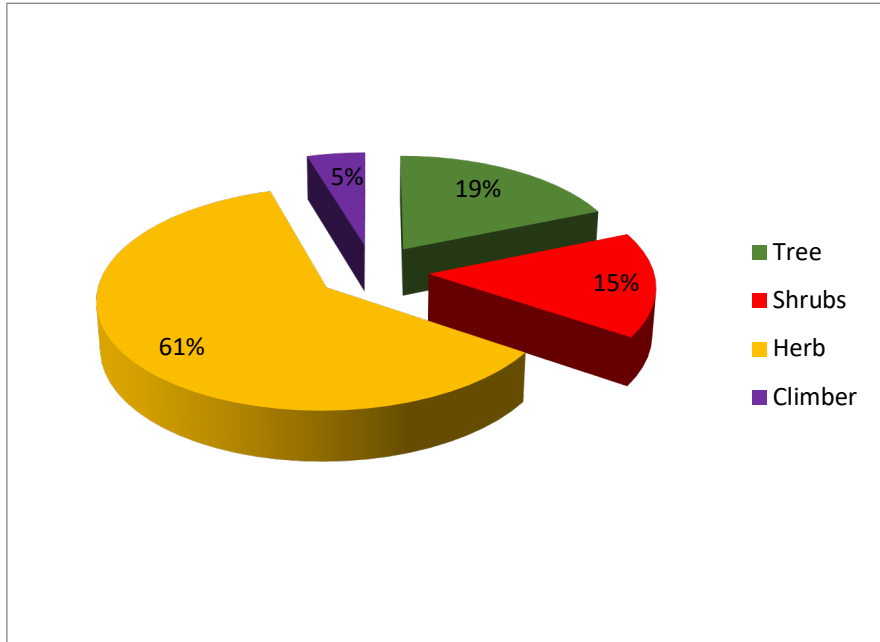


Figure 4. Main life forms of plants

Mode of preparation and plant parts used

Most of the plant's parts used were leaves (35%) followed by seed (16%), root (12%), fruit (10%), flower (9%), stem (5%), bark (3%), latex (3%), areal part (3%), whole (2%), and wood (1%). Due to easy access, leaves of herbaceous plants were mostly used in herbal formulations (Fig. 5).

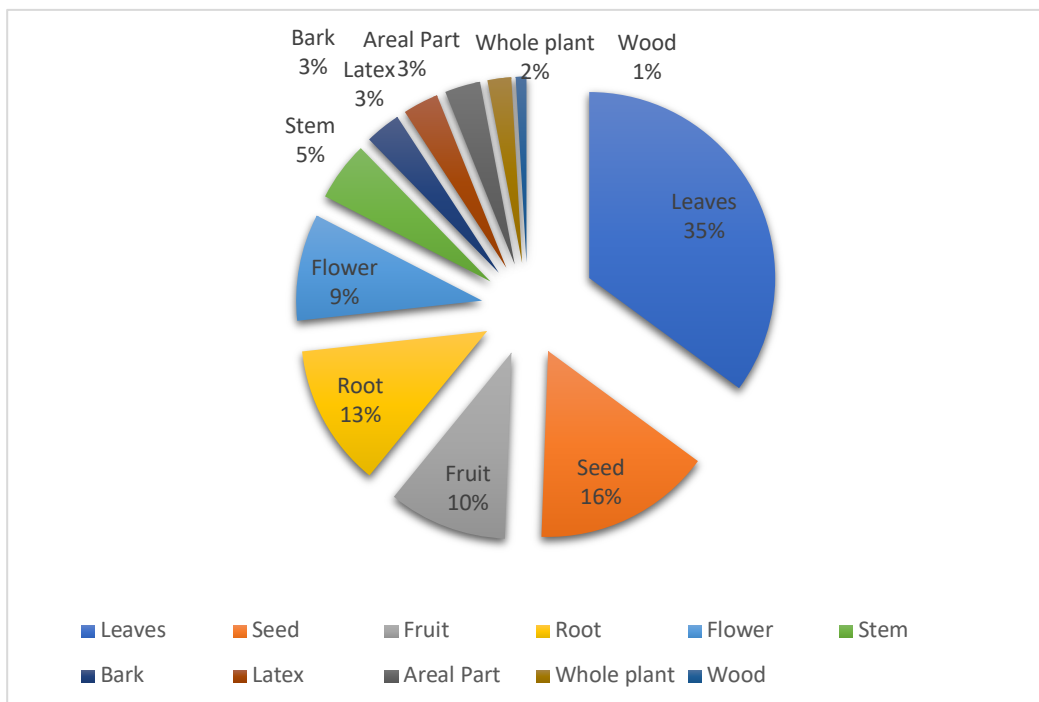


Figure 5. Percentages of plant parts used.

The utilization of leaves is safe for plant communities. The leaves are easier to collect and prepare the formulation as compared with other parts of the plant, (Telefo *et al.* 2011; Rehman *et al.* 2022a). Mostly common preparations were decoction and powder form (12%), followed by poultice (11%), extract (9%), juice (8%), paste (6.4%), infusion (5.60%), herbal tea (4.80%), raw food (4%), & toothbrush (3.20%), and oil form (2.40%). Due to its ease of preparation by combining with water or tea, decoction is a most often used method for preparing indigenous herbal therapies (Khan *et al.* 2011) (Fig. 6).

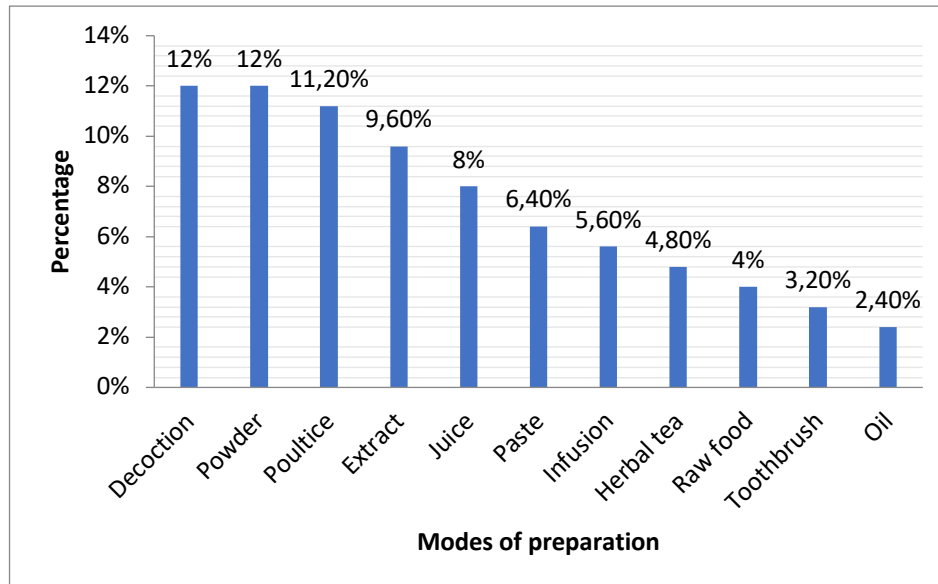


Figure 6. Method of preparation of plant recipes.

Quantitative ethnobotany

Relative frequency of citation (RFC)

The RFC of each plant species reveals its importance in terms of informants who reported its usage (Vitalini *et al.* 2013). The values of RFC of that study area were ranged from 0 to 1. The maximum value of frequency of citation indicates a high exploitation rate of plant species among the local inhabitant of that area (Ahmad *et al.* 2017). *Ficus palmata* was recorded with the maximum RFC (0.78), followed by *Ficus benghalensis* (0.76), *Dalbergia sissoo* (0.75), *Psidium guajava* (0.75), and *Ricinus communis* (0.71). Because these plants are so common in the research region, the inhabitants are highly familiar with them. Phytochemical analysis should be performed in future research of plants with high RFC value for the discovery of novel drugs (Mukherjee & Wahile 2006). Strategies for sustainable use of such plants should be implemented due to high anthropogenic activities to minimize the overexploitation of these plants species (Ahmad *et al.* 2017).

Use Value (UV)

The high usage value of a plant demonstrates the plant's widespread presence and importance among respondents, as they utilize it regularly in herbal remedies to cure a variety of ailments. In our study, *Mallotus philippensis* got the highest UV (0.82), followed by *Mentha spicata* (0.80), *Ficus benghalensis* (0.70), *Syzygium cumini* (0.70), *Zanthoxylum armatum* (0.68) and *Ficus palmata* (0.67). The species with high UV has a high rate of exploitation as compared with species with low UV. Marking as low UV of species by the local people may be attributed in the region for being unaware of the applications of these plants, which means that knowledge of their uses is at risk of being lost to future generations. Resultantly, this information may eventually disappear (Maqsood *et al.* 2022). Plants with a higher number of use reports (UR) have higher UVs, while those with a low number of URs recorded by informants have lower UVs. Excessively utilized plant species are thought to be physiologically more active, thus they may be subjected to phytochemical and pharmacological screening to enhance sustainable plant resource consumption and conservation (Trotter & Logan 2019).

Table 2. Ethnomedicinal data of plants of Khuiratatta AJK, Pakistan.

Table 2. Informant consensus factor (ICF) of reported plant species against various ailments.

Disease categories	Common Diseases	Most Commonly Used Plants	Nut	Nur	ICF
Digestive Disorders	Constipation, Piles, Stomach Inflammation, Prevent Vomiting, Haemorrhoids, Vomiting & Nausea, Dysentery, Stomach Inflammation, Ulcer, Gastritis, Abdominal Pain, Cholecystitis	<i>Zanthoxylum armatum</i> DC., <i>Morus alba</i> L., <i>Punica granatum</i> L., <i>Cannabis sativa</i> L., <i>Ziziphus nummularia</i> Wight & Arn.	30	55	0.46
Respiratory Disorders	Asthma, Tonsillitis, Lungs Inflammation, Throat Infection, Sinusitis	<i>Ficus palmate</i> Forssk., <i>Morus alba</i> L. <i>Achyranthes aspera</i> L. <i>Rosa damascena</i> L. <i>Vitex negundo</i> L. <i>Pinus roxburghii</i> Sarg.	13	45	0.72
Reproductive System Disorders	Erectile Dysfunction, Spermatorrhoea, Infertility, Sperm Production, Infertility, Nocturnal Enuresis	<i>Ficus benghalensis</i> L. <i>Vitex negundo</i> L. <i>Asparagus setaceus</i> Jessop <i>Cannabis sativa</i> L. <i>Urtica dioica</i> L.	8	27	0.70
Antidote	Snake, Scorpion And Aunt Bites	<i>Achyranthes aspera</i> L. <i>Opuntia ficus-indica</i> L. <i>Adiantum incisum</i> Forssk.. <i>Calotropis procera</i> (Aiton) Dryand <i>Oxalis corniculata</i> L.	5	21	0.80
Musculoskeletal Inflammation	Anti-rheumatic	<i>Mirabilis jalapa</i> L. <i>Vitex negundo</i> L. <i>Taraxacum officinale</i> (L.) Weber ex F.H. Wigg. <i>Cardiospermum halicacabum</i> L.	5	19	0.77
Skin Problems	Abscesses, Skin Emollient, Itchiness, Leprosy, Abscesses, Ringworm, Pimples, Burned Skin, Allergy, Pruritus, Psoriasis	<i>Mirabilis jalapa</i> L. <i>Ocimum basilicum</i> L. <i>Xanthium strumarium</i> L. <i>Vernonia cinerea</i> (L.) Less. <i>Opuntia ficus-indica</i> (L.) Mill. <i>Hemidesmus indicus</i> (L.) R.Br. <i>Mallotus philippensis</i> (Lam.) Müll.Arg. <i>Tagetes erecta</i> L.	20	25	0.20
Kidney and Urinary Tract Problems	Kidney Stones, Diuretics, Urine Incontinence Urethral Infection	<i>Tribulus terrestris</i> L. <i>Punica granatum</i> L. <i>Solanum americanum</i> Mill. <i>Dalbergia sissoo</i> DC.	4	23	0.86
Pain	Toothache, Body Painkiller Headache, Chronic Headache	<i>Zanthoxylum armatum</i> DC. <i>Cannabis sativa</i> L. <i>Vitex negundo</i> L. <i>Salix caroliniana</i> Michx.	6	30	0.82
Sensory Disorders	Eyes Infection, Ear Infection	<i>Psidium guajava</i> L. <i>Vitex negundo</i> L. <i>Rosa damascena</i> Mill. <i>Tagetes erecta</i> L. <i>Mentha spicata</i> L. <i>Artemisia vulgaris</i> L. <i>Cardiospermum halicacabum</i> L.	9	19	0.55
Blood Circulation and Diabetes	Blood Purifier, Blood Flow	<i>Melia azadarch</i> L. <i>Justicia adhatoda</i> L. <i>Hemidesmus indicus</i> (L.) R.Br. <i>Fumaria indica</i> (Hauskn.) Pugsley <i>Origanum vulgare</i> L.	12	24	0.52

		<i>Cynoglossum lanceolatum</i> Forssk. <i>Calotropis procera</i> (Aiton) Dryand <i>Syzygium cumini</i> (L.) Skeels			
Fever and Cough	Sputum Expectorant, Chronic Cough, Whooping Cough, Catarrh, Chronic Fever	<i>Punica granatum</i> L. <i>Eclipta alba</i> (L.) Hassk. <i>Zanthoxylum armatum</i> DC. <i>Boerhavia procumbens</i> Banks ex Roxb. <i>Ipomoea hederacea</i> (L.) Jacq. <i>Solanum surattense</i> Burm. f. <i>Cirsium arvense</i> (L.) Scop. <i>Mentha spicata</i> L.	18	36	0.54
General Disorders	Obesity, Hair Growth, Immune System, Bleeding Gums, Lice Killer, Appetizer, Teeth Whitening, Hydropsy, Weakness, Abdominal Pain, Premature Hair Whitening, Chest Infection, Hyperhidrosis	<i>Zanthoxylum armatum</i> DC. <i>Dalbergia sissoo</i> DC. <i>Ricinus communis</i> L. <i>Punica granatum</i> L. <i>Solanum americanum</i> Mill. <i>Catharanthus roseus</i> (L.) G. Don <i>Eclipta alba</i> (L.) Hassk.	19	38	0.51
Wound Healing	General Wound Like Cuts And Injuries	<i>Jasminum grandiflorum</i> L. <i>Nerium oleander</i> L. <i>Cynodon dactylon</i> (L.)	6	14	0.61
Abdominal Worms	Vermicide	<i>Chenopodium album</i> L. <i>Calotropis procera</i> (Aiton) Dryand <i>Psidium guajava</i> L. <i>Mallotus philippensis</i> Müll. Arg. <i>Helianthus annuus</i> L.	6	21	0.75
Liver Problems	Jaundice, Inflammation in Liver, Hepatitis	<i>Rosa damascene</i> Mill. <i>Boerhavia procumbens</i> Banks ex Roxb. <i>Oxalis corniculata</i> L. <i>Solanum americanum</i> Mill. <i>Taraxacum officinale</i> (L.) Weber ex F.H. Wigg.	8	37	0.80
Tonic	Heart Tonic, Stomach Tonic, Liver Tonic, Dentonic, Brain Tonic	<i>Punica granatum</i> L. <i>Mentha spicata</i> L. <i>Mentha spicata</i> L. <i>Cyperus scariosus</i> R.Br.	8	34	0.78
Parasitic	Rabies, Cholera, Hepatitis, Influenza, Gonorrhoea	<i>Adiantum incisum</i> Forssk. <i>Cyperus rotundus</i> L. <i>Taraxacum officinale</i> (L.) Weber ex F.H. Wigg. <i>Salix caroliniana</i> Michx. <i>Opuntia ficus-indica</i> (L.) Mill.	8	28	0.74
Women Problems	Galactagogue, Pregnancy, Breast Inflammation, Womb Infection, Leucorrhoea	<i>Ricinus communis</i> L. <i>Datura innoxia</i> Mill. <i>Dalbergia sissoo</i> DC. <i>Verbascum thapsus</i> L.	8	12	0.36
Nervous disorders	Epilepsy, Paralysis, Bells Palsy, Prosopagia	<i>Luffa acutangula</i> (L.) Roxb. <i>Clerodendrum bungei</i> Steud. <i>Ricinus communis</i> L.	4	13	0.75

Informant consensus factor (ICF)

The ICF is used to determine consistency among respondents surveyed for the purpose of healing illness categories utilizing recorded plant species, with an emphasis on the research area's most important diseases (Tuttolomondo *et al.* 2014). Different disorders were categorized into groups to apply this method. All the diseases that were treated in this research were divided into 19 categories (Fig. 7, Table 3)). ICF was varied from 0.20 to 0.86. Higher ICF values were reported for Kidney and Urinary tract problems (0.86 each), followed by pain (0.82), antidote and

liver problems (0.80 each), and Musculoskeletal inflammation (0.77); the lowest ICF was recorded for skin problem (0.20).

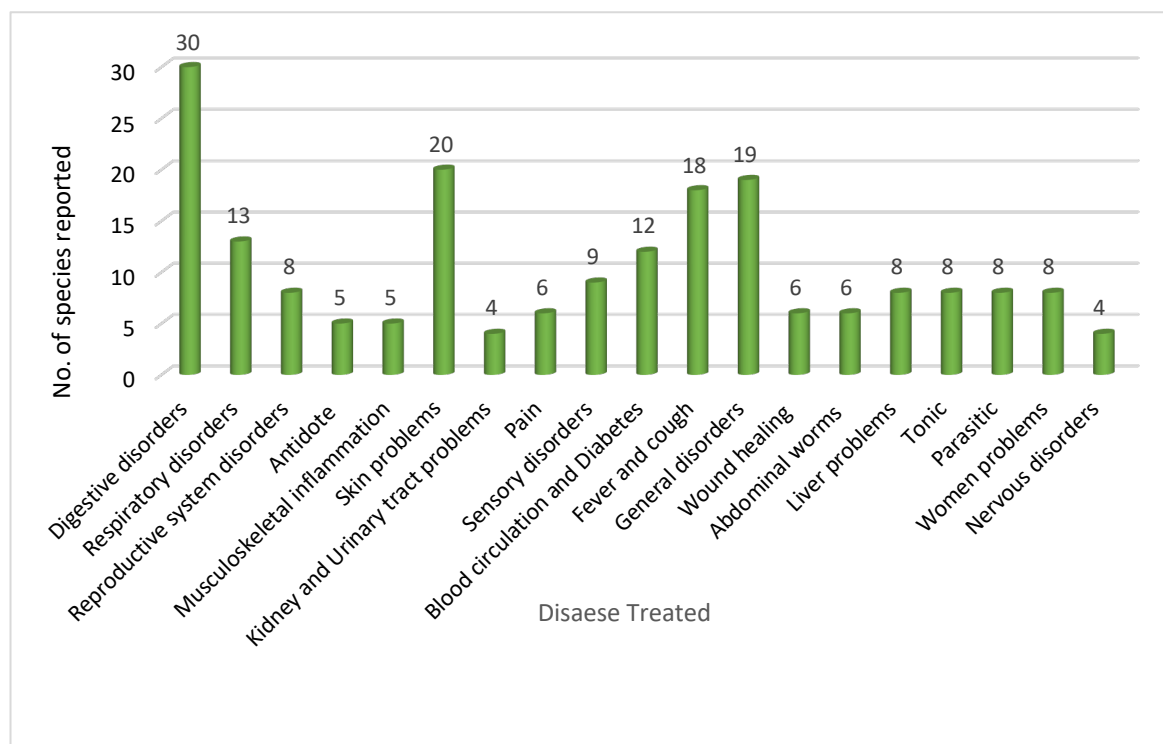


Figure 7 Number of medicinal plants used for the treatment of various ailments.

Jaccard index (JI)

Jaccard similarity index was performed to compare the current ethnobotanical investigation with 15 different previously published studies of Pakistan, AJK, and surrounded counties. Because of the differences in cultural and social practices, ethnobotanical knowledge varies widely among indigenous tribes. Such comparison examination among communities is quite beneficial in that it can reveal enormous knowledge of information among societies, leading to the discovery of novel herbal formulations (Leonti *et al.* 2020).

In terms of novelty, it was discovered that out of 65 plant species, 13 were recorded having novel uses from the area of Khuiratta, AJK. These newly reported plant species with their therapeutic uses include *Vernonia cinerea* (Skin infection), *Tagetes erecta* (Tonsillitis), *Catharanthus roseus* (Chest and lung infection), *Asparagus setaceus* (Spermatorrhoea), *Cyperus scariosus* (Brain tonic), *Ipomoea hederacea* (Dysentery and expectorant), *Clerodendrum bungei* (Paralysis), *Fumaria indica* (Jaundice), *Adiantum incisum* (Snake poisoning and rabies), *Rumex obtusifolius* (Constipation), *Cardiospermum halicacabum* (Asthma), *Salix caroliniana* (Influenza), and *Abelmoschus esculentus* (Urinary tract infection).

The result showed that among 65 species, the percentage of similarity was ranged from 0% to 8.75%; while the percentage of dissimilarity was ranged from 2.15% to 26%. In the present study, the highest similarity (8.75%) was found as that of Qaseem *et al.* (2018), followed by 6% as of Ullah *et al.* (2013), 5.71% with Azeem *et al.* (2020) and 4% that of Shafique *et al.* (2017). The maximum Jaccard similarity index is 19.5 and 17.8 was found by Ullah *et al.* (2013) and Qaseem *et al.* (2018), which shows that both places had the same ethnic values, as well as the same sort of vegetation geography and climatic conditions. These areas are located closer to each other. Similar cultures between indigenous populations may have happened in the past, resulting in identical ethnobotanical knowledge in both places. While the minimum Jaccard similarity index value was noted as 2.28 to 2.51 as reported by other scientists (Chellapandian *et al.* 2012; Tharanga *et al.* 2019). The lowest JI values indicate limited cultural interchange between the countries, which are separated by mountain ranges and other cultural differences. The geographical barriers had a significant influence on the vegetation type. Any variation in JI is caused by the distance between the research area and the bordering region (Houghton & Manby 1985).

Table 3 Jaccard index comparison of present study with previous reports.

Previous studies	No. of species reported(A)	No. of species in present study area(B)	Similar uses	Disimilar use	Plants common in both areas(C)	Species only in alined areas	% of Similarity	% of Dissilarity	Species only in studied area	c×100	A+B	(A+B)-C	Jaccard Index	References
From AJK														
Tattapani valley Kotli , AJK	70	65	4	14	18	52	5.71%	20%	47	1800	135	117	15.3	Azeem et al., 2020
Rawalakot, District Poonch, AJK	41	65	1	7	8	33	2.43%	17.07%	57	800	106	98	8.16	Hussain et al., 2019
Neelum Valley, AJK	50	65	2	7	9	41	4%	14%	56	900	115	106	8.49	Ahmad et al., 2017
Rajh Mehal and Goi union councils of District Kotli AJK	80	65	7	15	22	58	8.75%	18.75%	43	2200	145	123	17.8	Qaseem et al., 2018
Harighal, tehsil of district Bagh, AJK	150	65	3	23	26	124	2%	15.30%	39	2600	215	189	13.7	Amjad et al., 2020
From Pakistan														
Wana district south Waziristar agency, Pakistan	50	65	3	7	10	40	6%	14%	55	1000	114	104	9.61	Ullah et al., 2013
Malakand Pass Hills, Khyber Pakhtunkhwa, Pakistan	92	65	2	21	23	69	2.17%	22.80%	42	2300	157	134	17.16	Ibrar et al., 2015
District Mastung of Balochistan province- Pakistan	102	65	1	9	10	92	0.98%	8.82%	55	1000	167	157	6.36	Bibi et al., 20114
Hafizabad district, Punjab Pakistan	85	65	3	17	20	65	3.52%	20%	45	2000	150	130	15.3	Umair et al., 2017
Gujranwala Region, Punjab ,Pakistan	100	65	1	26	27	73	1%	26%	38	2700	165	138	19.56	Iqbal et al., 2020
From other countries														

District kavarepalanchowk, Nepal	68	65	0	5	5	63	0%	7.35%	60	500	133	128	3.9	Malla&Chhetri 2009
Polonnaruwa District in North Central Province of Sri Lanka	159	65	1	4	5	154	0.62%	2.51%	60	500	224	219	2.28	Napagoda et al., 2019
District, East Shewa Zone of Oromia Regional State, Ethiopia	131	65	0	7	7	124	0%	5.34%	58	700	196	189	3.7	Kefalew et al., 2015
Izmir province, Turkey	108	65	0	6	6	102	0%	5.55%	59	600	173	167	3.59	Ugulu et al., 2009
Paliyar tribe in Sathuragiri hills, Virudhunagar district, Tamil Nadu, India	139	65	2	3	5	134	1.43%	2.15%	60	500	204	199	2.51	Chellappan et al., 2012

Conclusion

This is the first quantitative ethnobotanical appraisal of Tehsil Khairatta of district Kotli, Azad Kashmir, Pakistan focused on recording traditional knowledge of medicinal plants used by the local inhabitants for their healthcare needs. People in the research region still favor native plants because of their low cost and accessibility. Most elder people and herbal practitioners possess considerable information about medicinal plants as compared to younger generations. Traditional healers (*Hakeems*) have extensive information but most of them are reluctant to share it with other people. Therefore, there is a need to promote such kind of research in every area of the country to prevent the erosion of traditional medicinal knowledge among the local rural communities of the area. Overexploitation of medicinal plant species, such as uprooting, forest fires, deforestation, overgrazing, and urbanization, all contribute to the reduction of medicinal plant species in the study region. Plants with novel and high medicinal importance should be further investigated for pharmacological, phytochemical, toxicological, preclinical, microbiological, and clinical investigations.

Declarations

List of abbreviations: Relative Frequency of Citation (RFC), Use Value (UV), Informant Consensus Factor (ICF), Jaccard Index (JI) and AJK (Azad Jammu & Kashmir).

Conflict of Interest: Authors have no conflict of interest.

Consent for publications: Not applicable.

Ethics Approval: The authors confirm that the study was reviewed and approved by an institutional review board of Pir Mehr Ali Shah-Arid Agriculture University Rawalpindi, Pakistan (ethics committee) before the study began. The committee further confirmed that the study have no direct harmful impact on participants and the biodiversity of the area under investigation.

Data Availability: Data available on request from the authors.

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Author Contribution: R.Q. and A.W. conceived of the idea. F.A. conducted the experiment and conducted the literature review. R.Q. provided technical expertise to strengthen the basic idea helped in statistical analysis. R.Q. proofread and provided intellectual guidance. T.M. helped in statistical work. M.R. and S.R. did some edit work. All authors read the first draft, helped in revision, and approved the article. All authors have read and agreed to the published version of the manuscript.

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