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Full Length Article

Ethnomedicinal Plant Utilization in Rural Northern Punjab, Pakistan: A Quantitative and Qualitative Analysis

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Abstract

Plants have long been utilized as traditional medicine by the inhabitants of Northern Punjab, Pakistan. However, this local knowledge has not been well documented. Data were collected from 150 informants, of whom 66.67% were women. To record ethnomedicinal data from indigenous people, ethnobotanical data were collected using semi-structured questionnaires and interviews with indigenous people. The significance of species was quantified by Use Value (UV), Frequency of Citation (FC), Informant Consensus Factor (ICF), Jaccard Index (JI), and Fidelity Level (FL) indices. A total of 90 ethnobotanical important plant species belonging to 40 plant families were recorded in this area. Fabaceae and Poaceae are the most commonly used plant families, with seven species. People use these plants primarily in the form of juice (21.95%). TheUV) ranged from 0.01-0.97. A high UV of 0.97 was found for *Aloe vera* (L.) Burm. The relative (RFC) ranged from 0.02-0.89 for different species, showing *Mentha longifolia*, *Aloe vera*, *Trachyspermum ammi*, *Azadirachta indica* A. Juss, *Foeniculum vulgare,* and *Vachellia nilotica* (*Acacia nilotica*) as useful species with RFC value above 0.8. Medicinal plants' l (FL) ranged from 11.11% to 100%. (ICF) ranged from 0.57 to 0.96. The highest ICF value (0.96) was recorded with 34 plant species for digestive diseases. The (JI) was calculated to compare our results with previous published studies and ranged from 1.96 to 54.39. Our analysis concludes that the locals of this area still prioritize medicinal plants to cure their diseases. It may contribute significantly to the reservoir of information already available in the field of ethnomedicine.

Keywords: Ethnobotany; Flora; Indigenous knowledge; Ethnomedicine; Pakistan; Medicinal plants

Introduction

The evolution of plants and their related life (bacteria, fungi, and algae, and also viruses that are not living organisms) on earth changed the environmental conditions and made it suitable for the survival of animals and humans. From early times, human had an intimate relationship with plants, as the plants runare widely used as food (grains, pulses, fruits, drinks, condiments, and vegetables), medicines, pesticides, wood, dye, household goods, cordage, and industrial fuel (Azhar *et al*. 2015; Ajaib *et al.* 2016). Ethnobotany is focused on the relationship of people with plants, encompassing the aspects of exploring plants for human well-being (Qureshi *et al*. 2009). It is evident that humans employed medicinal flora for disease treatment historically and 80% of the world's population relies on traditional medicine (Adnan *et al*. 2015). Ethnobotanical studies reflect the interaction of social and cultural richness of an area in terms of plants and it helped to cultivate useful plants (Mirzaman *et al*. 2023) Documenting traditional knowledge of plants is a vital step in obtaining new lead bioactive compounds to develop allopathic drugs (Tahir *et al*. 2023).

Ethnobotany deals with various aspects such as botany, anthropology, archaeology, and ecology, which means the study of the relationship that exists between people of primitive societies and their plant environment (Hamrouni *et al*. 2023). During fieldwork, an ethnobotanical survey is conducted in the study area to evaluate the interest and use of selected plants in the target population, and documented through free listings, key informant interviews,

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and semi-structured interviews regarding knowledge, the part used, how to use it, and diseases treated (Imene *et al*. 2023). Thus, ethnobotanical data collected must be analyzed using quantitative indices (informant consensus factor, use value, fidelity level, etc.). Therefore, such studies play an essential role in understanding plant diversity, uses of plant-based resources, biocultural variability, drug discovery, and conservation efforts (Abbas *et al*. 2022).

Biologically active compounds of plants are alkaloids, flavonoids, tannins, and phenolic compounds that directly affect human metabolism. People in developing countries depend completely on herbal medicines; however, their demand is rapidly increasing in developed countries, (Zaman *et al*. 2014). The recording of knowledge or information about conventional herbal treatments is an important step toward ensuring the sustainable management of medicinal plants (Kumar *et al*. 2021). Furthermore, it provide enough details on the value of various plant species, how to use them effectively, and how to aid in the search for novel therapeutics (Kilasho *et al*. 2023). Herbal medicine is the cornerstone of traditional medicine, and several pharmaceuticals have been derived from phytochemicals (Hamrouni *et al*. 2023). Herbal medicines are now recognized as a feasible and affordable source of alternative medicine with lower side effects (Tamang *et al.* 2023). Extensive studies are required on bioactive compound isolation from plant sources, so exploring and employing traditional medicine may help to reduce the cost of drug discovery (Khamphilavong *et al*. 2023).

Various botanists have done great work in the country to increase opportunities for food and medicine. Many areas of Pakistan have not yet been explored and well-studied by ethnobotanists (Adeel *et al*. 2011). Plants are a good source of natural dyes that are used in coloring silk, wool, and leather. Pakistan is blessed with a variety of climatic conditions and rich biodiversity; thus, 6,000 higher plant species are reported from this country, of which 600-700 are important medicinally. Some plants are uniregional, while others are distributed widely (Sher *et al*. 2012; Zereen *et al*. 2013; Hazrat *et al*. 2015). Wild plants are of great concern and are used enormously by herbalists and researchers due to newly discovered values (Ali and Qaiser 2009). In Pakistan, edaphic and climatic factors support 600 medicinal flowering plants (Khan and Rehman 2016). Worldwide, 2500 plants are traded that fulfill the requirement of 4-20% usage of herbal medicines (Shinwari and Qaiser 2011). Medicinal uses of plants considering the variations in factors such as; social groups, communities, or tribal groups are studied under medical ethnobotany. It is important for the conservation of the wisdom of traditional healers and to ensure sustainability (Appamaraka *et al.* 2023).

This study hypothesized that the indigenous communities of rural Northern Punjab, Pakistan, possess a rich yet under-documented ethnomedicinal knowledge system, with specific plant species playing a crucial role in traditional healthcare. It was aimed to document and preserve the traditional knowledge of plant species used by local people, particularly focused on the medicinal importance, as plants are commonly used in healthcare as home remedies. It sought to provide a comprehensive record of the therapeutic applications of local flora and develop a floristic inventory based on plant uses. Thus, it offers valuable insights into regional ethnomedicine and biodiversity conservation.

Materials and Methods

Study area

Punjab is the largest province; has 55.6% population of Pakistan. Jhelum is the largest district of Punjab, located on the Pothohar Plateau. The common habitats were plain land, hilly areas, and the banks of the river. Pind Dadan Khan (Fig. 1) is rich in floral diversity, and cultural values enhance its beauty. It is located between latitudes 32°27 and 32°45 north and longitudes 72°35 and 73°25 east. The overall area is 247,102 acres; hilly areas are 41,207 acres, and the salt mine covers 2268 acres.

Qualitative data collection

From 2017 to 2018, different field visits were conducted to collect ethnobotanical information about medicinal plants. This information was collected from indigenous people (men and women). Ethnobotanical data were collected using semi-structured questionnaires and face-to-face interviews. The questionnaire consisted of analyzing demographic data from 150 informants (100 females and 50 males), including names, sex, age, main occupation, and experience using medicinal plants. It also comprised ethnomedicinal information about the local name of the plant, the family, the part of the plant used, the mode of use, and the ethnobotanical significance. Out of 90 plant samples, 50 plants were herbaceous. All plants were collected, dried, and placed in the herbarium of the PMAS Arid Agriculture University, Rawalpindi. The naming of the plants and plant families was verified using the World Flora Online portal (WFO).

Quantitative data analysis

Quantitative data analysis provides information on medicinally important plant species. This analysis was done using the following ethnobotanical indices:

Relative frequency of citation (RFC)

The RFC of medicinally important plants in the study area was calculated using the following formula:

$$RFC = FC/N \ (0 < RFC < 1)$$

Where FC indicates the number of participants who report the use of specific species and N indicates the total number of informants who are involved in the study (Birjees *et al.* 2022).

Fidelity level (FL)

The fidelity level was calculated using the following formula (Friedman *et al*. 1986).

$$FL = Np / N \times 100$$

Where Np demonstrates the number of contributors who specify the use of species for a particular illness category and N designates the number of informants who use them for any type of disease category.

Use value (UV)

The use-value (UV) reflects the relative significance of each plant species used by informants within the study area. This value was determined using the following formula as proposed by Phillips and Gentry (1993).

$$UV = \Sigma U / n$$

In this context, ΣU represents the number of use reports provided by each informant for a specific plant species, while 'n' denotes the total number of informants interviewed regarding that plant. The UV parameter helps to identify the plants most commonly used for a particular purpose. Consequently, UV is high when many informants mention the plant and low when it is cited infrequently.

Informant consensus factor (ICF)

The Informant Consensus Factor was used to determine the efficacy of each medicinal plant for each disease category according to Heinrich *et al*. (2009) ICF is determined by using the following formula:

$$IFC = (Nur - Nt)/(Nur - 1)$$

Here, Nur are reports for plant use against a specific disease category, while Nt is the total number of plant species used for this disease by all informants.

Jaccard index (JI)

In ethnobotany, the Jaccard index is an essential statistical tool, especially for determining how similar species compositions are and comprehending the architecture of plant communities. This index is useful for comparing plant species in various environments or geographical areas because it measures how similar two sets are. The Jaccard Index was calculated to compare our findings with previously published studies from neighboring areas. This was calculated by using the following formula (Gonz 2008).

$$JI = C * 100/ a + b - c$$

Here, 'a' is the species only in the aligned area, and 'b' is the species only in the study area, while 'c' is the common plant species in both studies.

Fig. 1: Tehsil Pind Dadan Khan study area

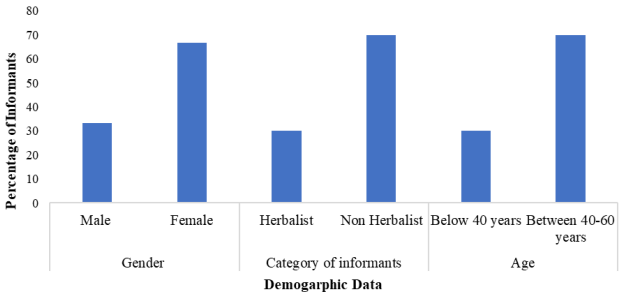

Fig. 2: Demographic data of informants from the area studied

Results

Demographical data of informants and folk knowledge source

Data related to ethnomedicinal plants were recorded from 150 inhabitants through face-to-face interviews as well as by the use of semi-structured questionnaires. Concerning gender, 100 women (66.67%) and 50 men (33.33%) participated in this study. Females were found to be more active and interested in medicinal plants, and many women prepared recipes to cure diseases. More female informants were reported in other studies. Similarly, 45 informants (30%) were traditional health practitioners (THPs), and all informants were residents of the studied area (Fig. 2).

Age data showed that the main knowledge about traditional medicinal products comes from individuals in the 40-60 age range, who constituted 70% of the total population who were interviewed, and the age of other informants was between 30-40 years.

Documented plant species and their taxonomic position

A total of 90 plant species belonging to 40 families were recorded in the study area (Table 1). The most common life form used for herbal preparation was herb (56%), followed by shrubs (21%), trees (19%), and climbers (4%) (Fig. 3).

Regarding the use of plant families, our results showed that the most commonly used plant families were Fabaceae and Poaceae. These two families are abundant in this study because the plants belonging to these species are more common and easily available to local inhabitants of this area. So it's easy for them to collect the plant and use it for medicinal purposes. Our study showed that 7 Plant species belong to the family Fabaceae, including *Albizia lebbeck*, *Medicago polymorpha*, *Pongamia pinnata*, *Acacia nilotica, Prosopis cineraria, Dalbergia sissoo,* and *Indigofera linifolia.* The Poaceae family includes *Avena sativa, Bambusa arundinacea, Cymbopogon jwarancusa, Cymbopogon citratus, Saccharum bengalense, Saccharum officinarum,* and *Triticum aestivum*. Solanaceae, Asteraceae, Brassicaceae, Cucurbitaceae, Euphorbiaceae, and Liliaceae (four species each) followed these two plant families. Some plants belonging to two major families also showed medicinal significance among local inhabitants, like *Acacia nilotica, Saccharum officinarum* showed 0.93 and 0.87 UV values, respectively. Similarly, *Saccharum officinarum, Acacia nilotica,* and *Albizia lebbeck* showed high RFC values of 1, 0.87, and 0.84, respectively. Some common plant families are shown in Fig. 4. The parts of the plant used the most were the entire plant (22%) and the leaves (21%). These were followed by fruit (19%), seeds, roots, flowers, and stems, with a percentages of 9%, 8%, 7%, and 5%, respectively (Fig. 5).

Quantitative ethnobotany

Quantitative analysis of the study area has shown that our Use Value ranged from 0.01-0.97. High Use values were found for 0.97 (Table 2) for *Aloe vera* (L.) Burm. f. followed by *Mentha longifolia* (L.) L. 0.96 UV, *Trachyspermum ammi* Sprague (0.95 UV) and *Allium sativum* L., *Vachellia nilotica* (L.) P.J.H.Hurter and Mabb. (*Acacia nilotica* L.) Willd. ex Delile, *Foeniculum vulgare* Mill., with 0.93 Use values. Lowest Use values were found for *Rydingia limbata* (Benth.) Scheen & V.A. Albert (*Otostegia limbata* Benth. Hook.), *Asphodelus tenuifolius* Cav. with 0.01 UV, and *Heliotropium europaeum* L. with 0.02 UV. The High Use value gives us information about the extensive use and awareness of medicinal plants by residents of the study area (Fig. 6).

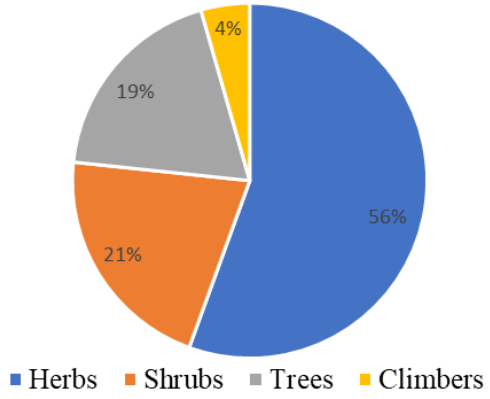

Fig. 3: Life forms of plant species used in the study area

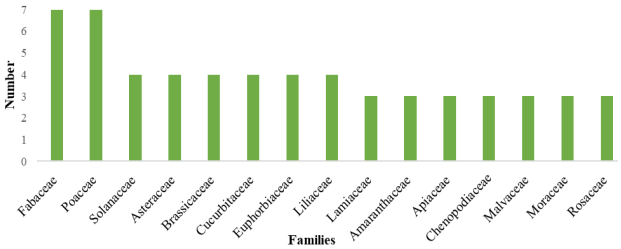

Fig. 4: The most important plant families of the study area

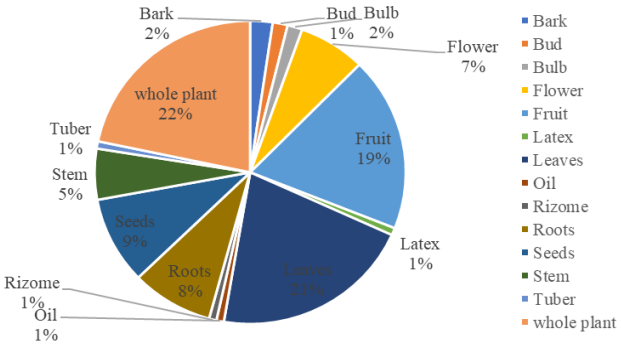

Fig. 5: Percentages of plant parts used

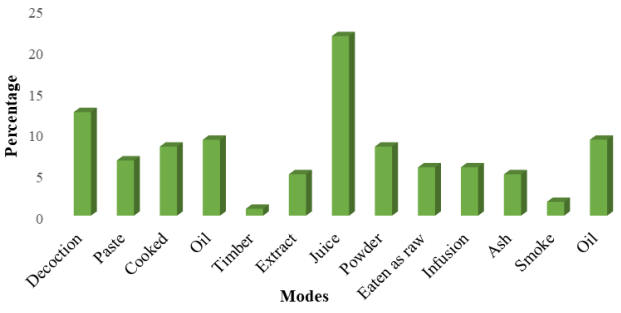

Fig. 6: Mode of utilization of plant parts

In this study, the RFC ranged from 0.02-0.89. The highest values of RFC (Fig. 7) for *Mentha longifolia* (0.89) were recorded, followed by *Aloe vera* (0.86), *Trachyspermum ammi,* and *Azadirachta indica* A. Juss (0.85).

Table 1: Recorded medicinal plant species from the study area

Botanical name	Local name	Family	Part used	Life form[1]	Ethnobotanical importance	Mode of use	Comparison with previous studies
Abelmoschus esculentus Moench	Bhindi	Malvaceae	Fruit	H	Vegetable, emollient and diuretic	Cooked	1-,2-,3-,4+,5*,6-,7-,8-,9-,10-,11-,12+
Abutilon indicum (L.) Sweet	Peeli buti	Malvaceae	All parts	H	Leaves for piles, toothache, and bladder inflammation. Roots are diuretics and seeds are stimulants	Decoction and leaf extract	1-,2-,3-,4-,5-,6-,7+,8-,9-,10-,11-,12-
Achyranthes aspera L.	Puthkanda	Amaranthaceae	Whole plant	C	Ash for cough and asthma, skin diseases	Ash, decoction	1-,2+,3+,4*,5*,6+,7-,8-,9-,10+,11+,12-
Albizia lebbeck (L.) Benth.	Shirin	Fabaceae	Stem, bark	T	Blood purifier, pain reliever, cures respiratory diseases	Extract	1-,2-,3-,4*,5-,6*,7-,8-,9-,10-,11*,12*
Allium cepa L.	Piaz	Amaryllidaceae (formerly Liliaceae)	Bulb and leaves	H	Reduces blood pressure, antidiabetic, prevents cancers, hair loss, and sexual disorder	Cooked or salad	1-,2-,3-,4+,5-,6+,7-,8-,9-,10-,11-,12+
Allium sativum L.	Thoum	Amaryllidaceae (formerly Liliaceae)	Bulb	H	Flavoring agent, reduces blood pressure, colic pain, and stomach disorder	Infusion	1-,2-,3-,4*,5-,6+,7-,8-,9-,10-,11-,12+
Aloe vera (L.) Burm.f.	Kawar gandal	Asphodelaceae (formerly Liliaceae)	Leaves	H	Used in skin diseases, stomach disorders, and bleeding gums	Cooked vegetables, as a gel on the skin.	1-,2+,3-,4-,5-,6+,7-,8-,9+,10-,11-,12+
Amaranthus viridis L.	Cholai	Amaranthaceae	Leaves	H	Emollient property. Used for cough and asthma	Leaf extract	1+,2-,3-,4*,5*,6-,7-,8-,9-,10+,11+,12*
Asphodelus tenuifolius Cav.	Bhokat	Asphodelaceae (formerly Liliaceae)	Whole plant	H	Cures piles, scorpion bites and jaundice	Juice and powder	1*,2-,3+,4-,5-,6-,7-,8-,9-,10-,11-,12-
Avena sativa L.	Jai	Poaceae	Fruit	H	General body tonic	Paste.	1-,2-,3-,4-,5-,6-,7-,8-,9-,10-,11*,12*
Azadirachta indica A.Juss.	Neem	Meliaceae	Leaves and stem	T	Antibacterial, used for blood purification	Decoction.	1-,2+,3-,4-,5-,6+,7-,8-,9-,10+,11-,12+
Bambusa bambos (L.) Voss (= *B. arundinacea* (Retz.) Willd.)	Bans	Poaceae	Stem	H	Making bamboo sticks, stairs	Whole stem	1-,2-,3-,4-,5-,6*,7-,8-,9-,10-,11-,12-
Bauhinia variegata L.	Kachnar	Fabaceae/Caesalpiniaceae	Bark, buds, and root.	T	The bark is an appetizer, a cooling agent, and sweet. Buds are used as piles for coughing and eye diseases. Root is laxative	Paste of roots and decoction.	1-,2*,3-,4-,5,6+,7-,8-,9-,10-,11-,12+
Boerhavia procumbens Banks ex Roxb.	Itsit	Nyctaginaceae	Flower, root, and leaves.	H	As tonic and treatment of dysmenorrhea	Juice and extract	1-,2*,3*,4-,5-,6-,7*,8-,9-,10+,11-,12-
Brassica rapa L. (as *B. campestris* L.)	Sarsoon	Brassicaceae	Leaves	H	Cures abdominal worm, constipation, laxative and anti-microbial	Potherb, oil	1-,2-,3-,4*,5-,6*,7-,8-,9-,10-,11-,12*
Brassica rapa L.	Shalgum	Brassicaceae	Root	H	Rich in vitamins C and K, good for the eyes	Cooked	1-,2-,3-,4*,5-,6-,7-,8-,9-,10*,11-,12*
Calotropis gigantea (L.) Dryand.	Ak desi	Apocynaceae	All parts	S	Ear pain and cholera, salt for cough, asthma, and rheumatism	Juice, salt, and latex	1-,2-,3-,4-,5-,6-,7+,8-,9-,10-,11-,12-
Calotropis procera (Aiton) Dryand.	Ak	Apocynaceae	All parts	S	Cough, asthma, and rheumatism	Juice, salt, and latex	1-,2*,3+,4+,5+,6+,7+,8,9+,10+,11*,12+
Cannabis sativa L.	Bhang	Cannabaceae	Whole plant	H	Narcotic, sedative, and intoxicant	Juice and infusion.	1+,2-,3-,4-,5-,6+,7+,8-,9-,10+,11-,12+
Capparis decidua Edgew.	Karir	Capparaceae	All parts	S	Cures asthma, chronic pain, gout, dropsy and rheumatism	Paste, infusion, and decoction	1-,2-,3+,4-,5+,6-,7+,8-,9-,10*,11-,12-
Carthamus oxyacantha M. Bieb.	Pohli	Asteraceae	Flowers and seeds	S	Laxative and pain relieving cures ulcers and itching	Oil of seeds	1-,2-,3-,4-,5+,6+,7-,8-,9-,10-,11-,12-
Centella asiatica (L.) Urb.	Barhami buti	Apiaceae	Whole plant	H	Blood purifier cures skin diseases and leprosy	Powder	1-,2-,3-,4-,5-,6-,7+,8-,9+,10-,11-,12-
Chenopodium album L.	Bathu	Amaranthaceae (formerly Chenopodiaceae)	Whole plant	H	Anthelmintic, cures measles and skin diseases	Decoction	1+,2*,3-,4*,5*,6+,7-,8-,9-,10*,11*,12*
Chrozophora tinctoria (L.) A.Juss.	Bakhra	Euphorbiaceae	Whole plant	H	The plant is emetic, with a poisonous effect and cathartic	-	1-,2-,3-,4-,5-,6-,7+,8-,9-,10+,11-,12-

Table 1: Contined

Table 1: Continued

Chrysojasminum humile (L.) Banfi (= *Jasminum humile* L.)	Chambeli	Oleaceae	Root and flower	S	The roots are anthelmintic and diuretic, juice cures headaches and skin diseases, and fragrance.	Juice	1-,2-,3-,4-,5-,6-,7-,8-,9-,10-,11-,12-
Citrullus colocynthis (L.) Schrad.	Tumma	Cucurbitaceae	Fruit	H	Purgative and expectorant cures gas trouble and constipation	Juice	1-,2-,3-,4-,5+,6-,7+,8-,9-,10-,11-,12+
Convolvulus arvensis L.	Lihli	Convolvulaceae	Leaves, roots, and flowers.	C	Used for spider bites and fever. Laxative	Decoction	1*,2-,3-,4*,5-,6+,7+,8-,9-,10+,11*,12*
Corchorus depressus (L.) Stocks	Bhon phalli	Malvaceae (formerly Tiliaceae)	Seeds and leaves	H	Cooling effect, wound healing, and cures leucorrhea	Crushed	1-,2-,3-,4-,5-,6-,7+,8-,9-,10-,11-,12-
Croton tiglium L.	Jamal ghota	Euphorbiaceae	Whole plant	H	Purgative and vesicant	Oil	1-,2-,3-,4-,5-,6-,7+,8-,9-,10-,11-,12-
Cucumis melo L.	Tarbooz	Cucurbitaceae	Fruit	H	Skin hydrating agent and stomach tonic	Eaten raw	1-,2-,3-,4-,5-,6-,7-,8-,9-,10-,11-,12*
Cucurbita pepo L.	Kaddu	Cucurbitaceae	Fruit	H	Food, medicine, anti-viral and anti-ulcer	Cooked, oil	1-,2-,3-,4-,5-,6-,7-,8-,9-,10-,11-,12*
Cuscuta reflexa Roxb.	Amarbail	Convolvulaceae	Whole plant	H	Blood purifiers, cure jaundice. Relief from body pain	Juice and decoction.	1-,2-,3+,4-,5-,6-,7+,8-,9+,10-,11-,12*
Cymbopogon jwarancusa (Jones ex Roxb.) Schult.	Khavi	Poaceae	Whole plant	H	Stem matrices used for typhoid patients; used for measles	Smoke	1-,2-,3-,4-,5-,6-,7-,8-,9-,10-,11-,12-
Cymbopogon citratus (DC.) Stapf	Lemon grass	Poaceae	Whole plant	S	Insect repellant, cures headache, digestion, and tonic for nerves	Oil	1-,2-,3-,4-,5-,6+,7-,8-,9-,10-,11-,12-
Dalbergia sissoo Roxb. ex DC.	Shisham	Fabaceae	Wood	T	Furniture making	Timber	1-,2*,3-,4+,5-,6*,7-,8-,9-,10*,11*,12+
Datura stramonium L.	Datura	Solanaceae	Seeds and leaves	H	Cures pimples and asthma, leaves are narcotic	Juice, smoke, and ash	1-,2-,3-,4-,5+,6+,7+,8+,9-,10-,11-,12-
Digera muricata (L.) Mart.	Tandla	Amaranthaceae	Leaves	H	Fodder and cures constipation	Cooked	1-,2-,3+,4-,5-,6-,7+,8-,9-,10-,11-,12-
Echinops echinatus Roxb.	Kandiari	Asteraceae	Root and seed	S	Treat sexual vitality and expel roundworm	Infusion	1-,2-,3-,4-,5-,6-,7+,8-,9-,10-,11-,12-
Eclipta prostrata (L.) L.	Bhangra	Asteraceae	Whole plant	H	Effective for flu, toothache, and spleen enlargement	Juice	1-,2-,3-,4-,5-,6-,7+,8-,9*,10-,11*,12+
Eriobotrya japonica (Thunb.) Lindl.	Lauqat	Rosaceae	Fruit	T	Cures chronic skin and lung diseases	Eaten raw	1-,2-,3-,4*,5-,6-,7-,8-,9-,10-,11-,12-
Eruca vesicaria (L.) Cav. (= *E. sativa* (L.) Hill)	Jamhan	Brassicaceae	Leaves, flowers, seeds	H	Oil to relieve ear pain, anti-microbial and anti-lice	Oil	1-,2*,3-,4+,5-,6-,7-,8-,9-,10-,11-,12-
Euphorbia helioscopia L.	Dodhi Kalan	Euphorbiaceae	Latex	H	Cures ringworm, respiratory diseases, and eczema	Latex	1-,2*,3-,4+,5-,6-,7+,8-,9-,10*,11*,12-
Euploca strigosa (Willd.) Diane & Hilger (= *Heliotropium strigosum* Willd.)	Tindu	Boraginaceae	Leaves	H	Effective in liver and stomach complaints, pimples, and other skin diseases	Juice	1-,2-,3-,4-,5*,6-,7+,8-,9-,10-,11-,12-
Farsetia jacquemontii Hook.f. & Thomson	Fareed Buti	Brassicaceae	Leaves	S	Body pain, rheumatism, constipation, and piles	Powder	1-,2-,3+,4-,5-,6-,7-,8-,9-,10-,11-,12-
Ficus carica L.	Anjeer	Moraceae	Fruit	T	Source of vitamins, minerals, and sugar, good for eyes and brain	Fresh and dried	1-,2-,3-,4-,5-,6-,7-,8-,9*,10-,11-,12-
Foeniculum vulgare Mill.	Saunf	Apiaceae	Fruit	H	Carminative, cures gas trouble and improves eyes	Oil	1-,2+,3-,4-,5-,6+,7+,8-,9+,10-,11-,12+
Gossypium arboreum L.	Kapas	Malvaceae	Seeds and fruit	S	Cattle feed, oil, and textile fiber	Oil	1-,2-,3-,4+,5-,6-,7-,8-,9-,10-,11-,12-
Haloxylon recurvum (Moq.) Bunge ex Boiss.	Lana	Amaranthaceae (formerly Chenopodiaceae)	Whole plant	S	Diuretics also used for cloth washing instead of soap	Ash	1-,2-,3-,4-,5-,6-,7+,8-,9-,10-,11-,12-
Heliotropium europaeum L.	Hathi sundi	Boraginaceae	Whole plant	H	Used in malaria, cough, and skin problems	Powder and ash	1-,2-,3-,4-,5-,6-,7+,8-,9-,10-,11-,12-
Indigofera linifolia (L.f.) Retz.	Neel	Fabaceae	Leaves	H	Cures asthma and bronchitis	Powder	1-,2-,3-,4-,5-,6-,7*,8-,9-,10-,11-,12-
Ipomea pes-tigridis L.	Panjpatia	Convolvulaceae	Fruit, leaves	T	Purgative action, treatment of sores and pimples, hemorrhoids, arthritis, rheumatism, dropsy, swellings, edema, gout, boils, and dog bites	Eaten raw, juice	1-,2-,3-,4-,5-,6-,7-,8-,9-,10-,11-,12-
Lactuca serriola L.	Berm dandi	Asteraceae	Whole plant	H	Blood purifier cures skin diseases and enhances memory	Powder	1-,2-,3-,4-,5-,6-,7+,8-,9-,10-,11-,12-

Table 1: Continued

Table 1: Continued

Lawsonia inermis L.	Mehndi	Lythraceae	Leaves	S	Against jaundice and skin diseases. Relieves from the irritation of feet and hands	Powder, decoction, and paste	1-,2-,3-,4*,5-,6-,7+,8-,9+,10-,11-,12+
Medicago polymorpha L.	Maina	Fabaceae	Whole plant	H	Fodder	Eaten raw	1-,2-,3-,4+,5*,6-,7-,8-,9-,10-,11-,12-
Mentha longifolia (L.) L.	Jangli podina	Lamiaceae	Stem and leaves	H	Effective in fever, headache, cough, urinary tract infection and indigestion	Paste of leaves	1-,2+,3-,4-,5-,6+,7-,8-,9+,10-,11-,12+
Momordica balsamina L.	Jangli karela	Cucurbitaceae	Fruit and seed	C	Anti-diabetic, blood purifier, treat boils and pimples	Juice, extract	1-,2-,3-,4-,5-,6-,7-,8-,9-,10-,11-,12-
Morus alba L.	Sufaid toot	Moraceae	Fruit	T	Cures constipation and cough	Extract	1+,2-,3-,4-,5-,6+,7-,8-,9+,10+,11*,12*
Morus nigra L.	Sia toot	Moraceae	Fruit	T	Cooling property, cures sore throat	Eaten raw, juice	1-,2+,3-,4*,5-,6-,7-,8-,9-,10-,11+,12+
Ocimum basilicum L.	Niazbo	Lamiaceae	Leaves, flowers, and seed	H	Cures snake bites, indigestion, stomach cramps, and skin infection	Fresh juice	1-,2+,3-,4+,5-,6+,7-,8-,9*,10-,11-,12*
Olea europaea L.	Zaitoon	Oleaceae	Fruit	T	Pain relieving	Oil	1-,2-,3-,4-,5-,6-,7-,8-,9-,10-,11-,12-
Oxalis corniculata L.	Khati buti	Oxalidaceae	Whole plant	H	Cures liver and stomach problems, cooling property	Cooked, juice	1+,2-,3-,4-,5-,6*,7+,8-,9+,10*,11*,12+
Peganum harmala L.	Harmal	Nitrariaceae (formerly Zygophyllaceae)	Seed, leaves, and roots	S	Blood purifier, ant-diabetic and emetic	Infusion	1-,2-,3*,4-,5*,6*,7*,8-,9*,10-,11-,12+
Pongamia pinnata (L.) Pierre	Such chain	Fabaceae	Fruit and leaves	T	Relieves from gas troubles	Decoction	1-,2-,3-,4-,5-,6*,7-,8-,9-,10*,11-,12*
Portulaca oleracea L.	Luca	Portulacaceae	Whole plant	H	Cures liver, kidney, and lung diseases. Reduces the effect of heat	Paste and juice	1-,2-,3*,4+,5-,6-,7+,8-,9*,10-,11*,12*
Prosopis cineraria (L.) Druce	Jand	Fabaceae/Mimosaceae	Bark, flower, and fruit	T	Flower with sugar avoids miscarriage, bark for rheumatism, and scorpion string.	Ash	1-,2-,3-,4-,5-,6-,7+,8-,9-,10+,11-,12-
Psidium guajava L.	Amrood	Myrtaceae	Fruit and leaves	T	Cures abdominal worms, appetizer	Fresh, powder	1-,2+,3-,4*,5-,6+,7-,8-,9-,10-,11-,12*
Punica granatum L.	Anar	Lythraceae (formerly Punicaceae)	Fruit and seed	S	Blood purifiers, cure stomach diseases	Fresh, dried seeds.	1-,2*,3-,4-,5-,6+,7-,8-,9+,10-,11-,12+
Raphanus raphanistrum subsp. *sativus* (L.) Domin (= *R. sativus* L.)	Muli	Brassicaceae	Root	H	Appetizer, treats cough and bronchitis	Oil, cooked.	1-,2*,3-,4*,5-,6-,7-,8-,9-,10-,11-,12*
Ricinus communis L.	around	Euphorbiaceae	Seeds, oil, and leaves	S	Cures swelling and joint pain, purgative, and used in constipation	Oil	1+,2-,3+,4+,5-,6+,7+,8-,9+,10-,11+,12+
Roemeria hispida (Lam.) Stace (= *Papaver hybridum* L.)	Post	Papaveraceae	Petals, fruit	H	Effective in ear and eye pain relief, cures cough, flu, and constipation	Decoction	1-,2-,3-,4-,5-,6-,7+,8-,9-,10-,11-,12-
Rosa damascena Mill.	Gulab	Rosaceae	Petals and buds	S	Mixed with sugar to make gulkand, arq-e-gulab cures eye problems	Decoction and paste	1-,2-,3-,4-,5-,6-,7+,8-,9-,10-,11-,12-
Rumex dentatus L.	Jangli palak	Polygonaceae	Whole plant	H	Vegetable	cooked	1-,2-,3-,4-,5-,6-,7-,8-,9-,10*,11*,12*
Rydingia limbata (Benth.) Scheen & V.A.Albert (= *Otostegia limbata* Benth. ex Hook.f.)	Bui	Lamiaceae	Leaves	S	Cures children's gum problems and ophthalmic properties	Juice	1-,2-,3-,4-,5-,6-,7+,8-,9-,10-,11-,12-
Saccharum officinarum L.	Ganna	Poaceae	Stem and leaves	H	Source of sugar and fodder	Juice	1-,2-,3-,4-,5-,6-,7-,8-,9-,10-,11-,12+
Salvadora oleoides Decne.	Wan	Salvadoraceae	Whole plant	T	Used for camel fodder	Pastes, decoction	1-,2-,3-,4-,5*,6-,7+,8-,9-,10-,11-,12*
Solanum nigrum L.	Mako	Solanaceae	All parts	H	Anti-inflammatory and antioxidant, used in veterinary medicine	Juice	1*,2*,3-,4*,5-,6*,7-,8-,9*,10*,11*,12-
Solanum tuberosum L.	Alu	Solanaceae	Tuber	H	Vegetable	Cooked	1-,2-,3-,4-,5-,6-,7-,8-,9-,10-,11-,12+
Solanum virginianum L. (= *S. surattense* Burm.f.)	Choti kandiari	Solanaceae	Whole plant	H	Improves digestion, cures chest pain	Juice and pulp	1+,2-,3-,4*,5+,6-,7*,8-,9-,10+,11-,12-
Suaeda vermiculata Forssk. ex J.F.Gmel. (= *S. fruticosa* Forssk. ex J.F.Gmel.)	Lani	Amaranthaceae (Chenopodiaceae)	Leaves	S	Used as an emetic, ophthalmic agent, salt for kidney and bladder stone	Infusion	1-,2-,3-,4-,5*,6-,7-,8-,9-,10+,11-,12-

Table 1: Continued

Table 1: Continued

Terminalia bellirica (Gaertn.) Roxb.	Lahura	Combretaceae	Fruit and kernel	T	Cures asthma, piles, cough, and diarrhea. Good for eyesight	Powder	1-,2-,3-,4-,5-,6-,7+,8-,9-,10-,11-,12-
Tinospora cordifolia (Willd.) Miers ex Hook.f. & Thomson	Gilo	Menispermaceae	Root and stem	S	Diuretic and febrifuge	Juice	1-,2-,3-,4-,5-,6*,7+,8-,9-,10-,11-,12-
Trachyspermum ammi (L.) Sprague	Ajwain	Apiaceae	Fruit and root	H	Carminative and antiseptic. Cures cholera and diarrhea	Dried	1-,2-,3-,4+,5-,6+,7+,8-,9+,10-,11-,12-
Tribulus pentandrus Forssk. var. *pentandrus* (= *T. longipetalus* Viv.)	Bakhra	Zygophyllaceae	Whole plant	H	Emetic, fodder	Powder	1-,2-,3-,4-,5-,6-,7*,8-,9-,10-,11-,12-
Tripidium bengalense (Retz.) H.Scholz (= *Saccharum bengalense* Retz.)	Sarkanda	Poaceae	Root	H	Against renal stones	Decoction and infusion	1-,2-,3-,4-,5*,6-,7-,8-,9-,10-,11-,12-
Triticum aestivum L.	Gandum	Poaceae	Seeds and stem	H	Staple food, fodder	Floor	1-,2-,3-,4*,5-,6-,7-,8-,9-,10*,11-,12+
Vachellia nilotica (L.) P.J.H.Hurter & Mabb. (= *Acacia nilotica* (L.) Willd. ex Delile)	Babul kiker	Fabaceae/Mimosaceae	All parts	T	Cures impotency, sexual debility, and leucorrhoea	Powder	1-,2+,3-,4-,5+,6+,7+,8-,9+,10+,11+,12*
Vitis vinifera L.	Angoor	Vitaceae	Fruit	C	Used for constipation, seeds are anti-oxidant	Juice	1-,2-,3-,4-,5-,6-,7-,8-,9-,10-,11-,12*
Zaleya pentandra (L.) C.Jeffrey	Mechachi buti	Aizoaceae	Roots, Leaves	S	Cough, asthma, jaundice, and flue	Juice, powder	1-,2-,3-,4-,5-,6-,7-,8-,9-,10-,11-,12-
Zingiber officinale Roscoe	Adhrak	Zingiberaceae	Rhizome	H	Treats cough, cold, vomiting, and joint pain and prevents blood from clotting.	Juice	1-,2-,3-,4-,5-,6-,7-,8-,9-,10-,11-,12-
Ziziphus mauritiana Lam.	Bair	Rhamnaceae	Fruit and leaves	T	Cures jaundice	Fresh and dried	1-,2-,3*,4*,5*,6-,7-,8-,9-,10*,11-,12-

Similar use of Plant [+]; Different use of Plant [*]; Use not reported before [-]; [1] H (Herbs), C (Climbers), T (Trees), S (Shrubs)
The 1,2,3,4,5,6,7,8,9,10,11,12 references are mentioned in Table 4

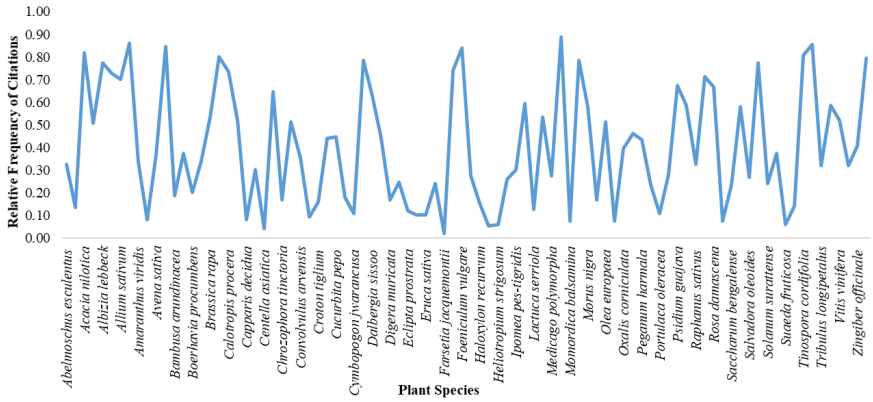

Fig. 7: RFC Values of plant species

This was followed by *Foeniculum vulgare* (0.84 RFC) and *Vachellia nilotica* (*Acacia nilotica*) (0.82 RFC). The lowest RFC was found for *Farsetia jacquemontii* Hook and Thomson, with 0.02 values, and *Heliotropium strigosum* Willd. With 0.04 RFC.

Fidelity level

The Fidelity level depicts the preference for a particular plant species related to a particular disease by local people. Results showed that 81 plant species have medicinal uses, while other plants are being used for fodder, food, and other purposes. The Fidelity level of these medicinal plants ranged from 11.11% to 100% (Table 3). The Fidelity level of five plants, including *Trachyspermum ammi*, *Allium cepa* L., *A. sativum*, *Mentha longifolia*, and *Punica granatum* L., was 100% for the treatment of cholera, diabetes, lowering blood pressure, stomachache, and dysentery, respectively. It was followed by *Aloe vera* with 98% FL used for skin diseases and *Solanum nigrum* L. with 96. 75% FL is used for anti-inflammatory purposes. This was followed by *Foeniculum vulgare* with 96.67% FL used to strengthen the eyes. Of 81 plants, 50 plant species showed FL of more than 50%.

Informant consensus factor

To measure the ICF (Informant Consensus Factor) values, 14 different categories of ailments were made. Based on the information provided by informants, values of Nt, Nur, Nur-Nt, and Nur-1 were found for each disease category. ICF values were calculated from this data using the ICF formula.

Table 2: Use Value of ethnobotanical plant species

Plant species	UR	UV
Aloe vera (L.) Burm.f.	146	0.97
Mentha longifolia (L.) L.	144	0.96
Trachyspermum ammi Sprague	142	0.95
Allium sativum L.	140	0.93
Vachellia nilotica (L.) P.J.H.Hurter & Mabb. (= *Acacia nilotica* (L.) Willd. ex Delile)	140	0.93
Foeniculum vulgare Mill.	139	0.93
Azadirachta indica A.Juss.	135	0.90
Solanum nigrum L.	135	0.90
Allium cepa L.	133	0.89
Gossypium arboreum L.	131	0.87
Zingiber officinale Roscoe	130	0.87
Saccharum officinarum L.	130	0.87
Cucumis melo L.	130	0.87
Rosa damascena Mill.	126	0.84
Cannabis sativa L.	125	0.83
Achyranthes aspera L.	125	0.83
Cucurbita pepo L.	125	0.83
Abelmoschus esculentus Moench	123	0.82
Punica granatum L.	121	0.81
Psidium guajava L.	121	0.81
Calotropis procera (Aiton) Dryand.	115	0.77
Morus nigra L.	115	0.77
Morus alba L.	110	0.73
Ocimum basilicum L.	107	0.71
Lawsonia inermis L.	105	0.70
Ricinus communis L.	100	0.67
Brassica rapa L. (as *B. campestris* L.)	98	0.65
Calotropis gigantea (L.) Dryand.	95	0.63
Cymbopogon citratus (DC.) Stapf	85	0.57
Dalbergia sissoo Roxb. ex DC.	85	0.57
Olea europaea L.	85	0.57
Albizia lebbeck (L.) Benth.	82	0.55
Roemeria hispida (Lam.) Stace (= *Papaver hybridum* L.)	79	0.53
Triticum aestivum L.	75	0.50
Brassica rapa L.	65	0.43
Ipomea pes-tigridis L.	65	0.43
Raphanus raphanistrum subsp. *sativus* (L.) Domin (= *R. sativus* L.)	65	0.43
Chrysojasminum humile (L.) Banfi (= *Jasminum humile* L.)	55	0.37
Chenopodium album L.	54	0.36
Ziziphus mauritiana Lam.	50	0.33
Prosopis cineraria (L.) Druce	48	0.32
Bambusa bambos (L.) Voss (= *B. arundinacea* (Retz.) Willd.)	45	0.30
Datura stramonium L.	45	0.30
Vitis vinifera L.	45	0.30
Bauhinia variegata L.	41	0.27
Citrullus colocynthis (L.) Schrad.	41	0.27
Peganum harmala L.	41	0.27
Carthamus oxyacantha M.Bieb.	37	0.25
Ficus carica L.	36	0.24
Zaleya pentandra (L.) C.Jeffrey	36	0.24
Medicago polymorpha L.	35	0.23
Tinospora cordifolia (Willd.) Miers ex Hook.f. & Thomson	35	0.23
Abutilon indicum (L.) Sweet	30	0.20
Chrozophora tinctoria (L.) A.Juss.	30	0.20
Pongamia pinnata (L.) Pierre	30	0.20
Terminalia bellirica (Gaertn.) Roxb.	30	0.20
Solanum virginianum L. (= *S. surattense* Burm.f.)	29	0.19
Convolvulus arvensis L.	28	0.19
Croton tiglium L.	26	0.17
Momordica balsamina Wall.	26	0.17
Oxalis corniculata L.	25	0.17
Salvadora oleoides Decne.	25	0.17
Solanum tuberosum L.	25	0.17
Centella asiatica (L.) Urb.	24	0.16
Indigofera linifolia (L.f.) Retz.	24	0.16
Amaranthus viridis L.	23	0.15
Corchorus depressus (L.) Stocks	21	0.14
Tripidium bengalense (Retz.) H.Scholz (= *Saccharum bengalense* Retz.)	21	0.14
Portulaca oleracea L.	19	0.13
Suaeda vermiculata Forssk. ex J.F.Gmel. (= *S. fruticosa* Forssk. ex J.F.Gmel.)	19	0.13
Capparis decidua Edgew.	18	0.12
Euphorbia helioscopia L.	18	0.12
Tribulus pentandrus Forssk. var. *pentandrus* (= *T. longipetalus* Viv.)	18	0.12
Eclipta prostrata (L.) L.	17	0.11
Euploca strigosa (Willd.) Diane & Hilger (= *Heliotropium strigosum* Willd.)	16	0.11
Eriobotrya japonica (Thunb.) Lindl.	15	0.10
Cuscuta reflexa Roxb.	15	0.10
Farsetia jacquemontii Hook.f. & Thomson	14	0.09
Haloxylon recurvum (Moq.) Bunge ex Boiss.	14	0.09
Avena sativa L.	13	0.09
Eruca vesicaria (L.) Cav. (= *E. sativa* (L.) Hill)	13	0.09
Echinops echinatus Roxb.	11	0.07
Lactuca serriola L.	10	0.07
Digera muricata (L.) Mart.	8	0.05
Rumex dentatus L.	8	0.05
Cymbopogon jwarancusa (Jones ex Roxb.) Schult.	6	0.04
Boerhavia procumbens Banks ex Roxb.	4	0.03
Heliotropium europaeum L.	3	0.02
Asphodelus tenuifolius Cav.	1	0.01
Rydingia limbata (Benth.) Scheen & V.A.Albert (= *Otostegia limbata* Benth. ex Hook.f.)	1	0.01

The value of ICF from 0.57 to 0.96 for disease categories. The highest ICF value 0.96 (Fig. 8) was recorded for digestive diseases with 34 plant species followed by dermatological 0.95 ICF and sexual diseases with 0.94 ICF values. The lowest ICF values of 0.57 were found for oral diseases. Diseases including Scorpion stings, insect bites, snake bites, dog bites, spider bites, antiviral, anti-lice, roundworms, antioxidant, and bacterial infections, are categorized as others in these disease categories. The ICF value for this category is 0.92. Nt value for finding the value of ICF includes 34 plant species for digestive diseases, followed by 20 and 4 plant species for dermatological and sexual diseases, respectively. Disease category named others include 13 plant species as Nt value.

Discussion

An ethnobotanical analysis of the study area plays a significant role in plant biodiversity in the livelihoods and traditional healthcare practices of local communities. The dominant presence of Poaceae and Fabaceae aligns with previous ethnomedicinal surveys conducted in arid and semi-arid regions, where these families are often well-represented due to their ecological adaptability and wide therapeutic applications (Bahadur *et al*. 2020; Ullah *et al*. 2024). The high UV and RFC for species such as *Mentha longifolia*, *Aloe vera*, *Trachyspermum ammi*, and *Azadirachta indica* reflect their widespread cultural acceptance and perceived efficacy, specifically in treating common ailments like digestive issues, skin infections, and reproductive health disorders. Similar patterns of high informant consensus and FL have been observed in ethnobotanical studies from nearby regions,

Table 3: Fidelity Level of medicinal plant species

Plant Species	Medicinal use	FL
Abelmoschus esculentus Moench	Diuretic.	75
Abutilon indicum (L.) Sweet	Toothache	83.33
Achyranthes aspera L.	Asthma	58.82
Albizia lebbeck (L.) Benth.	Respiratory diseases	80
Allium cepa L.	Diabetes	100
Allium sativum L.	Lowering blood pressure	100
Aloe vera (L.) Burm.f.	Skin diseases	98
Amaranthus viridis L.	Cough	50
Asphodelus tenuifolius Cav.	Jaundice.	67
Avena sativa L.	Body tonic	56.67
Azadirachta indica A.Juss.	Blood purification	93.1
Bauhinia variegata L.	Piles	55.17
Boerhavia procumbens Banks ex Roxb.	Dysmenorrhea	56
Brassica rapa L. (as *B. campestris* L.)	Constipation	33.56
Brassica rapa L.	Strengthen eyes	67.5
Calotropis gigantea (L.) Dryand.	Ear pain	15
Calotropis procera (Aiton) Dryand.	Rheumatism	96.15
Cannabis sativa L.	Sedative	73.76
Capparis decidua Edgew.	Gout,	62.5
Carthamus oxyacantha M.Bieb.	Laxative	55.17
Centella asiatica (L.) Urb.	Leprosy	28.57
Chenopodium album L.	Anthelmintic	33.33
Chrozophora tinctoria (L.) A.Juss.	Emetic	14.29
Chrysojasminum humile (L.) Banfi (= *Jasminum humile* L.)	Anthelmintic	49.37
Citrullus colocynthis (L.) Schrad.	Gas trouble and constipation.	47.22
Convolvulus arvensis L.	Fever	40
Corchorus depressus (L.) Stocks	Leucorrhea	37.5
Croton tiglium L.	Purgative	50
Cucumis melo L.	Skin hydrating agent	92.67
Cucurbita pepo L.	Anti-ulcer	40.91
Cuscuta reflexa Roxb.	Jaundice	42.11
Cymbopogon jwarancusa (Jones ex Roxb.) Schult.	Typhoid	18.18
Cymbopogon citratus (DC.) Stapf	Digestion	60.8
Datura stramonium L.	Pimple	50
Digera muricata (L.) Mart.	Constipation.	21.43
Echinops echinatus Roxb.	Sexual vitality	52.38
Eclipta prostrata (L.) L.	Toothache	25
Eriobotrya japonica (Thunb.) Lindl.	Lung diseases	18.18
Eruca vesicaria (L.) Cav. (= *E. sativa* (L.) Hill)	Anti-microbial	11.11
Euphorbia helioscopia L.	Eczema	58.06
Euploca strigosa (Willd.) Diane & Hilger (= *Heliotropium strigosum* Willd.)	Liver and stomach complaints	33.33
Farsetia jacquemontii Hook.f. & Thomson	Rheumatism	25
Ficus carica L.	Eyes	92.59
Foeniculum vulgare Mill.	Strengthen eyes	96.67
Haloxylon recurvum (Moq.) Bunge ex Boiss.	Diuretic	42.11
Heliotropium europaeum L.	Skin problems	22.22
Indigofera linifolia (L.f.) Retz.	Asthma	42.86
Ipomea pes-tigridis L.	Arthritis, rheumatism	53.13
Lactuca serriola L.	Skin diseases	63.64
Lawsonia inermis L.	Skin-soothing	93.75
Mentha longifolia (L.) L.	Stomachache	100
Momordica balsamina Wall.	Anti-diabetic	33.33
Morus alba L.	Constipation	40.44
Morus nigra L.	Sore throat	92
Ocimum basilicum L.	Stomach cramp	61.9
Olea europaea L.	Pain relieving	95
Oxalis corniculata L.	Stomach problem	74.55
Peganum harmala L.	Ant-diabetic	64.41
Pongamia pinnata (L.) Pierre	Gas trouble	44.83
Portulaca oleracea L.	Lung diseases.	23.08
Prosopis cineraria (L.) Druce	Prevent miscarriage	32.43
Psidium guajava L.	Appetizer	90
Punica granatum L.	Dysentery	100
Raphanus raphanistrum subsp. *sativus* (L.) Domin (= *R. sativus* L.)	Treat cough and bronchitis	79.71
Ricinus communis L.	Joint pain,	84.03
Roemeria hispida (Lam.) Stace (= *Papaver hybridum* L.)	Ear and eye pain	45.65
Rosa damascena Mill.	Eye problems	73.33
Rydingia limbata (Benth.) Scheen & V.A.Albert (= *Otostegia limbata* Benth. ex Hook.f.)	Children gum problem	33.33
Solanum nigrum L.	Anti-inflammatory	96.75
Solanum virginianum L. (= *S. Surattense* Burm.f.)	Improve digestion	50
Suaeda vermiculata Forssk. ex J.F.Gmel. (= *S. fruticosa* Forssk. ex J.F.Gmel.)	Kidney and bladder stone	21.43
Terminalia bellirica (Gaertn.) Roxb.	Cough	40
Tinospora cordifolia (Willd.) Miers ex Hook.f. & Thomson	Diuretic	76.56
Trachyspermum ammi (L.) Sprague	Cholera	100
Tribulus pentandrus Forssk. var. *pentandrus* (= *T. longipetalus* Viv.)	Emetic	70.51
Tripidium bengalense (Retz.) H.Scholz (= *Saccharum bengalense* Retz.)	Renal stones	48.28
Vachellia nilotica (L.) P.J.H.Hurter & Mabb. (= *Acacia nilotica* (L.) Willd. ex Delile)	Sexual debility and leucorrhoea	90.91
Vitis vinifera L.	Constipation	55.13
Zaleya pentandra (L.) C.Jeffrey	Cough,	31.25
Zingiber officinale Roscoe	Cough, cold	92.59
Ziziphus mauritiana Lam.	Cures jaundice	83.45

Table 3: Continued

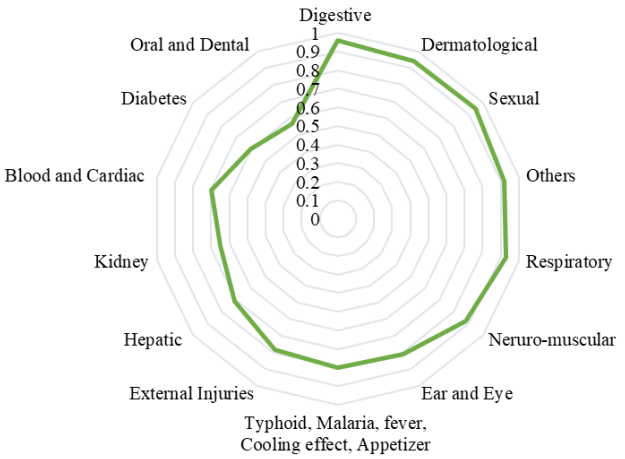

Fig. 8: Informant Consensus Factor of different disease categories

indicating a shared traditional knowledge base and consistent reliance on these species for primary healthcare (Shinwari 2010; Bano *et al.* 2014). This highlights the importance of these plants in cultural heritage, with potential pharmacological relevance.

Our findings on the use of plants as ethnomedicines align with previous studies by Maqsood *et al.* (2022), Munawar *et al.* (2022) and Rehman *et al.* (2024), reinforcing the significance of traditional plant-based healing practices. The dominance of herbs in our study suggests that traditional healers prefer them due to their easy accessibility, simple processing methods, and potent medicinal properties.

Similar to our results, Fabaceae family emerged as the most represented taxon, a pattern consistent with reports

Table 4: Comparison of the study area with previously published studies from neighboring areas

Previous study	Total documented species in the previous study	Total documented species in the study area	Similar use of plant	dissimilar use of plant	plants common in both areas [c]	species only in aligned area [a]	species only in the study area [b]	C*100	A+B	A+B-C	Jaccard Index	References
Neighboring areas of Pind Dadan Khan												
Tehsil Chakwal	29	90	8	3	11	18	79	1100	97	86	12.79	(Qureshi *et al.* 2009)
Dinga, District Gujrat,	50	90	9	10	19	31	71	1900	102	83	22.89	(Parvaiz *et al.* 2013)
Tilla Jogian District Jhelum	64	90	8	4	12	52	78	1200	130	118	10.17	(Ajaib *et al.* 2021)
Bhera, District Sargodha	97	90	12	17	29	68	61	2900	129	100	29.00	(Qureshi *et al.* 2012)
Profitable Halophytes of District Chakwal	68	90	7	11	18	50	72	1800	122	104	17.31	(Hassan *et al.* 2018)
Medicinal Plants in Jech Doab	60	90	22	9	31	29	59	3100	88	57	54.39	(Munawar *et al.* 2022)
Salt Range Pind Dadan Khan	69	90	25	5	30	39	60	3000	99	69	43.48	Iqbal *et al.* (2011)
Other Studies from the Province of Punjab												
District Sialkot, Punjab	18	90	1	1	2	16	88	200	104	102	1.96	(Ikram *et al.* 2014)
Morgah Biodiversity Park, Rawalpindi	40	90	13	6	19	21	71	1900	92	73	26.03	(Husain *et al.* 2014)
Hafizabad District	85	90	13	11	24	61	66	2400	127	103	23.30	(Umair *et al.* 2017)
Tehsil Gojra, District Toba Tek Singh	100	90	5	13	18	82	72	1800	154	136	13.24	(Tufail *et al.* 2020)

from Haripur District, Khyber Pakhtunkhwa (Siddique *et al.* 2021), and Tehsil Taunsa Sharif, District DG Khan (Mustafa *et al*. 2023). Majeed *et al*. (2022) reported in their study the occurrence of 52 Poaceae species in the Jhelum District. Poaceae was reported as a dominant family with 15 species in District Bahawalnagar by Anwer *et al*. (2020), and the same trend of dominance was found in our observations. Arshad *et al*. (2024) also found a similar trend of Poaceae and Fabaceae dominance, with 17 species each, in their study on the flora of Okara, Pakistan. A study with similar results was done by Waheed *et al*. (2023). They reported the wild food plants from the semi-arid region of Punjab and found that 11 wild food-providing plants were from Fabaceae.

Our study confirms that leaves are the most frequently used plant parts, aligning with findings by Siddique *et al*. (2021) and Aftab *et al*. (2023) who reported leaf utilization rates of 35% and 47.9%, respectively. Leaves are often preferred due to their high bioactive compound content, ease of harvesting, and year-round availability. Additionally, our findings are in agreement with Rehman *et al.* (2024), who reported leaves and fruits as the most commonly used parts, a trend also observed in our study, where leaves accounted for 31.51% and fruits for 26.03% of herbal applications.

Regarding the preparation of herbal remedies, we found that juice extraction was the dominant mode of utilization (21.95%), diverging from the findings of Jarić *et al.* (2024), who reported tea as the primary preparation method (60.78%) in southeastern Serbia. The regional variation in preparation methods may be attributed to cultural preferences, availability of specific plant species, and climatic differences influencing plant chemistry and therapeutic effectiveness. Decoction, another widely used preparation form, was reported for 16 plant species in our study, a slightly lower figure than the 22 species documented by Siddique *et al*. (2021). These variations indicate that traditional knowledge is shaped by both environmental and cultural factors.

The highest Use Value (UV) in our study was recorded for *Aloe vera*, which aligns with the findings of Gamage *et al*. (2021). The high Relative Frequency of Citation (RFC) for *Mentha longifolia* supports previous work from Tehsil Kallar Syedan, District Rawalpindi (Zareef *et al*. 2023), where it was the most frequently cited plant. Similarly, our findings corroborate those of Dixit and Tiwari (2020), who documented *Aloe vera* as the most cited medicinal species. In contrast, Munawar *et al*. (2022) identified *Trachyspermum ammi* as having the highest RFC, a result that is also comparable to our study. The high RFC and UV values indicate strong ethnomedicinal reliance on these species, suggesting their potential for further phytochemical and pharmacological investigations (Faruque *et al.* 2018; Bibi *et al*. 2022).

Fidelity Level (FL) quantifies the percentage of informants reporting the use of a plant for a specific ailment (Zhou *et al.* 2020). High FL values typically indicate well-established traditional uses of medicinal plants. Some species, such as *Chrozophora tinctoria* (14.29%) and *Eruca vesicaria* (11.11%), exhibited lower FL values, which could be attributed to their limited availability in the study area or a lack of widespread knowledge among indigenous communities (Chaachouay *et al*. 2019). Despite their low FL, these plants should not be overlooked, as they may hold significant medicinal potential in different ecological or cultural settings.

A high Informant Consensus Factor (ICF) indicates

strong agreement among local communities regarding plant usage for specific ailments (Uddin and Hassan 2014). Our study found the highest ICF for digestive disorders, mirroring the findings of Lu *et al*. (2022), who reported an ICF of 0.80 for digestive diseases. Similarly, Amjad *et al*. (2020) recorded an ICF of 0.95 for digestive issues in Harigal, Azad Jammu Kashmir, followed by skin-related ailments. The prominence of digestive disorders in traditional medicinal use is likely linked to poor dietary habits, consumption of unhygienic food, and waterborne diseases. The high ICF values emphasize the importance of these medicinal plants in primary healthcare and their potential for further pharmacological validation (Heinrich *et al*. 2009).

To assess the ethnobotanical similarity of our findings, we compared our documented medicinal plant use with 12 previous studies from neighboring regions. The highest Jaccard Index (JI) of 54.39 was observed, followed by 43.48 in studies by Iqbal *et al*. (2011) and Munawar *et al*. (2022). The lowest JI (1.96) was found in the studies by Ikram *et al*. (2014). Notably, species such as *Zingiber officinale*, *Zaleya pentandra*, *Olea europaea*, *Ipomoea pes-tigridis* and *Cymbopogon jwarancusa* were documented for the first time in Pind Dadan Khan and had not been previously recorded in adjacent areas.

Regions with higher JI values exhibited greater ethnobotanical overlap, indicating a shared cultural and ecological knowledge base. Conversely, lower JI values suggest a decline in traditional medicinal knowledge, likely due to urbanization, modernization, and shifts in socio-economic structures. This underscores the urgent need for documentation and conservation of indigenous ethnomedicinal practices to prevent the loss of valuable traditional knowledge.

Conclusion

Our study highlights the rich medicinal flora in Pind Dadan Khan, which plays a crucial role in meeting the healthcare needs of the local population. Beyond their ethnomedicinal significance, these plant species also contribute to various industries, including herbal medicine, furniture, dyes, and cosmetics. Data related to plant uses was collected from 150 informants 100 women (66.67%) and 50 men (33.33%). People of this area use *Mentha longifolia*, *Aloe vera*, *Trachyspermum ammi, Acacia nilotica, Allium sativum, Albizia lebbeck, Foeniculum vulgare*, and *Azadirachta indica* commonly for treating diseases. The most common diseases cured by medicinal plants in this area are digestive diseases including Cholera, gas troubles, diarrhea, dysentery, piles, and constipation. The findings of this study indicate that indigenous communities rely heavily on plant-based remedies, often preferring them over allopathic treatments. This underscores the need for sustainable conservation efforts to protect these valuable species such as *Mentha longifolia*, *Aloe vera*, *Trachyspermum ammi,* and *Azadirachta indica* A. Juss from overexploitation and habitat loss. By documenting traditional knowledge, we have provided a foundation for future research on the pharmacological potential of these plants. Further scientific investigations, including phytochemical and clinical studies, could validate their therapeutic properties and expand their applications. Preserving this indigenous knowledge is essential, not only for maintaining cultural heritage but also for exploring novel plant-based solutions for modern healthcare challenges.

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Authors Contributions

TA performed field surveys and communication with informants. TM analyzed and interpreted the data obtained. GAN reviewed and assisted in the technical parameters of the manuscript. JP reviewed the manuscript for the botanical terminologies and write-up. YB and AJ played a role in the writing, editing, and formatting of the manuscript. All authors read and approved the final manuscript.

Conflict of Interests

The authors declare that they have no competing interests.

Data Availability

The datasets generated and analyzed during the current study are available from the corresponding author upon reasonable request.

Ethics Approval

All participants agree to share the information gathered.

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