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Ethnobotanical knowledge and ethnomedicinal uses of plant resources by urban communities of Khyber Pakhtunkhwa, Pakistan: a novel urban ethnobotanical approach

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Abstract

Study Background Ethnobotanical knowledge of plants in rural and remote areas is more common in Pakistan than in urban areas. This study was carried out to find the indigenous knowledge of plants in anthropogenically disturbed urban areas of Khyber Pakhtunkhwa, Pakistan.

Materials and methods Eight visits (Two per season) were carried out from March 2023 to March 2024. The semi-structured questionnaire was administered to informants and analyzed using informant consensus factor (ICF), use values (UV), fidelity level (FL%), average direct matrix ranking (ADMR), and Jaccard index (JI).

Results A total of 138 plant species belonging to 54 families, Asteraceae with the highest number of plant species (14) were recorded from 101 informants. Herbs were the dominant plant species (75%) and leaves were the most used parts (43%). The ICF value of 0.97 indicated a high consensus among informants regarding the use of plants for kidney disorders. The highest UV value of 0.78 showed a maximum use of the plant for ear diseases. The highest FL% of 91.8 indicated the highest use of *A. sativum* for alopecia. For plant use in medicinal purposes, the ADMR ranking came in first. JI values showed that 73 plant species were common in all the three urban areas.

Conclusions The study area was highly disturbed by anthropogenic activities. However, it still contains a rich diversity of plant resources. Furthermore, investigation is required for the conservation and utilization of plant resources, discovery of novel drugs and climate resilience for the welfare of mankind.

Keywords Traditional knowledge, Urban ethno-botany, Plant resources, Ethnomedicine, Ethnobotanical indices

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Introduction

Ethnobotanical studies emphasize the intricate relationship that exists between the local inhabitants and the plant species found in their surrounding environment, encompassing customs, rituals, etiquettes, and cultural values related to various applications [1]. These research studies are crucial for emphasizing the usefulness of native plant species, such as for the development of new medications and health-based products. Native plants have great importance for the welfare and health improvement of poor communities globally [2]. Globally, 35,000–70,000 (14%-28%) plant species are used for medicinal purpose. Plant-based medicines are still used by 60–80% of the population in developing countries due to their economic and safety benefits compared to allopathic therapy, which is often inaccessible [3]. Herbal treatments are widely utilized in industrialized countries, with 30–50% of the population in China, 40–50% in Germany, 48% in Australia, 42% in the USA, and 49% in France utilizing them for additional health care [4]. Approximately 25% of contemporary allopathic medications are derived from plants or synthetic equivalents of substances obtained from medicinal plants [5, 6].

Plant-based medications are effective and typically have fewer negative effects and this could be best for local inhabitants. Many local inhabitants including elders' people, local healers, and local herbal sellers (Pansari) still hold onto their traditional knowledge of therapeutic plants and the use of crude drugs [7, 8]. This kind of traditional knowledge is passed down through the generations from their ancestors to their precedents [9]. Fascinating similarities and differences in traditional knowledge and practices between two distinct cultural groups residing in the same ecological region can help us understand how cultural reflection can alter people's perspectives about the environment and influence how humans interact with ecosystem resources [10]. Nonetheless, conventional wisdom on plant species is gradually dwindling worldwide [1]. This knowledge is typically passed down orally to the next generation by hakims (traditional healers) and the elderly [11–13], Hence, there is a real risk of knowledge loss as a result of the development of the contemporary healthcare system, the speed at which cities are growing, and the strained relationships between the younger and older generations [14]. It is crucial to record traditional ethnomedical knowledge since it could lead to the creation of novel medications. Additionally, this might support the preservation of native culture and the management of natural resources.

Pakistan, with its diverse environment, climate, and soil types, is home to over 6,000 wild plant species, many of which are aromatic and medicinal [15]. Among these, 400–600 species are used for medicinal purposes. Notably, 80% of this medicinal flora is found only in Azad Kashmir and Northwestern Pakistan [16]. Various ethnobotanical studies have previously documented traditional knowledge of medicinal plants and herbal recipes in remote areas of Pakistan [17–22]. However, urban areas in Khyber Pakhtunkhwa have not been thoroughly investigated from an ethnobotanical viewpoint, mainly due to challenges such as inaccessibility, security threats, and cultural and religious barriers that limit research opportunities to gather ethnobotanical information.

We hypothesize that ethnobotanical knowledge in urban areas differs significantly from that in other parts of Pakistan due to improved access to allopathic medications. Given the high demand and cost of allopathic drugs, they may be less accessible to urban communities; thus, our study aims to provide alternatives for this issue. The goal of this study is to document indigenous knowledge of medicinal plants used for primary healthcare, with a focus on plant species traditionally used by urban communities. The specific objective is to investigate the ethnobotanical knowledge and ethnomedicinal uses of plant resources by urban communities in Khyber Pakhtunkhwa, Pakistan. This study is novel as it explores ethnobotany in urban settings, where literature on the subject is scarce, and it aims to identify previously unreported ethnobotanical uses of plants. Majority of the ethnobotanical studies have focused on rural areas due to the limited access to modern medicines.

Materials and methods

Area description

Study areas consisted of urban areas of District Bannu, Kohat, and Peshawar of Khyber Pakhtunkhwa, Pakistan. District Bannu is located at latitude 32° 59′ 7" (North) and longitude 70° 36′ 9" (East), comprising a total area of 1231 km^2 with 1,169,981 inhabitants (male 53.21%: female 46.79%). It is situated at an elevation of 355.20 m (1165.35 feet) with humid subtropical climate. 99% of the inhabitants are Muslims and 1% non-muslims (Christian, Hindu and others). The local language of the inhabitants in district Bannu was Banuchi (Local dialect of Pashto language). Majority of the inhabitants residing in district Bannu were banuchi (Sub tribe of Pashtuns).

District Kohat is located at latitude 33° 19′ 60"(North) and longitude 71° 09′ 60" (East), comprised a total area of 2547 km^2 with 109,381 inhabitants (male 51.37%: female 48.63%). It is situated at an elevation of 436.30 m (1431.43 feet) with the arid to semi-arid climate. 98% of the inhabitants are Muslims and 2% non-muslims (Christian, Hindu and others). The local language of the district Kohat inhabitants was hindko and Pashto (afridi and orkzai dialect of Pashto language). Majority of the

inhabitants residing district Kohat were afridi, bangash and paracha (Sub tribe of Pashtuns).

District Peshawar is located at latitude 34°0′28"(North) and longitude 71°34′42" (East), comprised a total area of 1261 km^2 with 2,545,760 inhabitants (male 47.57%: female 52.43%). It is situated at an elevation of 360 m (1160.11 feet) with the sub –tropical climate with hot summers and mild winters. 97% of the inhabitants are Muslims and 3% non-muslims (Christian, Hindu, Sikh and others). The local language of the district Peshawar inhabitants was hindko and pashto (Peshawari dialect of Pashto language). Abbas et al. [23] reported that the majority of the informants were pashto speaker belong to four different communities including Christians, Shia, Sunni and Sikh in district Kurram of northwest Pakistan.

Majority of the inhabitants residing in district Peshawar were afridi, peshawari and muhajirs (Sub tribes of Pashtuns). A geographical map of the study area is given in (Fig. 1).

Informant selection

General information about the study area was collected before plant collection and their traditional knowledge. Traditional knowledge and plant collection were done in four seasons (spring, summer, autumn, and winter) from March 2023 to March 2024 in eight visits. The informants' selection was based on random sampling techniques. The interview process entailed two sections. The first section involved collecting basic data such as the respondent's name, age, gender, place of birth, and educational attainment. In the second section, a semi-structured questionnaire consisting of six questions was administered (1) Did the informants use medicinal plants to treat or prevent diseases? (2) If yes, which diseases did the plant treat or prevent? (3) How were the plants used, including which parts were used, preparation techniques, and application methods excluding medicinal purpose? (4) Where did the plants come from? (5) How did the interviewee acquire this knowledge? (6) Is there anything else the interviewee would like to add? Majority of male informants (64%) were interviewed due to easily approach and local rituals. Informants were selected

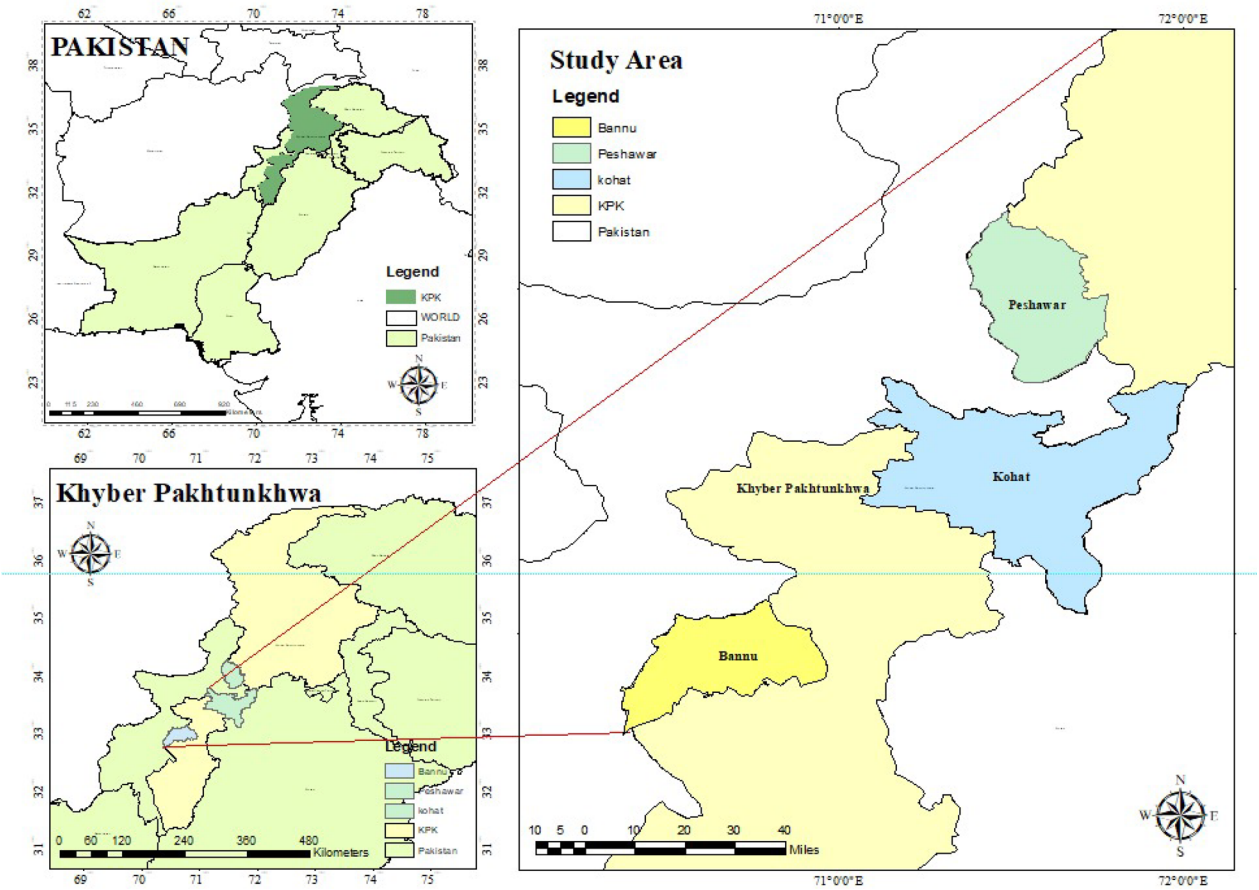

Fig. 1 Map of the study sites

based on age, knowledge about plants, and general and traditional uses. The age ranged from 20 to 80 years, education from uneducated to postgraduate, and occupation from housewife to farming. Informants were interviewed in their mother tongue (Pashto) and the aims and objectives of the questionnaire were detailed and discussed with them.

Plant collection, identification, and preservation

Plant species were collected from the study area. During plant collection, plant conservation guidelines were followed. Herbs were collected as a whole plant, while branches with flowers were collected from trees and shrubs. They were shade-dried and mounted on herbarium sheets. They were identified by a taxonomist at the Department of Botany, Kohat University of Science and Technology, and voucher specimens were deposited at herbarium. Their botanical names were cross-checked with the online flora of Pakistan (www.eFloras.org) for validation.

Information quality assurance and validation

All the informants were three times contacted for information validation and accuracy. Only the study-relevant information was collected from informants and subjected to further data analysis. Missing and irrelevant information about plant species was skipped. Moreover, the researcher and co-author were skilled in the ethnobotanical knowledge of plants to ensure data quality and accuracy.

Ethnobotanical data collection and interpretation

Ethnobotanical data were collected from informants through a semi-structured questionnaire and interpreted using demographic features, informant consensus factor, use values, fidelity level %, average direct matrix ranking, and Jaccard index.

Demographic features

A total of 101 informants were interviewed as resource persons for plant use data collection. There were 64 male and 37 female respondents. Their age ranged from 20 to 80 years. Male respondent's numbers were more as compared to female due to more engagement with traditional knowledge and profession of farming. Details of informants are given in (Table 1).

Table 1 Demographic features of informants from study area

District wise distribution	District Bannu	District Kohat	District Peshawar	Total		
01	Gender	Male	21	21	22	64
		Female	12	12	13	37
02	Age Group	20–30	03	04	02	9
		30–40	04	05	04	13
		40–50	07	06	07	20
		50–60	08	09	10	27
		60–70	08	07	10	25
		70–80	03	02	02	7
03	Ethnic Group	Tribes	Banuchi	Bangash	Peshawari	
04	Language	Dialect (Pashto)	Banuchi	Hindko	Peshawari	
05	Religion	Islam	Islam	Islam		
06	Literacy rate	Uneducated				31
		Primary				23
		Middle				16
		Secondary				13
		Higher secondary				10
		Undergraduate				5
		Graduate				2
		Post graduate				1
07	Occupation	House wife				27
		Business				33
		Service				17
		Farming				24

Informant consensus factor (ICF)

The informant consensus factor was determined by calculating the number of plant species used for a particular disease divided by the number of total use reports by local inhabitants [24].

$ICF = Nt/Nur$, where *ICF* is the Informant consensus factor, *Nt* is the number of plant species used for a particular disease, and *Nur* is the use reports.

Use values (UV)

Use values of plant species for a particular purpose were determined by dividing the total number of uses of plants by the total number of reported plant species [25].

$UV = NU/n$, where *NU* is used in reports and *n* is the total number of plant species.

Fidelity level (FL%)

Fidelity level was used to determine the particular use of plant species for a particular purpose. It was calculated by using the following formulae adopted by [26].

$FL\% = nr/n \times 100$ where np = number of primary respondent, and n = total number of local inhabitants.

Average direct matrix ranking (ADMR)

Average direct matrix ranking was used to find the multipurpose use of plants and evaluated by following the method of Cotton [27]. Fifteen key local inhabitants (10 men, 5 women) were selected on the base of their long experience and vast knowledge of plants as described by Yineger et al. [28].

Jaccard index

The Jaccard index was used to find the similarity of plant species among the three ecological different study areas. It was calculated by the following equation described by [29].

$JI = \frac{SA1 \cap SA2}{SA1 \, U \, SA2}$ Where JI is the Jaccard index, *SA1* is study area 1 and *SA2* is study area 2. The results were compared with previous literature ([30–33] etc.) to find the novelty of the study.

Statistical analysis

All the data were taken in three times and spss software (v.16) was used for data analysis.

Results and discussion

Plant species *diversity and life forms*

In the study area, 138 plant species representing 120 genera and 54 families were collected. Botanical names, family names, life forms, habitats, parts used, and ethnobotanical uses of these plant species were elucidated in (Table 2). Asteraceae was the dominant family with the highest number of plant species (14), followed by Fabaceae (12), Solanaceae (10), Poaceae (9), Amaranthaceae (7), Brassicaceae (5), Cucurbitaceae (5), Lamiaceae (5), Apiaceae (4), Euphorbiaceae (4), Apocynaceae (3), Malvaceae (3), Myrataceae (3), Polygonaceae (3), Rhamnaceae (3), Rosaceae (3), Anacardiaceae (2), Convolvulaceae (2), Moraceae (2), Plantaginaceae (2), Verbenaceae (2), Zygophyllaceae (2), Amaryllidaceae (2), Acanthaceae (1), Araceae (1), Arecaceae (1), Asphodelaceae (1), Athyriaceae (1), Berberidaceae (1), Cannabaceae (1), Commelinaceae (1), Cordiaceae (1), Cyperaceae (1), Equisetaceae (1), Geraniaceae(1), Heliotropiaceae (1), Hypericaceae (1), Lythraceae (1), Meliaceae (1), Linderniaceae (1), Nitrariaceae (1), Oxalidaceae (1), Papavaraceae (1), Portulacaceae (1), Punicaceae (1), Ranunculaceae (1), Rutaceae (1), Salvadoraceae (1), Spinadaceae (1), Tamaricaceae (1), Typhaceae (1), Urticaceae (1), Viticeae (1), Zingiberaceae (1) (Fig. 2). Our results were parallel with a research study conducted by Bibi et al. [34] that Asteraceae was the dominant family in terms of plant species number (11 spp). A study conducted by Dastagir et al. [35] concluded that Asteraceae was the dominant family having (7) plant species followed by Apiaceae (4), Lamiaceae (3), and Fabaceae (3) while conducting research studies on floristic diversity and medicinal plants of Chitral, Pakistan. Similar results were also reported by previous literature [36].

Herbs were the dominant plant species (75%), followed by trees (14%), and shrubs (11%) (Fig. 3). Herbs (69%) were the dominant life forms used in the formulation of herbal recipes followed by trees (15%), shrubs (12%), and climbers (3%) [37]. Zareef et al. [38] reported 169 medicinal plant species and the family Poaceae was dominant having 17 plant species from District Rawalpindi, Pakistan. Herbs (61%) were the dominant life form and leaves (35%) were frequently used as part of plant species. Rahman et al. [39] documented that herbaceous plants were the dominant plant species (259) and the family Asteraceae had a maximum number of plant species (36) while studying the Mahnoor valley of lessor Himalaya, Pakistan.

Mesophytes were the dominant plants (92%), followed by xerophytes (4%), hydrophytes (3%), and epiphytes (1) (Fig. 4). Saman et al. [40] reported 74 plant species belonging to 39 families were used in the preparation of 45 polyherbal and 101 monoherbal recipes for treating different types of diseases from Shakardara and adjacent villages of Khyber Pakhtunkhwa Pakistan. Rehman et al. [41] documented 108 plant species belonging to 54 families used to treat 119 different types of ailments from Shawal Valley District North Waziristan, Pakistan. Ahmad et al. [42] reported 112 plant species in which 84 plant species were used for medicinal, 35 plant species fodder, 26 plant species marketing, 24

Table 2 Ethnobotanical and traditional use of plant resources of study area

Botanical Name/Voucher No	Family Name	Locality	Part Used	Habit	Habitat	Local Name	Ethnobotanical/Traditional/local uses of plant species by local inhabitants for different purposes
Abroma augusta (L.) L. f. (BOT-KHS-90)	Malvaceae	Bannu/ Kohat/ Peshawar	R	S	M	Peri Maloch	Leaves are used for menstrual cycle irregularity and infertility in females. It is also used as a fodder and fuel plant
Acacia modesta Wall. (BOT-KHS-91)	Fabaceae	Bannu/ Kohat/ Peshawar	W	T	M	Palosa	Exudates of stems are used for pain relieving. Plants are used as a honey bee's plant species. Plants are also used for fencing, fuels, furniture and making agricultural tools
Acacia nilotica (L.) Benth. (BOT-KHS-92)	Fabaceae	Bannu/ Kohat/ Peshawar	W	T	M	Kekar	Leaves are used for relieving pain in livestock. Shoots and fruits are used to feed the goats. Wood is used for construction, fence, fuels, and timber products
Acacia senegal (Lam.) Willd. (BOT-KHS-21)	Fabaceae	Bannu/ Kohat/ Peshawar	W	T	M	Farmi Kekar	Leaves are used for treatment of pain in livestock. Shoots and fruits are used to feed the goats and camels. Wood is used for construction, fence, fuels, and timber products
Achyranthes aspera L. (BOT-KHS-93)	Amaranthaceae	Kohat/Bannu/Kohat	L	H	X	Kurashka	The plants are used for the fodder purposes to feed sheeps and goats
Albizia lebbek (DC.) Benth. (BOT-KHS-94)	Fabaceae	Bannu/ Kohat/ Peshawar	W	T	M	Sareen	Leaves and fruits are used to feed livestock. Wood is used for construction, and timber products. Plants are used for shade and ornamental and fuels, purposes
Alhagi maurorum Medik. (BOT-KHS-95)	Fabaceae	Peshawar/ Bannu/ Kohat/	L	H	X	Tandha	Young shoots are used to feed the camels and goats. Dry plants are used for cooking bread in tandhor and bricks in kilns
Allium cepa L. (BOT-KHS-22)	Amaryllidaceae	Bannu/ Peshawar	B	H	M	Pyaz	Leaves and swollen stems are used to treat the swelling of bones and skin pimples. Fleshy parts are used in green salads and in cooking purposes. Leaves juices are used for repellent of mosquitos
Allium sativum L. (BOT-KHS-19)	Amaryllidaceae	Bannu/ Peshawar/ Kohat	B	H	M	Wozha	Rhizomes are used in spices particularly in Bannu spices and condiments. Green leaves are chewed for hypercholesterolemia and cardiovascular disorders
Aloe vera (L.) Burm.f. (BOT-KHS-01)	Asphodelaceae	Bannu/ Kohat/ Peshawar	L	H	X	Zergera	Green leaves are peeled and applied on skin pimples. It is also used for glowing the face mixed with cucumber and tomato juices
Alternanthera philoxeroides (Mart.) Griseb (BOT-KHS-96)	Amaranthaceae	Peshawar	L	H	M	Spinzary	Leaves are used for the treatment of infection in female's reproductive parts and also for infertility in females. It is used for fodder and fuel purposes
Alternanthera sessilis (L.) R. Br. (BOT-KHS-97)	Amaranthaceae	Bannu	L	H	M	Obo Sazhi	Leaves are used for the treatment of infection in female's reproductive parts and also for infertility in females. It is used for fodder and fuel purposes

Table 2 (continued)

Botanical Name/Voucher No	Family Name	Locality	Part Used	Habit	Habitat	Local Name	Ethnobotanical/Traditional/local uses of plant species by local inhabitants for different purposes
Amaranthus blitum L. (BOT-KHS-98)	Amaranthaceae	Bannu	W	H	M	Tora Ranjaka	It is weed plant commonly used for fodder purposes to feed goats and sheep
Amaranthus viridis L. (BOT-KHS-99)	Amaranthaceae	Bannu/ Kohat/ Peshawar	W	H	M	Ranjaka	It is weed plant commonly used for fodder purposes to feed goats and sheep
Ammi visnage (L.) Lam. (BOT-KHS-100)	Apiaceae	Bannu/ Kohat	W	H	M	Sparky	Leaves are used for abdominal pain and diarrhea. Plant is used for fodder and fuel
Arundo donax L. (BOT-KHS-101)	Poaceae	Bannu/ Kohat/ Peshawar	L	H	X	Khana	It is weed plant commonly used for fodder purposes to feed cattle. It is also used for making handmade items like container in which bread is stored. It is also used in making roofs and fence of fields. The plant is used for preventing soil erosion especially in sandy places
Avena sativa L. (BOT-KHS-139)	Poaceae	Bannu/ Kohat	W	H	M	Kariana	It is weed plant commonly used for fodder purposes to feed goats and sheep. Bran and seeds are used for fodder purposes for horses
Bauhinia varigata L. (BOT-KHS-103)	Fabaceae	Kohat/ Peshawar	I	T	M	Kachnar	Young shoots and floral buds are used as a leafy vegetable. Wood is used for making timber and fuel purposes
Berberis lycium Royle (BOT-KHS-104)	Berberidaceae	Bannu/ Kohat/ Peshawar	R	S	M	Thor Khawari	Leaves are used for the treatment of piles, diarrhea and nasal congestion. Whole plant is used for fuel and fodder purposes
Brassica compestris L (BOT-KHS-27)	Brassicaceae	Peshawar Bannu/ Kohat/	W	H	M	Wairi	Young leaves are used as a leafy vegetable. Oil is extracted from seeds and used for baby massage, hair moisturizer, and cooking oil
Butea monosperma (Lam.) Taub (BOT-KHS-156)	Fabaceae	Bannu	W	T	M	Jungle Lamba	Leaves extract are used for the treatment of infection in females vagina and for irregularity in menstrual cycles. Plant is also used for fodder and fuel
Calendula arvensis L (BOT-KHS-147)	Asteraceae	Kohat	L	H	M	Zher Guli	Leaves are used for cough to goats. Plant is used for fodder purposes
Calotropis procera Aiton. (BOT-KHS-155)	Apocynaceae	Bannu/ Kohat/ Peshawar	L	S	M	Spalmac	Leaf exudates are used for wasps and bees bites. It is used as a fence plant, to prevent soil erosion and fuel purposes
Cannabis sativa L (BOT-KHS-143)	Cannabaceae	Kohat/ Peshawar	L	H	M	Bhanga	Leaf extracts are used as a cooling agent to cattle. Seeds are used as a fodder to hen for egg laying
Capsicum annuum L (BOT-KHS-28)	Solanaceae	Bannu	Fr	H	M	March	Unripen fruits are used to make taste and flavor in various cooked food. Ripened fruits are used for making spices and condiments
Caralluma tuberculata N.E. Br. (KUST.KHS.71)	Apocynaceae	Bannu/ Kohat	S	H	X	Pamani	Stems are cooked and eaten by diabetic patients. It is raw chewed to increase sexual desire in old males

Table 2 (continued)

Botanical Name/Voucher No	Family Name	Locality	Part Used	Habit	Habitat	Local Name	Ethnobotanical/Traditional/local uses of plant species by local inhabitants for different purposes
Carthamus oxycantha M. Bieb (BOT-KHS-108)	Asteraceae	Bannu	W	H	M	Konjal	Seeds are eaten with jaggery to control urination in bed especially in children. Whole plant is used as a fodder to feed camels. Plant is also burnt as fuels in bricks and pottery kilns
Cassia fistula L. (BOT-KHS-32)	Fabaceae	Bannu/ Kohat/ Peshawar	Fr	T	M	Gednali	Seeds extracts are used for abdominal pain and constipation in children. Wood is used in making timber and agricultural tools. It is also a honey bee plant species
Centaurea calcitrapa L (BOT-KHS-185)	Asteraceae	Kohat	L	H	M	Katasari	Leaves are used to feed camels. It is also used for fuel in bricks and pottery kilns. Plant is used for fence purposes
Chenopodium album L (BOT-KHS-110)	Amaranthaceae	Peshawar	W	H	M	Tor Batoo	It is weed plant commonly used for fodder purposes to feed goats and sheep. Bran and seeds are used for fodder purposes for horses
Chenopodium ambrosioides L (BOT-KHS-111)	Amaranthaceae	Bannu	W	H	M	Batoo	It is weed plant commonly used for fodder purposes to feed goats and sheep. Bran and seeds are used for fodder purposes for horses
Cirsium arvense (L). Scop (BOT-KHS-112)	Asteraceae	Peshawar	W	H	M	Kuch Batr	Leaves are used for the treatment of inflammation and joint pain. Bran and seeds are used for fodder purposes in winter season
Citrullus colocynthis L (BOT-KHS-169)	Cucurbitaceae	Bannu/Kohat/Peshawar	Fr	H	X	Maraghun	Seeds are used in powder form to relieve gastrointestinal pain. Seeds are used for fodder purposes for cattle
Citrus lemon L. (BOT-KHS-35)	Rutaceae	Bannu/Kohat/Peshawar	Fr	S	M	Nembo	Fruit juice is used in making squash, teeth whitening and for digestion purposes. It is grown in gardens for ornamental purposes
Commelina diffusa Burm.f (BOT-KHS-113)	Commelinaceae	Bannu	L	H	M	Shen Guli	It is used for the treatment of headache. It is also used as a fodder to buffalos
Convolvulus arvensis L (BOT-KHS-38)	Convolvulaceae	Bannu/ Kohat/ Peshawar	L	H	M	Perwata	It is weed plant commonly found in cereals and used for fodder purposes to feed goats and sheep
Conyza canadensis L. Cronquist (BOT-KHS-114)	Asteraceae	Bannu/ Kohat/ Peshawar	L	H	M	Speen gul	It is weed plant commonly found in cereals and used for fodder purposes to feed cattle
Cordia dichotoma G.Forst (BOT-KHS-115)	Cordiaceae	Bannu	Fr	T	M	Warra Malta	Fruits are used for food. Whole plant is used for fuel purposes
Coriandrum sativum L (BOT-KHS-39)	Apiaceae	Bannu/Kohat/Peshawar	L	H	M	Danria	Leaves are used for indigestion purposes and act as a carminative agent. Seeds are used in making spices and condiments
Croton bonplandianus Baill (BOT-KHS-116)	Euphorbiaceae	Bannu	L	H	M	Gand Boti	It is wild invasive plant species and used for fuel purposes

Table 2 (continued)

Botanical Name/Voucher No	Family Name	Locality	Part Used	Habit	Habitat	Local Name	Ethnobotanical/Traditional/local uses of plant species by local inhabitants for different purposes
Cucumis sativus L. (BOT-KHS-41)	Cucurbitaceae	Bannu/ Peshawar/ Kohat	Fr	H	M	Badrang	It is used as a green vegetable in making salad. Fresh fruits are used for glowing face and lighting of skin
Cucurbita pepo L. (BOT-KHS-40)	Cucurbitaceae	Bannu/Kohat/ Peshawar	Fr	H	M	Penta	It is used as a vegetable and making in sweets (Halwa)
Cuscuta reflexa Roxb (BOT-KHS-117)	Convolvulaceae	Bannu/ Kohat/ Peshawar	S	H	E	Chambal	It is a parasitic plant species and is used for abdominal problems in cattle especially camels and horses
Cynodon dactylon (L.) Pers (BOT-KHS-118)	Poaceae	Bannu/ Kohat/ Peshawar	S	H	M	Drab	It is used as a fodder to feed cattle especially donkeys. It is also used for ornamental purposes in gardens
Cyperus rotundrus L (BOT-KHS-119)	Cyperaceae	Bannu	W	H	M	Dhela	Leaves are used for fuel, fodder and making mats
Dalbergia sissoo Roxb. Ex DC. (BOT-KHS-44)	Fabaceae	Bannu/ Kohat/ Peshawar	L	T	M	Sawa	Leaves are used to relieve abdominal pain in livestock. Wood is used in making furniture, timber, construction and fuels purposes
Datura inormis Juss. Ex Jacq (BOT-KHS-120)	Solanaceae	Bannu/ Kohat/ Peshawar	L	H	M	Barbaka	It is a wild weed plant and used in fencing the cereals fields
Datura innoxia Mill (BOT-KHS-121)	Solanaceae	Bannu/ Kohat/ Peshawar	L	H	M	Brabaka	It is a wild weed plant and used in fencing the cereals fields. Leaves are used to reduce inflammation
Datura stramonium L (BOT-KHS-45)	Solanaceae	Kohat/ Peshawar	L	H	M	Babara Barbaka	It is a wild weed plant and used in fencing the cereals fields. Seeds are used to kill worms in cattle
Daucus carota L. (BOT-KHS-46)	Apiaceae	Bannu/ Kohat/Peshawar	R	H	M	Gajara	Its roots are commonly used for eye sighting in the form of fresh salad. Leaves are used for fodder purposes and act as diuretics
Diplazium esculentum (Retz.) Sw (BOT-KHS-122)	Athyriaceae	Peshawar	L	H	M	Mor boti	Leaves extract is used to treat skin wounds and pimples Whole plant is used for fodder and fuel
Dodonaea viscosa Jacq. (BOT-KHS-123)	Spinadaceae	Kohat/ Peshawar	L	S	M	Sanata	It is a fence plant and also used for ornamental purposes. Plant is also used for fuel and to control soil erosion
Eclipta prostrata (L).L (BOT-KHS-124)	Asteraceae	Bannu/ Kohat	L	H	M	Spin Gulli	Plant is used for fuel purposes
Equisetum ramosissimum Desf (BOT-KHS-125)	Equisetaceae	Bannu/ Kohat/ Peshawar	L	H	M	Bandaki	Leaves are used for the treatment of kidney disorders. Whole plant is used for fodder and fuel
Erigeron canadensis L (BOT-KHS-126)	Asteraceae	Peshawar	L	H	M	Zangli wakha	Leaves are used to treat cough in buffalos. Plant is also used for fuel and fodder purposes
Eriobotrya japonica (Thunb.) Lindley. (BOT-KHS-96)	Rosaceae	Kohat/ Peshawar	Fr	S	M	Alokat	Fruits are used to relive constipation. It is also used for ornamental purposes

Table 2 (continued)

Botanical Name/Voucher No	Family Name	Locality	Part Used	Habit	Habitat	Local Name	Ethnobotanical/Traditional/local uses of plant species by local inhabitants for different purposes
Eucalyptus camaldulensis Dehnh. (BOT-KHS-49)	Myrataceae	Peshawar	L	T	M	Lochi	Leaves are used as a flavouring agent in cooking rice. The plant species is used to reclaim water logged soil and to conserve soil erosion. Wood is used for timber, construction, fuels and agricultural tools
Euphorbia helioscopia L (BOT-KHS-127)	Euphorbiaceae	Bannu/ Kohat/ Peshawar	W	H	M	Parpari	It is a wild weed plant species and used as a fodder by herders
Euphorbia Prostrata Aiton (BOT-KHS-128)	Euphorbiaceae	Bannu/ Kohat/ Peshawar	W	H	M	Sheen Parpari	It is a wild weed plant species and used as a fodder by herders
Fagonia cretica L. (BOT-KHS-50)	Zygophyllaceae	Bannu/ Kohat/ Peshawar	Fr	H	M	Spelaghzai	Fruits and leaves extracts are used to kill worms and treat skin pimples and rashes
Foeniculum vulgare Mill. (BOT-KHS-53)	Apiaceae	Bannu/ Kohat/ Peshawar	Fr	H	M	Kaga	Seeds are used for flavouring agent and to treat indigestion of stomach
Fumaria indica Pugsley (BOT-KHS-129)	Papavaraceae	Bannu/ Kohat/ Peshawar	W	H	M	Lewani Gajara	It is a wild weed plant species and used as a fodder to cattle particularly sheep and goats. Leaves are also used for the treatment of skin rashes and pimples, diarrhea and blood disorders
Geranium wallichianum D. Don ex Sweet. (BOT-KHS-130)	Geraniaceae	Bannu	R	H	M	Rathi Zar	Leaves are used to treat skin injuries in donkeys. It is wild weed plant species and used as a fodder donkeys and horses
Helianthus anus L. (BOT-KHS-131)	Asteraceae	Bannu/ Kohat/ Peshawar	Se	H	M	Almargul	Seeds are used for oil extraction that are rich in vitamin A and D. After oil extraction, the remaining seeds parts are used to feed the cattle
Heliotropium europaeum L. (BOT-KHS-132)	Heliotropiaceae	Bannu	L	H	M	Markonri	Leaves and root barks are used for teeth whitening. Whole plant is used as a fodder and fuel
Hibiscus esculentus L. (BOT-KHS-20)	Malvaceae	Bannu	W	H	M	Bhindi	Unripe fruits are used as a vegetable. Dry stems are used to concentrate the jaggery. Stems are also used for fuel purposes
Hordeum vulgare L. (BOT-KHS-97)	Poaceae	Bannu/ Kohat/ Peshawar	Se	H	M	Arbasa	Grain flour, straw and hay is used to feed cattle
Hypericum perforatum L. (BOT-KHS-133)	Hypericaceae	Bannu	Se	H	M	Shana Chai	Dry seeds are used to make tea for digestion and to treat obesity in body
Justicia adhatoda L. (BOT-KHS-134)	Acanthaceae	Bannu /Kohat/ Peshawar	W	S	M	Bazha	The leaves are boiled and used for chest infection. It is used as a fuel and attracts honey bees
Lantana camara L. (BOT-KHS-99)	Verbenaceae	Bannu	L	S	M	Zrghuny Gul	It is used for ornamental purposes due to its shiny and varied color flowers. It is used as a fuel and fence purposes
Lemna minor L (BOT-KHS-135)	Araceae	Bannu	W	H	H	Obo Washa	Whole plant is used as a feed to ducks and geese

Table 2 (continued)

Botanical Name/Voucher No	Family Name	Locality	Part Used	Habit	Habitat	Local Name	Ethnobotanical/Traditional/local uses of plant species by local inhabitants for different purposes
Lepidium sativum L. (BOT-KHS-136)	Brassicaceae	Bannu/ Kohat/ Peshawar	L	H	H	Sarsamai	Leaves in powder form mixed with oil and applied for wounds and burning of feet. Plant is used as a fodder and fuel
Luffa aegyptiaca Mill. (BOT-KHS-137)	Cucurbitaceae	Bannu/ Kohat/ Peshawar	F	H	M	Thori	Food is eaten in the form of cooked vegetable to kidney stone patients. It is a good source of minerals and vitamins
Malva parviflora L. (BOT-KHS-138)	Malvaceae	Kohat	L	H	M	Pochki	It is used as a leafy vegetable. It is also used for fodder and ornamental purposes in gardens
Mangifera indica L. (BOT-KHS-102)	Anacardiaceae	Peshawar	F	T	M	Aam	Fruits is considered the king of fruits and declared national fruit of Pakistan. Dry wood is used as a fuel and timber based products
Medicago sativa L. (BOT-KHS-140)	Fabaceae	Bannu/ Kohat/ Peshawar	W	H	M	Sabi	It is used as a leafy vegetable. It is also used for fodder to feed horses and ornamental purposes
Melia azedarach L. (BOT-KHS-26)	Meliaceae	Bannu/ Kohat/ Peshawar	L	T	M	Makanra	Leaves and fruits are used for skin problems. Whole plants are used for shade and ornamental purposes
Mentha arvensis L. (BOT-KHS-58)	Lamiaceae	Bannu/ Kohat/ Peshawar	L	H	M	Welani	Leaves are used for expel of gas from digestive system. Dry powder of leaves are mixed with sugar and used. It is used to treat heart burn problems
Mentha longifolia (L). Huds. (BOT-KHS-183)	Lamiaceae	Bannu/ Kohat/ Peshawar	L	H	M	Potna	Leaves are used for expel of gas from digestive system. It acts as a carminative agent. Dry powder of leaves is used in making condiments and spices
Mentha piperita L. (BOT-KHS-142)	Lamiaceae	Bannu	L	H	M	Jangli potna	Leaves are used for expel of gas from digestive system. Dry powder of leaves are mixed with sugar and used. It is used to treat heart burn problems
Momordica charantia L. (BOT-KHS-59)	Cucurbitaceae	Bannu/ Kohat/ Peshawar	F	H	M	Karela	Vegetable is used for the treatment of diabetes and obesity. Raw vegetable is chewed for controlling blood sugar
Morus alba L. (BOT-KHS-60)	Moraceae	Bannu/ Kohat/ Peshawar	F	T	M	Speen toot	Fruits are used to relieve constipation and malfunctioning of large intestine. Wood is used for furniture, agricultural tools and timber products
Morus nigra L. (BOT-KHS-184)	Moraceae	Bannu/ Kohat/ Peshawar	F	T	M	Tor toot	Fruits are used to treat constipation and disorders of large intestine. Wood is used for furniture, agricultural tools and timber products. Leaves are used to feed silk worm
Nerium oleander L. (BOT-KHS-144)	Apocynaceae	Kohat/ Peshawar	L	S	X	Ganderi gul	Flowers are used for treatment of loose motion in goats and sheep. Wood is used in non-timber products and fuel purposes
Ocimum basilicum L. (BOT-KHS-64)	Lamiaceae	Bannu/ Kohat/ Peshawar	I	H	M	Babri	Leaves extract are used for toothache and earache. It is also used as an ornamental plant in gardens

Table 2 (continued)

Botanical Name/Voucher No	Family Name	Locality	Part Used	Habit	Habitat	Local Name	Ethnobotanical/Traditional/local uses of plant species by local inhabitants for different purposes
Oryza sativa L. (BOT-KHS-145)	Poaceae	Bannu	Se	H	M	Wreja	Grains are used as a staple food. Bran is used for feeding the cattle
Oxalis carniculata L. (BOT-KHS-142)	Oxalidaceae	Kohat/Bannu	L	H	M	Tarokhai	Leaves in powder form are mixed with water and sugar and used for the treatment of piles. Plant is used as a fodder and fuel. It is cooked as a leafy vegetable. Leaves are raw chewed for sour taste
Parthenium hysterophorus L. (BOT-KHS-106)	Asteraceae	Bannu	L	H	M	Speenguli	It is a wild invasive plant species and only used for fuel and fodder purposes in study area
Peganum harmala L. (BOT-KHS-67)	Nitrariaceae	Bannu/ Kohat	L	H	M	Spelani	Dry leaves and fruits are smoked for devil repellent. Leaves extract are is also used for mosquito repellent. Leaves are also used for indigestion and to remove worms
Phoenix dactylifera L. (BOT-KHS-68)	Arecaceae	Bannu	Fr	T	M	Kajor	Fruits are used for relieving constipation and indigestion problems. Leaves are used for making ropes, mats and ceilings of chapper. Plant is used for fuel purpose
Phyla nodiflora (L.) Greene. (BOT-KHS-148)	Verbenaceae	Bannu	L	H	M	Zhaba	Leaves are used for treatment of earaches and toothaches commonly mixed with clove oil
Physalis angulata L. (BOT-KHS-149)	Solanaceae	Bannu	L	T	M	Mangothi	Leaves and flowers are used for diarrhea and loose motion. Plant is used for fuel, furniture and timber based products
Plantago ovata L. (BOT-KHS-71)	Plantaginaceae	Bannu/ Kohat/ Peshawar	S	H	M	Spaghol	Dry seeds are soaked in water and used for diarrheal problems and for diabetic's patients. Seeds are also used for diuretics and kidney stones
Polygonum amplexicaule D.Don (BOT-KHS-150)	Polygonaceae	Bannu	L	H	M	Bhandaky	Leaves extracts are used to treat skin rashes and pimples. Plant is used as a fodder and fuel
Polygonum dichotomum Blume. (BOT-KHS-151)	Polygonaceae	Bannu	L	H	M	Terwaky	Leaves are cooked as a leafy vegetable. Whole plant is used for fodder and fuel
Polypogon monspeliensis (L) Desf. (BOT-KHS-152)	Poaceae	Bannu	L	H	M	Bor Washki	It is an invasive wild grass found in wheat crops. The plant is exclusively used for fodder purposes
Portulaca oleracea L. (BOT-KHS-190)	Portulacaceae	Bannu/ Kohat/ Peshawar	W	H	M	Werkhari	Young stems and leaves are used as a leafy vegetable. Whole plants are also used as fodder for cattle
Potentilla supina L. (BOT-KHS-154)	Rosaceae	Bannu	L	H	M	Zer guly	Leaves are used as a fodder for cattle especially camels
Psidium guajava L. (BOT-KHS-73)	Myrataceae	Kohat	Fr	S	M	Amrot	Fruits are used for relieving constipation. Plant is used for ornamental purposes
Punica granatum L (BOT-KHS-105)	Punicaceae	Bannu/ Kohat/ Peshawar	Fr	S	M	Anar	Fruit bark is used for flavouring agent. Seeds are used for blood disorders and heart patients. Plant is used for ornamental purposes

Table 2 (continued)

Botanical Name/Voucher No	Family Name	Locality	Part Used	Habit	Habitat	Local Name	Ethnobotanical/Traditional/local uses of plant species by local inhabitants for different purposes
Ranunculus sceleratus L. (BOT-KHS-157)	Ranunculaceae	Bannu	L	H	M	Gopi Gul	Plant is used for ornamental purposes in gardens
Raphanus raphanistrum L. (BOT-KHS-158)	Brassicaceae	Kohat	R	H	M	Sera moli	Leaves and roots are used in making green salad. Leaves are used as a fodder for goats. Leaves are used to expel gas from stomach and intestine. Plant is used for ornamental purposes in gardens
Raphanus sativus L. (BOT-KHS-159)	Brassicaceae	Bannu/ Kohat/ Peshawar	R	H	M	Moli	Leaves and roots are used in making green salad. Leaves are used as a fodder for goats. Leaves are used to expel gas from stomach and intestine
Ricinus communis L. (BOT-KHS-75)	Euphorbiaceae	Kohat/ Peshawar	S	S	M	Randa	It is a wild plant species and no local use is reported by informants. In some cases, it is used for fuel and fence purposes
Rosa indica L. (BOT-KHS-76)	Rosaceae	Bannu/ Kohat/ Peshawar	I	S	M	Gulap	Petals extract are used for skin problems especially in winter. Plant is used for ornamental purposes in gardens
Rumex dentatus L. (BOT-KHS-160)	Polygonaceae	Bannu	W	H	M	Terwaki	Leaves used in making green salad and leafy vegetable. Leaves are used as a fodder for cattle
Saccharum officinarum L. (BOT-KHS-77)	Poaceae	Bannu/ Peshawar	S	H	M	Ghana	Leaves are used as a fodder for cattle. Stem juices are used to make gurr (jaggery). Stem bagasse is used as a fuel when it dries
Salvadora persica L. (BOT-KHS-78)	Salvadoraceae	Bannu	L	S	M	Palyman	Wood is used for cleaning teeth, fuel and making furniture
Schinus molle L. (BOT-KHS-161)	Anacardiaceae	Bannu	L	T	M	Thor March	It is widely used in making spices and condiments. Seeds in powder form are used for throat and chest infection in winter. It is also used for ornamental purposes
Sisymbrium irio L. (BOT-KHS-162)	Brassicaceae	Kohat	L	H	M	sersamai	Oil is extracted and used for mosquito repellent. Green leaves are cooked and used as a leafy vegetable. After oil extraction the remaining parts of seeds are feed to cattle
Solanum lycopersicum L. (BOT-KHS-79)	Solanaceae	Bannu/ Kohat/ Peshawar	Fr	H	M	Tamatr	Fruits are used as a vegetable. It is also used for ornamental purposes. Its juice is mixed with cucumber juice and applied on face for beauty
Solanum melongena L. (BOT-KHS-163)	Solanaceae	Bannu/ Kohat/ Peshawar	Fr	H	M	Binganr	Fruits are used as a vegetable. It is also used for ornamental purposes for its beautiful flowers
Solanum nigrum L. (BOT-KHS-164)	Solanaceae	Bannu/ Kohat/ Peshawar	L	H	M	Mako	It is a wild plant and only used for fodder and fuel purposes
Solanum supinum Dunal. (BOT-KHS-165)	Solanaceae	Bannu	L	H	M	Kanderi	Leaves are used for chest infection and act as expectorant

Table 2 (continued)

Botanical Name/Voucher No	Family Name	Locality	Part Used	Habit	Habitat	Local Name	Ethnobotanical/Traditional/local uses of plant species by local inhabitants for different purposes
Sonchus asper L. Hill. (BOT-KHS-166)	Asteraceae	Peshawar	L	H	M	Paska	It is a wild plant and used for fodder purposes. Leaves are also used for the treatment of fever and high temperature
Sonchus oleraceus L. (BOT-KHS-167)	Asteraceae	Peshawar	L	H	M	Paska	It is a wild plant and used for fodder purposes. Leaves are also used for the treatment of fever and high temperature
Syzigium cumini L. Skeels (BOT-KHS-81)	Myrtaceae	Kohat	Se	H	M	Lwang	Seeds pods aqueous extract are used for earache and tooth ache. In earlier times, seeds necklaces were prepared for bridge grooms. It is also used for ornamental purposes due to its better smell
Tamarix aphylla (L.) H. Karst. (BOT-KHS-83)	Tamaricaceae	Bannu/ Kohat/Peshawar	L	T	M	Ghaz	Leaves extract are used for indigestion problems in cattle. Wood is used for construction, timber and fuel purposes
Taraxacum officinale F.H.Wigg. (BOT-KHS-168)	Asteraceae	Bannu/ Kohat/ Peshawar	L	H	M	Zergul	It is used as a fodder for cattle and also used for ornamental purposes due to its shining and beautiful flowers
Thymus serphyllum L. (BOT-KHS-05)	Lamiaceae	Bannu	L	H	M	Spin Kaleen	Whole plant is used for ornamental purposes in gardens due to its varied color beautiful flowers
Torenia cordifolia Roxb. (BOT-KHS-170)	Linderniaceae	Bannu	L	H	M	Asmani Gull	Whole plant is used for ornamental purposes in gardens due to its shiny color beautiful flowers. It is also used as a fodder
Tribulus terrestris L. (BOT-KHS-171)	Zygophyllaceae	Bannu/ Kohat/ Peshawar	Fr	H	M	Matter Boti	The leaves are used for diabetic patients and for lowering blood cholesterol level. Plant is also used for fuel purposes
Trifolium repens L. (BOT-KHS-172)	Fabaceae	Bannu/ Kohat/ Peshawar	L	H	M	Shotala	Whole plant is used as a fodder to livestock. Bran is fed sheep and goats in winter season. Bran is also burnt in bricks kilns and pottery kilns particularly in earthenware
Triticum aestivum L. (BOT-KHS-173)	Poaceae	Bannu/ Kohat/ Peshawar	Se	H	M	Ghanum	It is an important cereal plant and used as a staple food. Bran/hay is fed to cattle and livestock. Wheat flour are cooked with oil and gurr (jaggery) for reliving stomach ache and constipation
Typha latifolia L. (BOT-KHS-174)	Typhaceae	Bannu	L	H	H	Lokha	Leaves are used for making ropes and making charpais (Sleeping beds). Leaves are also used in making roofs particularly in chapper (Shed). Matured spikes are mixed with sugar and eaten for relieving constipation
Urtica dioica L. (BOT-KHS-175)	Urticaceae	Bannu	L	H	M	Sezanki	Leaves in powder form are mixed with jaggery and eaten for treatment of diarrhea and menstrual cycle. Whole plant is feed to sheep and goats

Table 2 (continued)

Botanical Name/Voucher No	Family Name	Locality	Part Used	Habit	Habitat	Local Name	Ethnobotanical/Traditional/local uses of plant species by local inhabitants for different purposes
Veronica anagallis-aquatica L. (BOT-KHS-176)	Plantaginaceae	Kohat	L	H	H	Sperli gul	Leaves are chewed for mouth rashes and wounds. Plant is used for ornamental purposes in gardens for beautiful flowers and scent
Vigna retusa (E. Mey.)Walp. (BOT-KHS-177)	Fabaceae	Bannu	L	H	M	Maat	The seeds are edible and used as pulses in houses and kitchens. Bran is fed to goats and sheep in winter season. Bran is also burnt in brick kilns. The seeds are rich in proteins
Vitis vinifera L. (BOT-KHS-86)	Viticeae	Bannu/ Kohat/ Peshawar	Fr	S	M	Angor	Fruits are used for relieving constipation. Fruits are edible and the plant species are planted for ornamental purposes due to occupying small space in urban areas
Withania somnifera (L.) Dunal (BOT-KHS-87)	Solanaceae	Bannu/ Kohat/ Peshawar	Fr	H	M	Zangli tamatr	Small fruits are used for indigestion problems in horses and donkeys. Plant is also used for fuel purposes. Fruits are also used for gastric pain in children
Woodfordia Fruticosa L. Kurz. (BOT-KHS-178)	Lythraceae	Bannu	Fr	S	M	Dour	Fruits are used for the treatment of whooping cough and leucorrhea disease in females. Plant is used for fuel and fence
Xanthium inaequilaterum DC. (BOT-KHS-179)	Asteraceae	Kohat	L	H	M	Ganda Boti	It is a wild invasive plant species that have no reported ethnobotanical use by local inhabitants. In some cases they may be used as a fence plant. It causes itching effects
Xanthium strumarium L. (BOT-KHS-180)	Asteraceae	Bannu/ Kohat/ Peshawar	L	H	M	Ganda Boti	It is also a wild invasive plant species that have no reported ethnobotanical use by local inhabitants. In some cases they may be used as a fence plant. It causes itching effects
Zea mays L. (BOT-KHS-181)	Poaceae	Bannu/ Peshawar/ Kohat	Se	H	M	Jawar	Leaves and young shoots are used as a fodder. Corn cobs are used as a fuel. Young corn cobs are cooked on open fire and eaten. Bread is prepared from corn flour
Zingiber officinale Roscoe (BOT-KHS-88)	Zingiberaceae	Bannu	Rh	H	M	Adrak	Fresh rhizomes are raw eaten and tea is also prepared for heart patients. Tea is also taken for hypercholesterolemia patients. It is cooked in making karri to impart taste and flavor
Zizpihus jujuba Mill (BOT-KHS-89)	Rhamnaceae	Bannu/ Kohat/ Peshawar	Fr	T	M	Pwanidbera	Leaves are feed to goats for abdominal pain. Fruits are used for relieving constipation. It is also a honey bee plant species. Wood are used for construction, timber based products etc

Table 2 (continued)

Botanical Name/Voucher No	Family Name	Locality	Part Used	Habit	Habitat	Local Name	Ethnobotanical/Traditional/local uses of plant species by local inhabitants for different purposes
Ziziphus mauritiana Lam. (BOT-KHS-182)	Rhamnaceae	Bannu/ Kohat/ Peshawar	Fr	T	M	Bera	Leaves are feed to goats for abdominal pain. Fruits are used for relieving constipation. It is also a honey bee plant species. Wood are used for construction, timber based products and as a fuel etc
Zizpihus nummularia (Burm.f.) Wight and Arn (BOT-KHS-109)	Rhamnaceae	Bannu/ Kohat/ Peshawar	Fr	T	M	Karkanra	Leaves are feed to goats for abdominal pain. Fruits are used for relieving constipation. It is also a honey bee plant species. Wood are used for construction, timber based products etc

Part Used: B (bulb), Fr (fruit), I (inflorescence), L (leaves), R (root), Rh (rhizome), S (stem/ shoot), Se (seeds), W (whole plant), Habit: H (herb), S (shrub), T (tree). Habitat: E (epiphytes), H (hydrophytes), M (mesophytes), X (xerophytes);

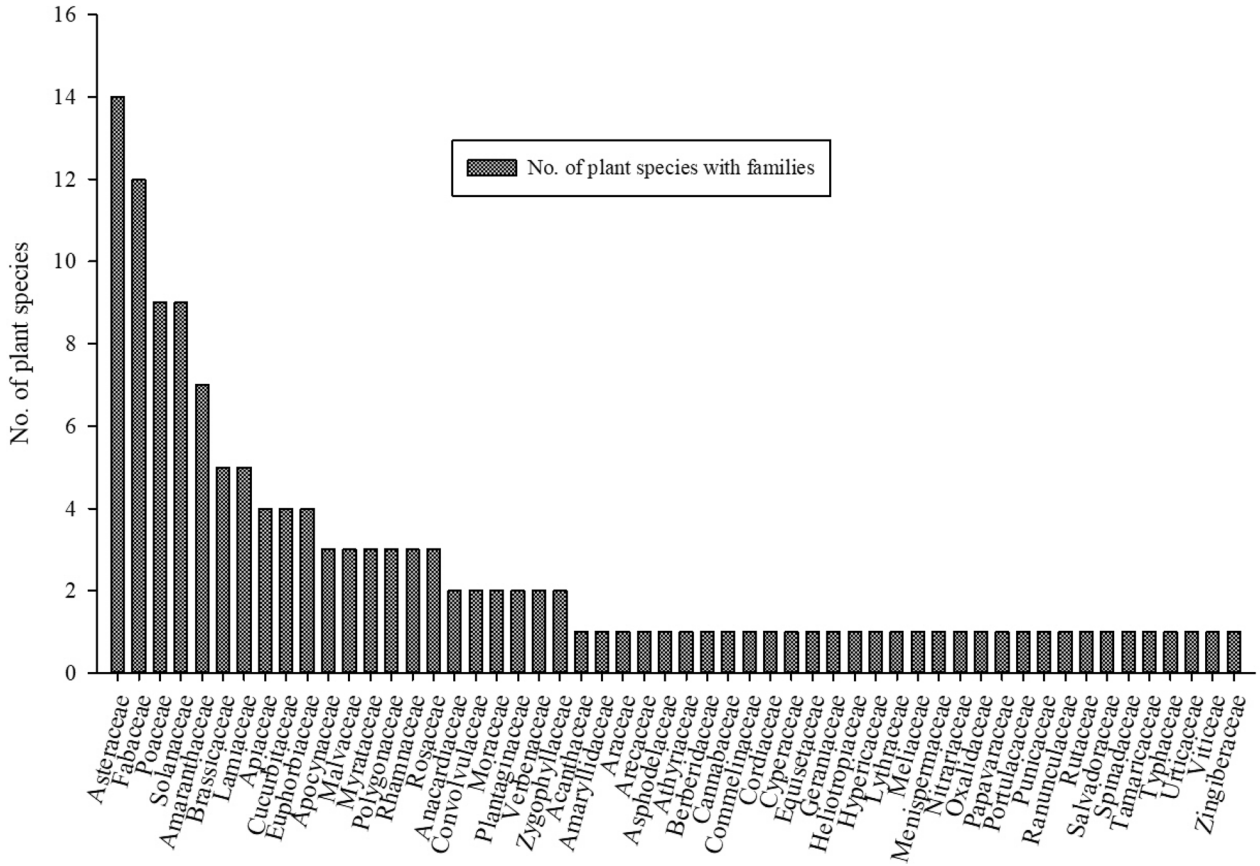

Fig. 2 Number of plant species with their family names in the study area

plant species fuel and 14 plant species for ornamental purposes from district Kotli Pakistan. A racent study by Amin et al. [43] reported that herbs (72%) were dominant growth form followed by trees (17%) and shrubs (10%) in district Kohistan, North Pakistan.

In herbal preparation, the herbaceous life form was utilized most frequently (78 plant species; 52%), followed by shrubs (27 plant species; 18%), trees (25 plant species; 16.6%), and ferns (5 plant species; 3.3%), grasses (12 plant species; 8%), and epiphytes or climbers [31]. Umair et al. [44] reported that the wild herbaceous flora made up 51% of the reported plant species, while studying ethnomedicinal local flora of Punjab, Pakistan. Perennial herbs were the most prevalent living behavior in the research area. Medicinal plants often have perpetual life cycles. Wild trees (13%) accounted of the medicinal flora, wild grasses and shrubs (8%) each, cultivated herbs (7%), shrubs (6%), grasses (5%) and cultivated grass and wild ferns for 1% each [45]. Similar results were reported by [46] and documented the leaves of *Mentha longifolia*, *Mentha arvensis* etc. for fresh salad and *Medicago* plant species as a leafy vegetable.

Parts of the plant species used in ethnomedicines

Leaves were the most dominant part of plant species, while rhizome was the least used part of plants for different purposes (Fig. 5). Their percentage was in leaves (43%), fruits (20%), whole plant (17%), stem (6%), seeds (5%), roots (4%), inflorescence (2%), bulbs (1%) and rhizome (1%). Similar results were reported by Bibi et al. [34] that, the leaves (24%) of the medicinal plants were the most frequently used part in the preparation of recipes. Aziz et al. [13] demonstrated that leaves (70%) were the dominant part of plant species used for the treatment of diabetes, followed by fruits (49%), seeds (20%), stem (10%), barks (9%), and whole plant (9%) while researching medicinal plants of northwest Pakistan. Young shoots and leaves (30%) were the most used part of plant species followed by fruits (18%), seeds (15%), bulbs (6%), and rhizomes (3%) in preparation of herbal medicines [47]. Ahmad et al. [48] reported that herbs (58%) were dominant life forms of all reported plants, followed by shrubs (28%), trees (12%), and climbers (2%).

Our research study was in line with previous studies [49–52]. The leaves (33%) were the most often used part of the plant, followed by roots (17%), fruits (14%), the

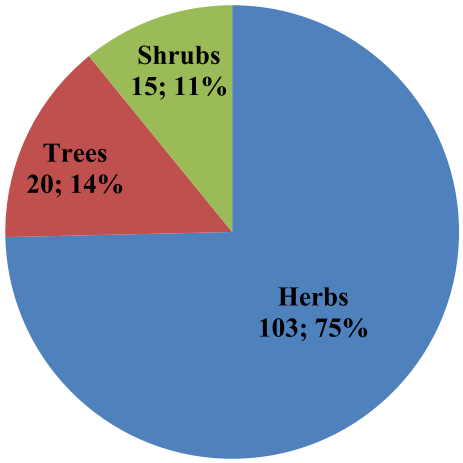

Fig. 3 Life forms of plant species found in the study area

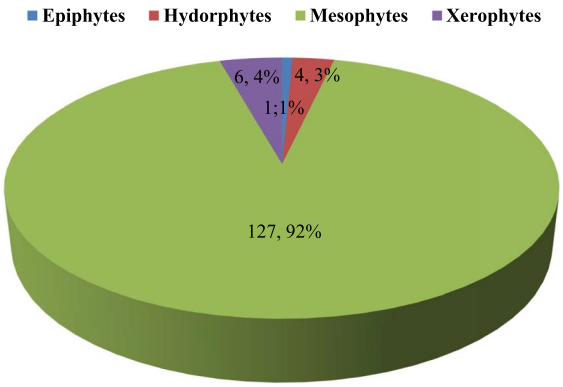

Fig. 4 Habitat of plant species found in the study area

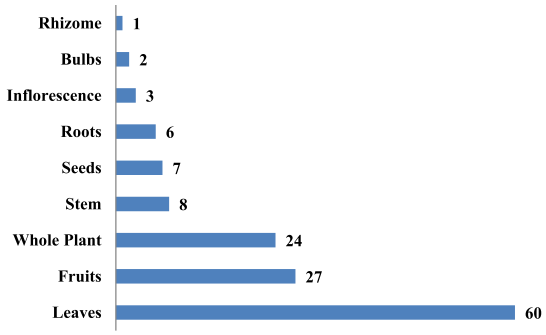

Fig. 5 Parts of plants plant species used for different purposes

entire plant (12%), and rhizomes (9%), stems (6%), barks (5%), and seeds (4%). Similar results were also reported by [49] that leaves (70%) were the most commonly used plant parts in medicines, followed by seeds (10%), roots (6%), latex (%), bark, bulb, flowers, tubers, and rhizomes (2% each) while conducting research in lesser Himalaya northern Pakistan [53, 54]. Concluded that the leaves of the plants were frequently used part in ethnomedicines while conducting a research study on the ethnobotany of the north west of Pakistan. Rehman et al. [55] suggested that the leaves (43.90%) of medicinal plants were frequently used in the preparation of remedies for the treatment of dental disorders. Similar results were also reported by Akhtar et al. [56], leaves (24%) were dominant part of plant species used for different purposes followed by fruits (18%) and roots (15%) in district Swat, Pakistan. Adnan et al. [57] reported that leaves were the dominant part of (34%) plant species used in the preparation of ethnomedicines in war affected areas of North West Pakistan. Ahmed et al. [58] reported that leaves (36.61%) were mostly used part of plant species for making indigenous recipe followed by fruits (24.11%) while studying ethnobotanical use of plants plant species in Tehsil Murree, Northwest Pakistan. The leaves and roots (17 plant species), fruits (16 plant species), seeds and nuts (15 plant species), bark (14 plant species) and gums and resins (13 plant species) were used to make various medications [59].

Ethnomedicinal uses of plant species

Ethnomedicinal uses of plant species for 21 diseases are given in (Table 3). The highest informant consensus factor (0.97) was recorded for kidney disorders. The lowest informant consensus factor (0.70) was recorded for chest infection. It is an indication that the majority of the plant species were traditionally used for treating different types of diseases from alopecia to xeroderma. Our findings were accordance to previous literature as Bibi et al. [60] documented the highest ICF value for *A. millefolium* (0.19) and the lowest ICF value for *B. sindica* (0.02) in the Balochistan province of Pakistan. An ethnobotanical study conducted by Aziz et al. [61] in tribal areas of Pakistan documented that *C. procera* had the highest ICF value (0.86), followed by *C. sativa* (0.82), *M. piperita* (0.82), *M. longifolia* (0.76), *A. sativum* (0.73), *C. sativum* (0.73) and *F. vulgare* (0.72). In an ethnobotanical study conducted by Bibi et al. [34] the highest ICF value (1.00) was calculated for the antidote category. Ali et al. [62] reported that participants have categorized plant uses into 15 categories while studying the floristic diversity of Swat valley, Pakistan. Almost nearly nine percent of the participants agree on choosing and usage of plants for the treatment of evil eyes, with comparable findings for body cuts (8.2%) and psychological/neural diseases (8.0%). Respondents agree that *B. lyceum* leads in all five criteria. *S. laureola* is also a key ethnobotanical plant, rating second in the salience index, sixth in the relative importance index, seventh in cultural value index, and third in the cultural importance index. It ranks thirty-fifth in the

Table 3 ICF values for different ailments in study area

Disease name	Nt/Nur		I_{CF}/F_{IC}
Alopecia	4/15	*A. cepa*, *A. vera*, *B. compestris*, *Z. mauritiana*	0.79
Chest infection	7/21	*A. sativum*, *C. fistula*, *D. carota*, *F. vulgare*, *M. alba*, *S. cumini*, *Z. officinale*	0.70
Constipation	5/41	*C. colocynthis*, *C. fistula*, *F. carica*, *F. vulgare*, *P. lenceolata*	0.90
Dental problems	3/19	*M. Azadirachta*, *E. camaldulensis*, *S. cumini*	0.89
Devil repellant	3/29	*P. harmala*, *F. cretica*, *T. aphylla*,	0.93
Dyspepsia	15/78	*A. sativum*, *C. limon*, *C. fistula*, *C. tuberculata*, *C. colocynthis*, *C. sativum*, *C. sativus*, *D. carota*, *F. vulgare*, *M. arvensis*, *M. piperita*, *M. longifolia*, *O. basillicum*, *S. cumini*, *Z. officinale*	0.82
Diabetes	11/48	*A. cepa*, *A.sativum*, *A. vera*, *M. azadirachta*, *C. sativum*, *C. limon*, *C. tuberculata*, *F cretica*, *F. vulgare*, *M. charantia*, *W. Coagulans*	0.79
Ear diseases	9/35	*A. sativum*, *E. camaldulensis*, *F. vulgare*, *M. arvensis*, *P. nigrum*, *S. persica*, *S. cumini*, *R. stricta*, *T. aphylla*	0.76
Gingivitis	4/13	*A. vera*, *O. basillicum*, *S. cumini*, *Z. officinale*	0.75
Hemorrhoids	4/19	*C.* sativum, *C. fistula*, *F. vulgare*, *P. lenceolata*	0.83
Helminthiasis	7/35	*A. sativum*, *C. limon*, *C. fistula*, *E. camaldulensis*, *F. vulgare*, *M. arvensis*, *P. nigrum*	0.82
Hypertension	8/41	*A. sativum*, *C. limon*, *C. tuberculata*, *C. colocynthis*, *C. sativus*, *O. basillicum*, *V. vinifera*, *Z. officinale*	0.83
Kidney disorders	2/31	*C. limon*, *M. azadirachta*	0.97
Obesity	11/65	*A. sativum*, *C. limon*, *C. tuberculata*, *C. colocynthis*, *C. sativus*, *M. arvensis*, *M. piperita*, *M. longifolia*, *F. vulgare*, *O. basillicum*, *Z. officinale*	0.84
Ophthalmic diseases	3/12	*D. carota*, *F.* vulgare, *S. officinarum*	0.82
Oral ulcers	5/22	*A. cepa*, *A. sativum*, *C. sativus*, *F. vulgare*, *S. cumini*	0.81
Pyrexia	5/17	*B. compestris*, *C. sinensis*, *C. sativus*, *P. guajava*, *S. persica*	0.75
Sore throat	7/31	*M. arvensis*, *M. piperata*, *M. longifolia*, *F. vulgare*, *O. basillicum*, *S. cumini*, *Z. officinale*	0.80
Vomiting	5/16	*A. cepa*, *C. tuberculata*, *C. limon*, *M. arvensis*, *Z. officinale*	0.73
Wound s healing	4/21	*A. vera*, *C. limon*, *C. tuberculata*, *M. arvensis*	0.85
Xeroderma	2/7	*A. vera*, *O. basillicum*	0.83

conservation priority index. Abbas et al. [63] reported that 53 percent of the plant species had many uses, 21% were eaten as wild fruits and vegetables, and 43 percent were used to treat various illnesses. The most commonly used medicinal plant species were determined to be *Thymus linearis*, *Hippophae rhamnoides*, *Convolvulus arvensis*; that with the highest RFCi values (0.54, 0.51, and 0.48, respectively) while studying the flora of Karakoram Range northern Pakistan. In an ethnobotanical study conducted in northern Punjab, Pakistan, herbs from 35 different plant species are utilized to treat various diseases [59]. Adnan et al. [57] reported that he use of plant species for carminative purposes were highest (14 spp), followed by blood purification in war affected areas of Northwest Pakistan.

Use values of single plant

Use values determined the use of a particular plant species for the treatment of a disease that was cited by many informants. Use values of a single plant species were elucidated in (Table 4). *S. cumini* was highly cited (0.78) by the informants for the treatment of ear diseases. *C. lemon* was less cited (0.03) by the local inhabitants for the relief of vomiting. The higher use values of plants in the study area mean that the particular plant species was frequently found in that area. Maximum numbers of plant species (16 spp) were used for the treatment of indigestion, followed by diarrhea (11 spp) and cough (10 spp) [41]. Bibi et al. [34] documented the highest use values reports for *C. colocynthis* (5 URs), *C. tuberculata* (5 URs), *M. neglecta* (5 URs), and *M. longifolia* (5 URs). Aziz et al. [61] concluded that the use values of a single plant were recorded for *B. lycium* (0.94) followed by *V. indica* (0.90), *I. rugosus* (0.88), *F. vulgare* (0.87), *P. harmala* (0.86), *S. virginianum* (0.85), and *C. fistula* (0.79) in a research study conducted in tribal areas of Pakistan. Bibi et al. [60] reported that *A. baluchistanicum* (0.73) and *B. baluchistanica* (0.56) have the highest use reports of (8 each) and lowest use reports *of T. stocksii* (0.13). Low use values did not mean that the plant species was not important; it meant that the plant species was less available to local inhabitants. Plant species with low use value should not be ignored and their use should be transferred to the next coming generation. An ethnobotanical study conducted by Khan and Badshah [64] in district Charsadda, Pakistan revealed that the majority of the plant species (164) were used as fodder/forage, fruits (27 spp), vegetables (28 spp), fuel (47 spp), medicinal (66 spp), timber (21 spp), thatching (8 spp), insect attractant (29 spp), and only 4 plant species were used as spices (condiments), while some plant

Table 4 Use values of different plant species for the treatment of different diseases

Disease name	Plant name	Habit	No of citation by informants	Total informants	Use value
Alopecia	*A. sativum*	Herb	31	101	0.31
Chest infection	*C. fistula*	Tree	77	101	0.76
Constipation	*P. lenceolata*	Herb	65	101	0.64
Dental problems	*O. basillicum*	Herb	47	101	0.47
Dyspepsia	*M. piperita*	Herb	51	101	0.50
Devil repellants	*P. harmala*	Herb	43	101	0.43
Diabetes	*C. tuberculata*	Herb	39	101	0.39
Ear diseases	*S. cumini*	Herb	79	101	0.78
Gingivitis	*M. azadirachta*	Tree	15	101	0.15
Hemorrhoids	*C. fistula*	Tree	35	101	0.35
Helminthiasis	*P. harmala*	Herb	48	101	0.48
Hypertension	*A. sativum*	Herb	63	101	0.62
Kidney disorders	*A. cepa*	Herb	21	101	0.21
Obesity	*C. tuberculata*	Herb	60	101	0.59
Ophthalmic diseases	*D. carota*	Herb	39	101	0.39
Oral ulcers	*F. vulgare*	Herb	27	101	0.27
Pyrexia	*B. compestris*	Herb	31	101	0.31
Sore throat	*M. arvensis*	Herb	5	101	0.05
Vomiting	*C. limon*	Herb	3	101	0.03
Wounds healing	*M. arvensis*	Herb	13	101	0.13
Xeroderma	*A. vera*	Herb	19	101	0.19

species, such as *Dryopteris stewartii*, *Equisetum arvense*, *Eichhornia crassipes* have not reported for any use. Khan et al. [65] suggested that the importance of every medicinal plant species in the area was significant,some have gained significant traction in the local healthcare system. *Dioscorea deltoidea*, for example, was used locally as an anthelmintic and tonic for urinary tract infections. *Podophyllum hexandrum* was used by the local hakeems (traditional medicine specialists) to cure cancer and stomach issues. *Berberis pseudoumbellata* fruit was prized as a tonic, while its powdered bark was used locally to cure fever, backaches, jaundice, and urinary tract infections. *Cypripedium cordigerum* and *Dactylorhiza hatagirea* were two orchid plant species that were used as nerve tonics and aphrodisiacs. Two other notable plant species for medicinal purposes were *Aesculus indica* and *Cedrus deodara*. *Cedrus deodara* oil was used to treat skin conditions, and *Aesculus indica* powdered fruit nuts were used to treat colic and eliminate worms. In terms of both plant species diversity and frequency of citation (FC), the Rosaceae family emerged as the dominant group. Fruit was the portion most frequently consumed, and July was the best month to find wild fruit products. *Olea ferrugenia* was the most often cited plant species, with an FC = 1. *Amaranthus spinosus* came in second (FC = 0.93). Approximately 14% (7) of the recorded plant species were commercially viable, while 27% (14) were initially reported to be utilized as wild food products plant species in Pakistan [30].

Traditional uses of plants (FL%)

Fidelity level was used to identify plant species that were mostly preferred by local inhabitants. Fidelity-level percentage results are shown in (Table 5). It determined the value of a plant species for medicinal purposes as well as other purposes. The highest fidelity level percentage (91.8) was recorded for *A. sativum* for the treatment of alopecia and other uses. The lowest fidelity percentage (41.7) was recorded for *M. longifolia* for wound healing and other traditional uses. Our research study was concordant with the other recent research studies. In an ethnobotanical study conducted by Bibi et al. [34] the highest fidelity level (100%) was calculated for the *C. tuberculata, C. colocynt*his, *S. quettense*, and *A. welhemsii* in Mastung District of Baluchistan, Pakistan. According to a research study conducted by Ullah et al. [66] on two medicinal plants plant species in District Bannu, Pakistan, the fidelity level of *B. lyceum* (89.9%) was highest for the treatment of gastro ulcers followed by *D. blancoi* (62.2%) for abdominal diseases, and *Solanum nigrum* and *S. thea* (53.3%) for blood disorders while the lowest fidelity level was recorded for the *A. grahamianus*, *C. longifolia*, and

Table 5 Fidelity level of studied medicinal plants in study area

Disease Name	Plant Name	Habit	No. of informants using plat plant species for medicinal purpose (Ip)	No. of informants using plant species for any purpose (Iu)	Fidelity level %
Alopecia	*A. sativum*	Herb	78	85	91.8
Chest infection	*C. fistula*	Tree	35	65	53.8
Constipation	*P. lenceolata*	Herb	41	45	91.1
Dental problems	*O. basillicum*	Herb	54	67	80.6
Dyspepsia	*M. piperita*	Herb	53	71	74.6
Devil repellants	*P. harmala*	Herb	31	43	72.1
Diabetes	*C. tuberculata*	Herb	17	34	50.0
Ear diseases	*S. cumini*	Herb	45	51	88.2
Gingivitis	*M. azadirachta*	Tree	23	45	51.1
Hemorrhoids	*C. limon*	Tree	21	27	77.8
Helminthiasis	*P. nigrum*	Herb	19	27	70.4
Hypertension	*A. sativum*	Herb	25	34	73.5
Kidney disorders	*A. cepa*	Herb	33	51	64.7
Obesity	*C. tuberculata*	Herb	42	66	63.6
Ophthalmic diseases	*D. carota*	Herb	50	78	64.1
Oral ulcers	*F. vulgare*	Herb	18	34	52.9
Pyrexia	*B. compestris*	Herb	48	78	61.5
Sore throat	*M. arvensis*	Herb	14	32	43.8
Vomiting	*C. limon*	Herb	23	39	59.0
Wound s healing	*M. longifolia*	Herb	25	60	41.7
Xeroderma	*A. vera*	Herb	20	45	44.4

X. strumarium. In a research study conducted by Bibi et al. [60] in Baluchistan province, the fidelity level of two plant species viz *S. quettense* and *B. baluchistanica* were (100%). Rehman et al. [55] reported the highest fidelity level (100%) for *B. ciliata*, *J. regia*, and *E. procera* followed by *B. lyceum* (97.67%) for the treatment of various tooth problems. A research study conducted by Liaqat et al. [67] suggested that *B. lyceum* and *P. lenceolata* had maximum fidelity levels (100%). According to Hussain et al. [68] herbs were commonly employed to treat digestive issues, including carminative (12 spp), diarrhea (11 spp), laxative (11 spp), and ulcers, (7 spp), appetizer (5 spp), digestive pain (4 spp), and antihelmintic (4 spp). Khan et al. [69] reported the use of certain plant species as a food in different cooking recipe like raw form, cooked, boiled in water etc. used by three ethnic groups in northwest Pakistan. Aziz et al. [70] reported various plant species that were used for the treatment of animal ailments in Pakistan.

Average direct matrix ranking

The average direct matrix ranking by 15 informants for 10 plant species was revealed in (Table 6). The highest ranking (1st) for ten plant species was recorded for their use in medicinal purposes. It was followed by Ethno- veterinary uses and food plants (2nd), Fuel plants and Timber /construction plants (3rd), Vegetable (4th), Furniture (5th), Fodder plants (6th), and Agricultural tools, Honey bee plants and Ornamental plants (7th). The last ranking (8th) was recorded for fencing, oil extraction, and fruit purposes by 15 key informants. The over-collection of plant species for fuel, food, and construction purposes leads to extinction and causes a huge loss of biodiversity. A study conducted by Khan and Khan [71] suggested that wood from timber plants was exported to nearby industries for making furniture and timber. Plant species like *A. nilotica*, *D. sissoo*, and *Z. jujuba* were under high pressure in the study area due to the high market value for timber/construction products. According to a study done in Pakistan's Gujrat region, *D. sissoo* used to make 80% of industrial furniture. The most commonly used non-timber forest product plant species include *A. nilotica*, *A. modesta*, *Z. nummularia*, *C. decidua*, and *M. boxifolia*. Our results were similar to that of Murad et al. [72] and reported a high rank of plant species that were used for medicinal purposes. Ahmad et al. [73] reported that the average direct matrix ranking (DMR) of tree plant species, *Olea ferruginea* was shown to have the highest multipurpose usage (56), followed by firewood (28), fodder (20), fruit and food (20), hedges and fences (12), while studying the ethno pharmacological uses of plant in Kashmir, Pakistan. Ahmed et al. [58] reported that

Table 6 average direct matrix ranking (DMR) of 15 key informants for 10 plant species

Ethnobotanical uses	*A. sativum*	*C. tuberculata*	*A. nilotica*	*A. lebbek*	*F. vulgare*	*O. basillicum*	*M. arvensis*	*A. modesta*	*T. aphylla*	*Z. jujuba*	Total	Rank
Medicinal uses	4	3	1	2	3	2	3	2	1	2	23	1st
Ethno- veterinary uses	1	0	1	0	2	1	2	1	1	2	11	2nd
Food plants	3	2	0	0	1	0	2	3	0	0	11	2nd
Fuel plants	0	0	2	3	0	0	0	1	2	2	10	3rd
Timber/ construction plants	0	0	3	2	0	0	0	1	1	1	10	3rd
Vegetables	3	4	0	0	0	0	2	0	0	0	09	4th
Furniture	0	0	3	1	0	0	0	0	3	1	08	5th
Fodder plants	2	1	1	0	0	0	0	1	0	2	07	6th
Agricultural tools	0	0	1	0	0	0	0	1	2	1	05	7th
Honey Bee Plants	0	0	1	1	0	0	0	1	0	2	05	7th
Ornamental plants	0	1	0	0	1	2	1	0	0	0	05	7th
Spices	2	0	0	0	2	0	1	0	0	0	05	7th
Fence plants	0	0	2	0	0	0	0	0	0	0	02	8th
Fruit plants	0	0	0	0	0	0	0	1	0	1	02	8th
Oily plant	0	0	0	0	0	1	1	0	0	0	02	8th

plant species were used for medicinal and fodder purpose (27.93%) followed by other uses (16.90%), wild fruits (6.55%), and vegetables (5.52%) and for ethnoveterinary (3.72%), while studying ethnobotanical use of plants plant species in Tehsil Murree, Northwest Pakistan. Our results were parallel with the report of Aziz et al. [13] while studying the traditional use of wild food plants in Kaniguram, northwest Pakistan.

Plant species common among study areas (Jaccard index/ Similarity index)

Jaccard index result showed that the plant species found in urban area of Bannu and Kohat were more similar (JI = 0.88). The similarity index of plant species found in urban area of Bannu and Peshawar was 0.44. Similarity index of plant species found in urban area of Kohat and Peshawar was 0.22 that were less similar [Fig. 6]. Plant species (73) were common in all the three study areas. Plants plant species (4) were common in Bannu and Kohat study areas and plant species (2) were common in Bannu and Peshawar study areas. Plant species (4) were common in Kohat and Peshawar study areas. A research study conducted by Bahadur et al. [32] on ethnobotany of Peshawar valley reported the highest JI (0.87) and lowest (0.50). Highest the JI values indicated that these areas were close together, while lowest JI indicated that the habitat of plant species, cultural diversity and population density were far away from each other [74]. Similar results to our study were also reported by Amjad et al. [31] that the plant species found in neighboring areas,Pearl valley and Toli peer were more similar. An ethnopharmacological study conducted by [33] concluded, while studying the ethnopharmacological uses of plants in Pakistan that the highest similarity/jaccard index means that the study area was sharing same plant resources and floristic diversity. Similar report was documented by Abbas et al. [23] that there were certain common plant species that were traditionally used by different communities in Kurram, northwest Pakistan. Our findings were in accordance with Khalid et al. [75]. Aziz et al. [76] reported the similarity and overlapping the use of plant species utilized by different ethnics groups in northwest Baluchistan, Pakistan. Our findings were in accordance with the previous studies conducted in nearby areas of northwest, Pakistan [54, 77–79].

Novelty of the study

The findings of current study were compared with 30 previous documented studies and some new traditional uses of plants were reported that were not found in previous studies. The comparison was based on similarity in geography, vegetation and climatic condition. The study was novel due to selection of urban ethnobotany and finding ethnobotanical knowledge because earlier studies focused on rural and remote areas ethnobotany. Some novel findings were the use of *Caralluma tuberculata*

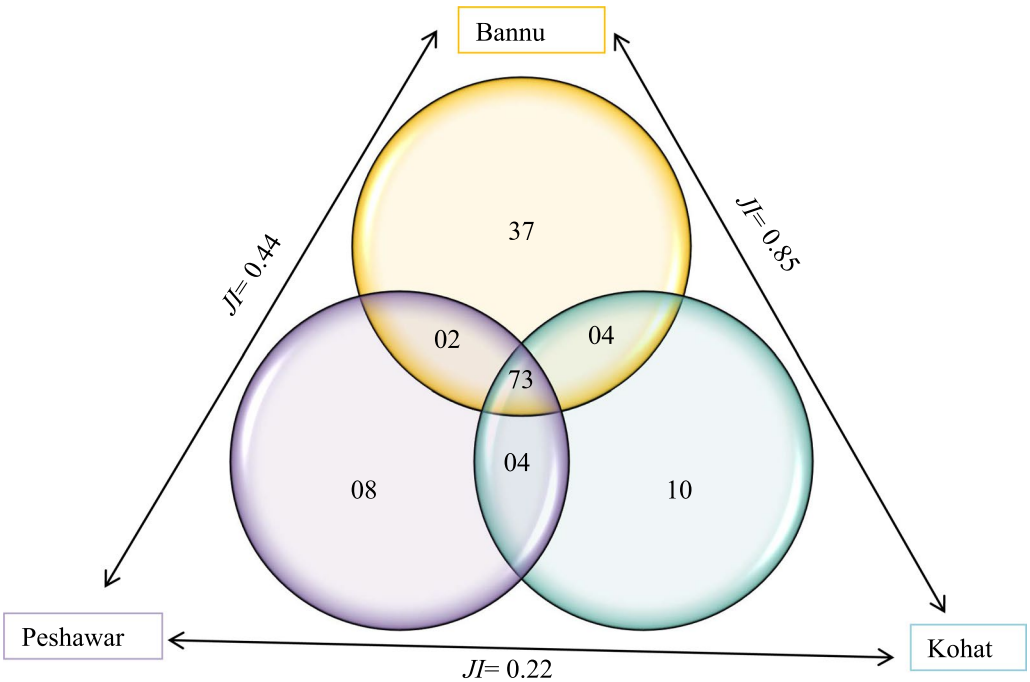

Fig. 6 Number of plant species common in urban areas of Bannu, Kohat and Peshawar (Jaccard Index)

fresh stems for improving sexual desire in males and act as aphrodisiacs. Fruits extract in raw form of *Lycopersicm esculentum* and *Cucumis sativus* for glowing of face and to remove pimples. The milky exudates of *Calotropis procera* leaves were used for bees and wasps sting for the first time.

Conclusion and future recommendation

The current study concludes that the study area has a rich source of medicinal flora and local inhabitants are heavily dependent on plant species for firewood, fodder, and medicinal needs. Herbs and leaves were the dominant life forms and used due to bioactive compounds. The native medicinal flora is being overused by the local inhabitants due to a lack of resources, changing lifestyles, and financial restrictions. It was observed that young people are completely unaware of this treasure of ethnomedical information, with elders, Hakeems (traditional practitioners), and Pensaries (local herb vendors) being the only groups with access to it. Because of the shift in societal values brought about by scientific and technological advancements, younger generations are adopting the new traditions much more quickly. Knowledge about medicinal plants will become outdated due to the influence of contemporary cultural shifts. Therefore, before indigenous knowledge disappears, it is crucial to record the native flora and their ethnomedicinal recipes. The main risks to the vegetation in the investigated area include overgrazing, collecting fodder, logging, collecting medicinal herbs, and invasive plant species. Multipurpose plant species like *D. sissoo* and *A. modesta* are now vulnerable as a result of these practices. Therefore, for the protection of threatened plant species, various preventive actions (restricted grazing, reforestation, rangeland management, etc.) must be taken. Additionally, as a long-term conservation initiative, both in-situ and ex-situ measures should be used. There may be more conservation education. The extension of horticultural products, particularly fruits, off-season vegetables, and mushrooms, could boost the local economy and decrease pressure on the trees from fuel wood. To further aid in the preservation of the indigenous flora, the traditional knowledge of the area must be documented. It is possible to educate and train the local community in the sustainable gathering and utilization of medicinal flora. This study is limited to only three urban areas of Khyber Pakhtunkhwa. Further ethnobotanical research studies are needed to explore these natural resources.

Abbreviations

A. augusta	*Abroma augusta*
A. modesta	*Acacia modesta*
A. nilotica	*Acacia nilotica*
A. senegal	*Acacia senegal*
A. aspera	*Achyranthes aspera*
A. lebbek	*Albizia lebbek*
A. maurorum	*Alhagi maurorum*
A. cepa	*Allium cepa*
A. sativum	*Allium sativum*
A. vera	*Aloe vera*
ADMR	*Average direct matrix ranking*
A. philoxeroides	*Alternanthera philoxeroides*
A. sessilis	*Alternanthera sessilis*
A. blitum	*Amaranthus blitum*
A. viridis	*Amaranthus viridis*
A. visnaga	*Ammi visnaga*
A. donax	*Arundo donax*
A. sativa	*Avena sativa*
B. variegata	*Bauhinia varigata*
B. lycium	*Berberis lycium*
B. compestris	*Brassica compestris*
B. monosperma	*Butea monosperma*
C. arvensis	*Calendula arvensis*
C. procera	*Calotropis procera*
C.sativa	*Cannabis sativa*
C.annuum	*Capsicum annuum*
C. tuberculata	*Caralluma tuberculata*
C. oxycantha	*Carthamus oxycantha*
C. fistula	*Cassia fistula*
C. calcitrapa	*Centaurea calcitrapa*
C. album	*Chenopodium album*
C. ambrosioides	*Chenopodium ambrosioides*
G. wallichianum	*Geranium wallichianum*
H. anus	*Helianthus anus*
H. europaeum	*Heliotropium europaeum*
H. esculentus	*Hibiscus esculentus*
H. vulgare	*Hordeum vulgare*
H. perforatum	*Hypericum perforatum*
J. adhatoda	*Justicia adhatoda*
L. camara	*Lantana camara*
L. minor	*Lemna minor*
L. sativum	*Lepidium sativum*
L. aegyptiaca	*Luffa aegyptiaca*
M. parviflora	*Malva parviflora*
M. indica	*Mangifera indica*
M. sativa	*Medicago sativa*
M. azedarach	*Melia azedarach*
M. arvensis	*Mentha arvensis*
M. longifolia	*Mentha longifolia*
M. piperita	*Mentha piperita*
M. charantia	*Momordica charantia*
M. alba	*Morus alba*
M. nigra	*Morus nigra*
N. oleander	*Nerium oleander*
O. basilicum	*Ocimum basilicum*
O. sativa	*Oryza sativa*
O. carniculata	*Oxalis carniculata*
P. hysterophorus	*Parthenium hysterophorus*
P. harmala	*Peganum harmala*
P. dactylifera	*Phoenix dactylifera*
P. nodiflora	*Phyla nodiflora*
P. angulata	*Physalis angulata*
P. ovata	*Plantago ovata*
P. supina	*Potentilla supina*
P. guajava	*Psidium guajava*
P. granatum	*Punica granatum*
R. sceleratus	*Ranunculus sceleratus*
R. raphanistrum	*Raphanus raphanistrum*
R. sativus	*Raphanus sativus*
R. communis	*Ricinus communis*
R. indica	*Rosa indica*
R. dentatus	*Rumex dentatus*
S. officinarum	*Saccharum officinarum*
S. persica	*Salvadora persica*
S. molle	*Schinus molle*
S. irio	*Sisymbrium irio*

S. lycopersicum	*Solanum lycopersicum*
S. melongena	*Solanum melongena*
S. nigrum	*Solanum nigrum*
S. supinum	*Solanum supinum*
S. asper	*Sonchus asper*
S. oleraceus	*Sonchus oleraceus*
S. cumini	*Syzigium cumini*
T. aphylla	*Tamarix aphylla*
T. officinale	*Taraxacum officinale*
T. serphyllum	*Thymus serphyllum*
T. cordifolia	*Torenia cordifolia*
T. terrestris	*Tribulus terrestris*
T. repens	*Trifolium repens*
T. aestivum	*Triticum aestivum*
T. latifolia	*Typha latifolia*
U. dioica	*Urtica dioica*
V. anagallis-aquatica	*Veronica anagallis-aquatica*
V. retusa	*Vigna retusa*
C. sativus	*Cucumis sativus*
C. pepo	*Cucurbita pepo*
C. reflexa	*Cuscuta reflexa*
C. dactylon	*Cynodon dactylon*
C. rotundrus	*Cyperus rotundrus*
D. sissoo	*Dalbergia sissoo*
D. stramonium	*Datura stramonium*
D. innoxia	*Datura innoxia*
V. vinifera	*Vitis vinifera*
D. carota	*Daucus carota*
D. esculentum	*Diplazium esculentum*
D. viscosa	*Dodonaea viscosa*
E. prostrata	*Eclipta prostrata*
E. ramosissimum	*Equisetum ramosissimum*
E. canadensis	*Erigeron canadensis*
UV	*Use values*
JI	*Jaccard index*
C. canadensis	*Conyza canadensis*
X. inaequilaterum	*Xanthium inaequilaterum*
X. strumarium	*Xanthium strumarium*
Z. mays	*Zea mays*
C. diffusa	*Commelina diffusa*
C. dichotoma	*Cordia dichotoma*
E. japonica	*Eriobotrya japonica*
E. camaldulensis	*Eucalyptus camaldulensis*
E. helioscopia	*Euphorbia helioscopia*
E. prostrata	*Euphorbia prostrata*
F. cretica	*Fagonia cretica*
F. vulgare	*Foeniculum vulgare*
F. indica	*Fumaria indica*
P. oleracea	*Portulaca oleracea*
C. sativum	*Coriandrum sativum*
C. bonplandianus	*Croton bonplandianus*
Z. jujuba	*Zizpihus jujuba*
Z. mauritiana	*Ziziphus mauritiana*
Z. nummularia	*Ziziphus nummularia*
D. inormis	*Datura inormis*
ICF	*Informant consensus factor*
FL	*Fidelity level*
W. somnifera	*Withania somnifera*
C. arvensis	*Convolvulus arvensis*
W. fruticosa	*Woodfordia fruticosa*
P. monspeliensis	*Polypogon monspeliensis*
C. lemon	*Citrus lemon*
P. dichotomum	*Polygonum dichotomum*
Z. officinale	*Zingiber officinale*
P. amplexicaule	*Polygonum amplexicaule*
C. arvense	*Cirsium arvense*

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Author contributions
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Declarations

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