Quantitative ethnobotanical study of medicinal plants used by the indigenous communities of Shawal Valley, District North Waziristan, Pakistan

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Research

Abstract

Background: The inhabitants of distant regions typically depend on traditional information of therapeutic plants to treat various disorders. The current survey was conducted to record and explore the indigenous utilization of the therapeutic plants among people dwelling in Shawal Valley, North Waziristan, Pakistan.

Methods: The data was collected through semi-structured interviews and data was analyzed by using different quantitative indices viz. use value (UV), use reports (UR), relative frequency of citation (RFC), fidelity level (FL), and family importance value (FIV). Plant specimens were submitted to the Department of Botany Herbarium, Hazara University Mansehra for future records.

Results: A total of108 medicinal plants belonging to 54 families were reported which were used to cure various 119 disorders. The informants documented the highest number of plants used for digestive disorders (16 spp.), followed by diarrhea (11 spp.) and cough (10 spp.). The maximum RFC value was recorded for *Bergenia ciliate* (0.36), followed by *Berberis lycium* and *Ephedra gerardiana* (0.35) each. The highest UV was recorded for *Bergenia ciliate* (0.89), followed by *Ephedra gerardiana* (0.87), and *Punica granatum* (0.85). The maximum fidelity levels values were recorded for *Bergenia ciliate* and *Ephedra gerardiana* (100%) each.

Conclusions: The present study revealed that Shawal valley has an important diversity of therapeutic plants, and the use of therapeutic plant remedies is still familiar in the study area. A total of 108 therapeutic plants, related to 54 families were recorded for the treatment of 119 disorders. Thus, the study provides baseline information for further pharmacological and phytochemical screening in order to study their bioactive compounds.

Keywords: Folk Knowledge, Quantitative study, Shawal valley, North Waziristan.

Background

Plant resources make available every necessary life maintenance resource like shelter, food, fodder, forage, and medicine (Hameed *et al.* 2012). Older inhabitants or herbalists are associated with therapeutic plants and use various herbs for preparing medication which is promoted in the community (Ishtiaq *et al.* 2021; Ahmad *et al.* 2011). Indigenous communities of distant areas of the globe are mainly reliant on wild flora for accomplishing their daily life necessities. Indigenous plants play a vital role in the basic health care system of the dweller of the study area. They provide medication and major raw materials to develop old and new drugs of herbal and allopathic forms (Ishtiaq *et al.* 2021).Herbal plants play a key role in supplying food and nutritive provision to the inhabitants of rural areas of the globe.

For primary healthcare, about 80% of the traditional communities depend upon medicinal plants (Sarma *et al.* 2012; Khan *et al.* 2021; Rehman *et al.* 2023). The plant contains active chemicals which are used for medicinal purposes in herbal medication (Bussmann *et al.* 2006). In rural areas, inhabitants use therapeutic plants in the form of herbal medication for the treatment of various diseases due to their effectiveness and easy availability (Hassan *et al.* 2017). Pastoral inhabitants used medicinal plants to treat diseases by using different plant parts either directly or mixed with other appropriate supplements (Nadeem *et al.* 2013; Giday *et al.* 2016)

There are more than 6,000 flowering plants used in herbal medicines in Pakistan (Bano *et al.* 2014) and used to cure various human ailments (Ozkan *et al.* 2016; Jima & Megersa 2018). In the majority of cases, certain medicinal plants are considered to be specific for a specific ailment, but some medicinal plants have numerous uses (Hamayun *et al.* 2005). The traditional communities are mostly depending on plants and plant-based medicine for their daily life needs (Murad *et al.* 2013; Kamal *et al.* 2016). In the majority of cases, herb collectors are illiterate or untrained (Sodhi *et al.* 2004). Several medicinal plants have earlier become extinct in Pakistan due to overutilization (Rehman *et al.* 2022b). Knowledge about the therapeutic plant is still transferred verbally and orally from one generation to another generation (Jan *et al.* 2011; Sabran *et al.* 2016). Ethnomedicinal study has been done in nearby areas of Shawal valley, North Waziristan, in previous literature (Aziz et al. 2016; Hussain *et al.* 2018; Hussain *et al.* 2022; Ullah *et al.* 2023) but this region was still unexplored. Therefore, study was designed with the objective to explore therapeutic plants and related traditional knowledge of the Shawal valley of District, North Waziristan, Pakistan.

Materials and Methods

Study area

Shawal valley is about 20 km broad from West to East and 35 km long from South to North side, bounded by mountain ranges 2000 to 3000 m high. The Shawal coniferous forest is located between 31° 0' 55.0002"/ and 3° 20' 39.9984"N latitudes and 69° 0' 15.0006"/ to70° 0' 15.0006" E longitudes. The total area of scrub and coniferous forests is 127400 acres and classified as dry temperate forests (Champion *et al.* 1965). The study area is located in the South to West part of the District North Waziristan, Pakistan. It is bounded North to East by Miran shah, West by Razmak, in the South by the Bernal valley of Afghanistan, and in the East by the Koh-e-Sofid range along Afghanistan Border (Fig. 1). The Shawal valley completely falls under the Sino-Japanese region (Ali & Qaiser 1986). The average rainfall is approximately 75 mm and the minimum temperature is 10 0C. The snowfall is about 0.5 to 1.5 m which starts from February to April. Shawal Valley is inhabited by Utmanzai Wazir, which is further divided into 3 main tribes i.e. Baka Khel, Kabul Khel, and Jani Khel.

Ethnobotanical fieldwork

An ethnobotanical study was conducted to collect the traditional information about the utilization of therapeutic plant species to cure the diseases by the indigenous people of Shawal valley, District North Waziristan, from April 2018 to October 2020. By using a semi-structured questionnaire (Martin 1995; Khan *et al.* 2021), we collected traditional information from 130 randomly selected informants of different age groups (above 75 (38.46%), followed by 65-75 (28.46%), and 55-65 (16.15%) years old. Preference was given to aged respondents and traditional herbalist. The majority of the informants were male (103) as compared to female (27). It was also observed during the study that males has enough knowledge about the use and preparation of therapeutic plants. The respondents comprise 58 herbalist, 39 shepherds, and 33 local healers. Informants were asked about their knowledge of the utilization of medicinal plant species for the cure of different ailments in the study area. Moreover, we reported information such as plant parts, route of administration, preparation method, and dosages used for the ailments.

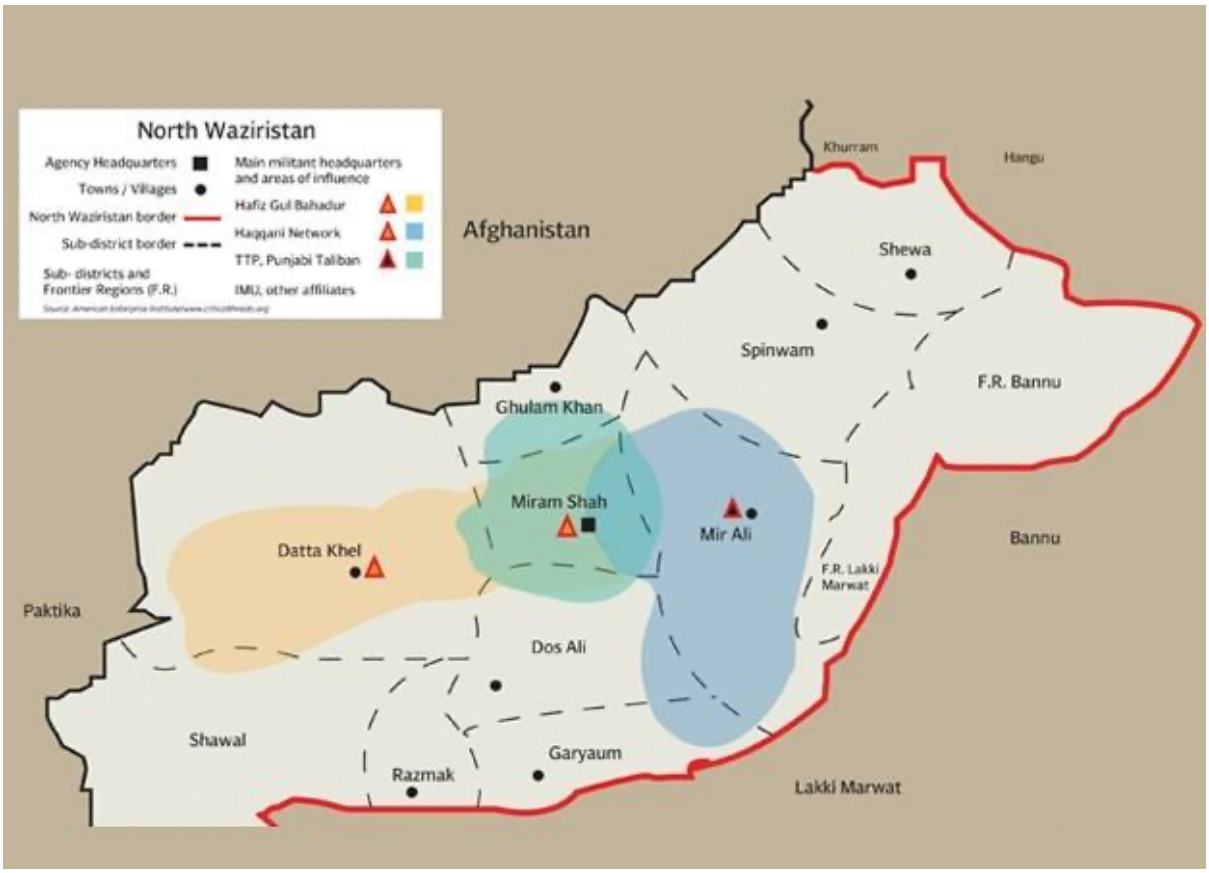

Figure 1. Map of the study area.

Plant collection and Identification

Plant specimens were collected from the research area on the bases of their local names. The collected specimens were properly pressed, dried, poisoned, and pasted on herbarium sheets. The plant specimens were identified by a taxonomist (Prof. DR. Rahmatullah Qureshi) and confirmed through published available literature (Khan *et al.* 2021) and kept at the Herbarium, Botany Department Hazara University Mansehra, Pakistan.

Statistical Analysis

The data collected were analyzed by using different quantitative ethnobotanical indices like Use Report (UR), Use Value (UV), Relative Citation of Frequency (RFC), Fidelity Level (FL), and Family Importance Value (FIV).

Use Value

The relative importance of each plant species was calculated by using the following equation (Vitalini *et al.* 2013).

$$\mathbf{UV} = \sum_1^n Ui\,/N \quad (1)$$

Where "Ui" is the total number of used reports of each therapeutic plant, and 'N' is the number of informants. Please define Ui?

Relative Frequency of Citation

Relative Citation of Frequency (RFC) was calculated by using the given equation (Butt *et al.* 2015).

$$RFC = FC/N \ (0<RFC<1) \quad (2)$$

Where "FC" is the number of informants who cited the use of plant, and "N" is the total number of informants who participated in the survey.

Fidelity Level

The Fidelity Level is the percentage of informants who mentioned the uses of particular plants to cure a particular ailment in the study area. The FL value is computed as:

$$FL(\%) = NP / N \times 100 \quad (3)$$

Where "N_p" is the specific number of informants for a specific disease, and 'N' is the total number of participants cited the plants for any ailments (Friedman *et al.* 1986)

Family Importance Value

Family Importance Value (FIV) was used to compute the relative importance of plant families. It was computed by taking the percentage of respondents citing the plant family.

$$FIV = FC/ N \times 100 \quad (4)$$

FC= Number of informants mention the plant family, while "N" is the sum number of respondents participating in the survey (Friedman *et al.* 1986; Rehman *et al.* 2022a)

Results

Demographic Characteristics of Respondents this should be clearly stated in the methods section!

In the present study, 130 participants were interviewed, of which 103 (79.23%) males and 27 (20.77%) were females. The prevalence of male respondents in the research area was higher as compared to women. Our result agreed with (Amjad *et al.* 2020; Malik *et al.* 2018) where male were major respondents. There was definite cultural boundary due to which women respondents could not talk with men interviewers outside of their families. Most of them were over 75 (38.46), followed by 65-75 (28.46%), and 55-65 (16.15%) years old. Most of the respondents were illiterate (51.54%), while only 2.31% had a university education. Our result agreed with (Gedif and Hahn, 2003; Giday *et al.* 2009). Informants were 58 herbalists, 39 Shepherds, and 33 local healers (Table 1). All the informants spoke the Pushto language.

Table 1. Demographic characteristics of the informants.

V**ariation**	**Category**	**Numbers**	**Percentage**
Gender	Male	103	79.23
	Female	27	20.77
Age	35-45	7	5.38
	45-55	15	11.54
	55-65	21	16.15
	65-75	37	28.46
	Over 75	50	38.46
Occupation	Herbalists	58	44.62
	Shepherds	39	30.00
	Local healers	33	25.38
Educational background	Illiterate	67	51.54
	Primary	27	20.77
	Middle	16	12.31
	Secondary	10	7.69
	Higher secondary	7	5.38
	University	3	2.31

Therapeutic plants and growth form

The present survey reported 108 plant species related to 54 families, which were used for therapeutic purposes. The plant species documented with their scientific name, family name, local name, growth form, part used, mode of preparation, mode of administration, therapeutic uses, FC, RFC, UV, and FL are presented in (Table 2). The leading family was Lamiaceae with (17 spp.), followed by Asteraceae with (9 spp.), Amaranthaceae with (5 spp.), Apiaceae, and Rosaceae with (4 spp.) each.

Herbs were the dominant growth form (69.44%), followed by shrubs (13.89%), trees (11.11%), ferns (3.70%), and climbers (1.85%) as shown in (Figure 2). The frequent utilization of herbs may be due to their ease of access and effectiveness in the cure of different ailments.

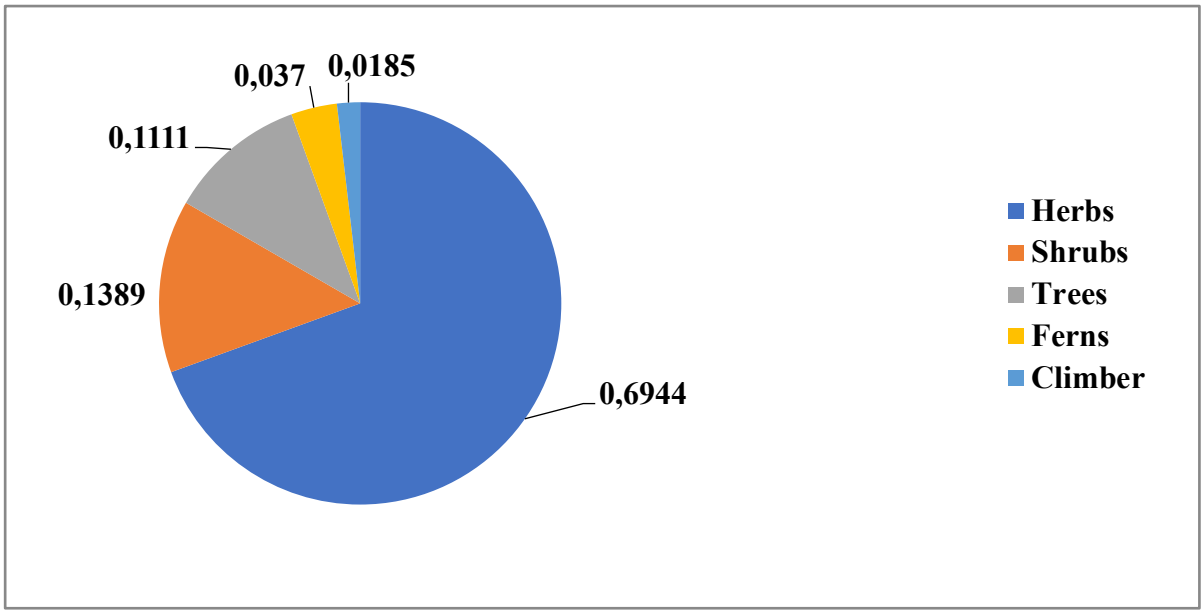

Figure 2. Growth forms of therapeutic plants at Shawal valley North Waziristan, Pakistan.

Plant parts used and Mode of preparation

The dominant plant part used in remedies preparations were leaves (24.22%), followed by aerial parts (15.63%), whole plants (12.50%), fruits and shoots (9.38%) each as shown in (Figure 3).

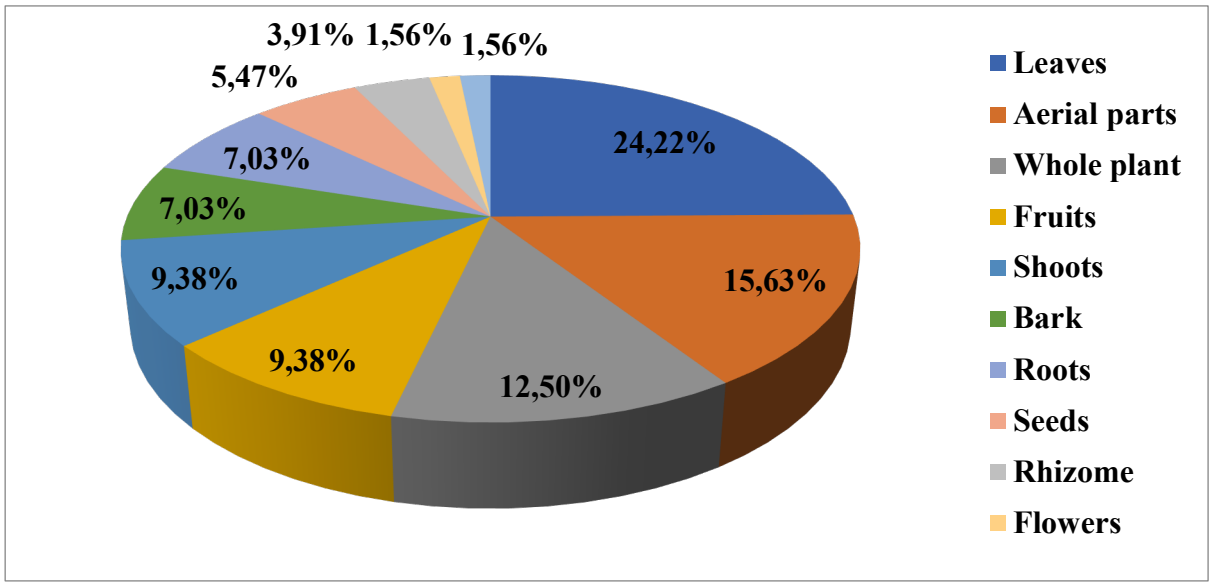

Figure 3. Plant parts used in remedies preparations in Shawal valley North Waziristan, Pakistan.

Decoction was the leading method of remedies preparation (39.17%), followed by powder (25.00%), raw (7.50%), juice (5.83%), herbal tea, infusion, and paste, each with 5.00% Ffigure 4).

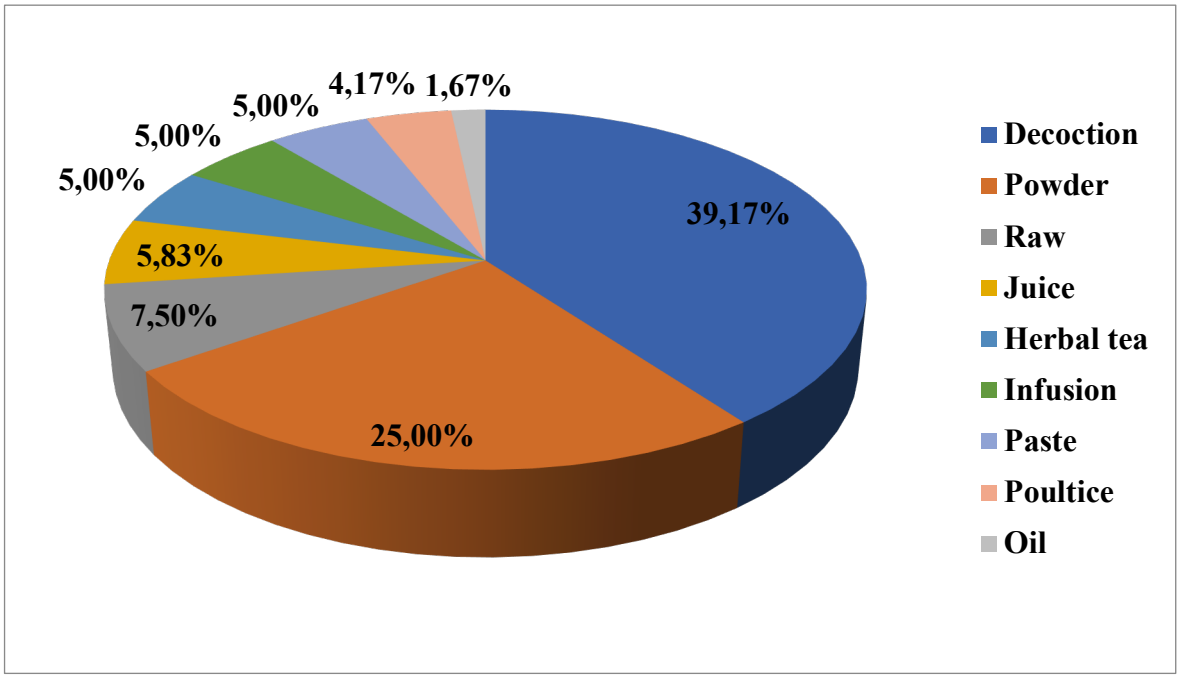

Figure 4.Mode of preparation of remedies in Shawal Valley North Waziristan, Pakistan.

Mode of Administration

The leading mode of administration was oral (81.03%), followed by topical (17.24%), and smoke (0.87%) (Figure 5).

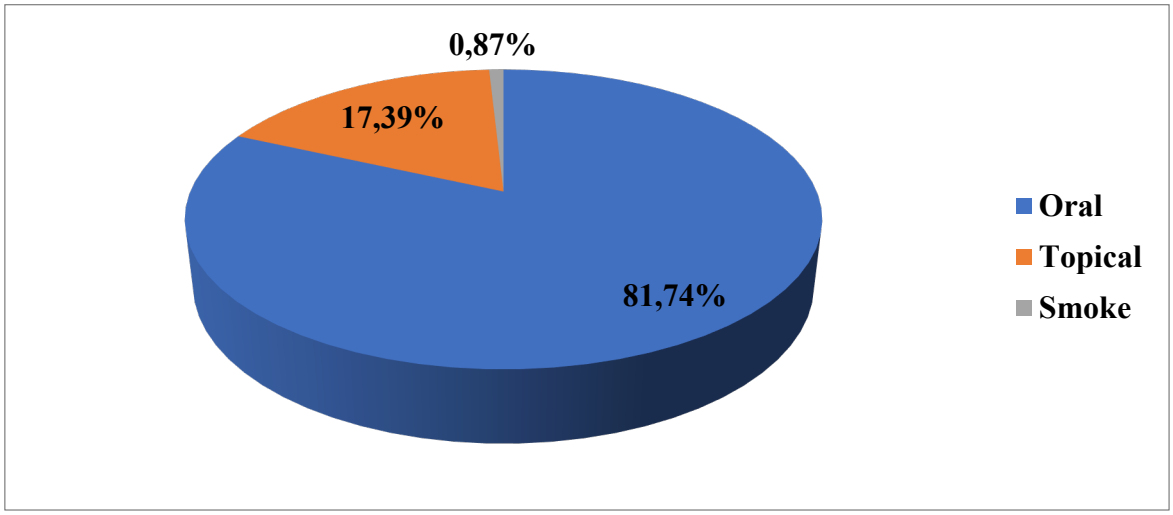

Figure 5. Mode of Administration of Shawal Valley, North Waziristan, Pakistan.

Medicinal flora used to cure different diseases

The indigenous people have great indigenous information for basic healthcare needs. During the current study, 119 different diseases were reported, which were treated by using 108 therapeutic plants. The most prevalent diseases in the study area were digestive disorders (16 species, 4.78%), followed by diarrhea (11 species, 3.28 %), cough (10 species, 2.99%), intestinal worm, blood purifier, dysentery, and inflammation (9 species, 2.69%) each, diuretic, body tonic, and expectorant (8 species, 2.39%) each, and so on (Figure 6).

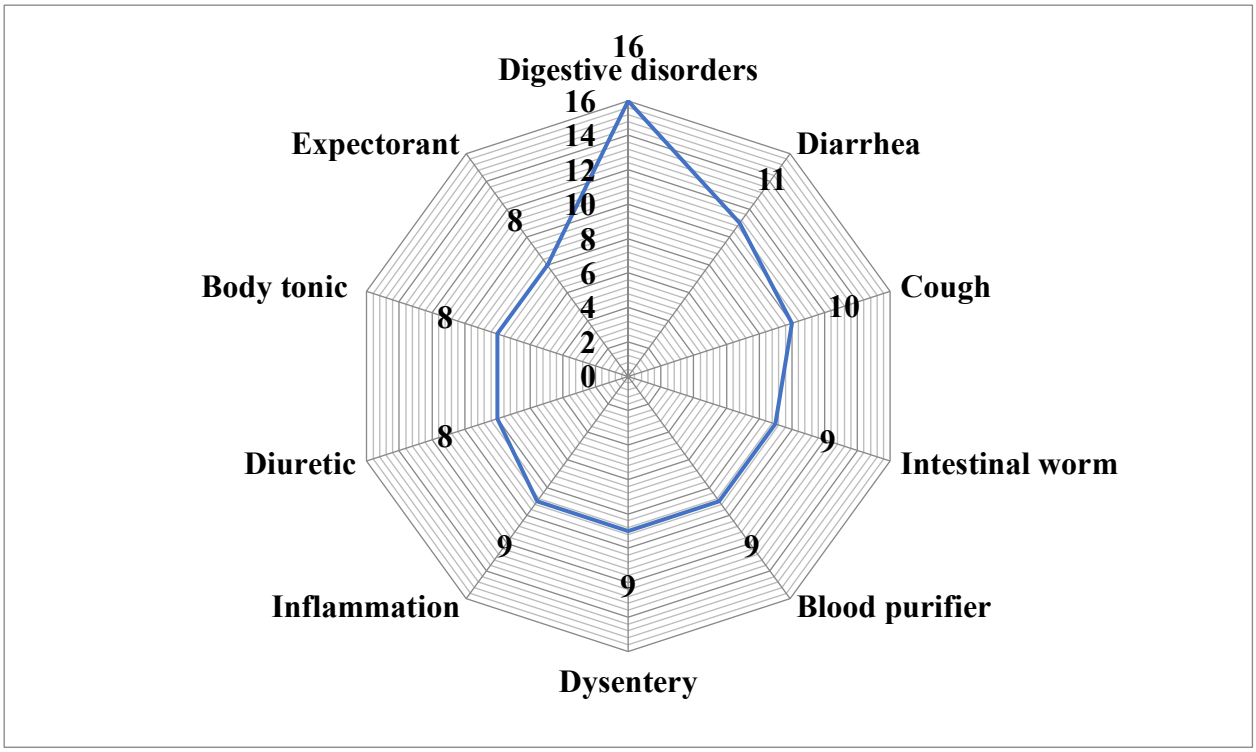

Figure 6. The number of plants used for treating the top ten disorders in Shawal Valley, North Waziristan, Pakistan

Quantitative data analysis

Relative Frequency of Citation

The RFC value of the recorded medicinal plants ranged from 0.14 to 0.36. The maximum RFC value was documented for *Bergenia ciliate* (0.36), followed by *Berberis lycium* and *Ephedra gerardiana* (0.35) each, *Pistacia integerrima* (0.34), *Peganum harmala* and *Tussilago farfara* (0.32) each, *Punica granatum* (0.31), and *Achyranthes aspera* (0.30), while the lowest RFC value was recorded for *Chrozophora obliqua* (0.14) (Table 2).

Use Value

The UV of the recorded medicinal plants varied from 0.33 to 0.89. The maximum UV was recorded for *Bergenia ciliate* (0.89), followed by *Ephedra gerardiana* (0.87), *Punica granatum* (0.85), *Berberis lycium* (0.84), *Peganum harmala* (0.83), *Plumbago zeylanica* (0.81), *Pistacia integerrima* (0.80), *Achyranthes aspera* (0.77), *Rhazya strictia* (0.76), while lowest was for *Chrozophora oblique* (0.33) (Table 2).

Fidelity Level

In the current study, the FL ranged from 38.89 to 100%. The medicinal plant most frequently utilized in the survey with 100% fidelity levels were *Bergenia ciliate*, *Ephedra gerardiana*, which were used to cure liver diseases and hemoptysis respectively. The FL recorded for *Berberis lycium* (liver diseases), *Peganum harmala* (Antiseptic), *Plumbago zeylanica* (spleen enlargement), *Pistacia integerrima* (diabetes) *Tussilago farfara* (haemoptysis), *Punica granatum* (stomachache), and *Achyranthes aspera* (Kidney stone) were 97.78%, 95.24%, 94.59%, 93.18%, 92.86%, 90.00% and 87.18% respectively (Table 2).

Family Importance Value (FIV)

In the current study, the most significant plant family on the basis of FC was Lamiaceae with (FIV= 97.69%) value, followed by Asteraceae (84.62%), Amaranthaceae (75.38%), Apiaceae (88.46%), Rosaceae (76.15%) and Fagaceae (51.54%), while the lowest FIV value was reported for Euphorbiaceae with (13.85%)(Table 3).

Table 2. Medicinal plants with scientific name, vernacular, family name, growth form, part used, UV, URs, FC, RFCs, and FL.

Botanical name/ Voucher Number	**Family name**	**Local name**	**Growth forms**	**Part used**	**Method of Preparation**	**Method of administration**	**Medicinal uses**	**FC**	**RFC**	**UV**	**UR**	**Fl%**
Abies pindrow Royle HU- 1331	Pinaceae	Lmanza	Tree	Bark	Decoction	Oral	Cough, asthma, catarrh	28	0.22	0.54	15	53.57
Achyranthes aspera L. HU-1332	Amaranthaceae	Ghoskai	Herbs	Whole plant	Decoction	Oral	Kidney stone, stomachache, toothache	39	0.30	0.77	30	87.18
Adiantum capillus-veneris L. HU-1333	Adiantaceae	Ferns	Ferns	Fronds	Infusion	Oral	Diuretic, demulcent, sore throat	33	0.25	0.52	17	51.52
Adiantum venustum D.Don HU-1334	Adiantaceae	Babozai	Ferns	Fronds	Infusion	Oral	Diuretic, emetic, expectorant	32	0.25	0.50	16	53.13
Adonis aestivalis L. HU-1335	Ranunculaceae	Gulakai	Herbs	Aerial part	Infusion	Oral	Diuretic, antispasmodic, sleeping draught, heart stimulant	34	0.26	0.53	18	52.94
Aerva javanica (Burm.f.) Juss. Ex Schult.. HU-1335	Amaranthaceae	Sperai	Herbs	Aerial part	Paste	Topical	Rheumatism, headache	19	0.15	0.53	10	57.89
Aesculus indica (Wall.ex Camb.) HU-1336	Hippocastannaceae	Jawaz	Tree	Seed	Oil	Topical	Skin diseases, headaches, rheumatism, intestinal worms	28	0.22	0.57	16	57.14
Ajuga brecteosa Wall. HU-1337	Lamiaceae	Varikai boti	Herbs	Whole plant	Decoction	Oral	Malaria, diabetes, diarrhea, cooling agent, blood purification	22	0.17	0.59	13	54.55
Alnus nitida (Spach) Endl. HU-1338	Betulaceae	Spedorkai	Tree	Bark	Decoction	Oral, topical	Hepatoprotective, inflammation, body pains	26	0.20	0.58	15	53.85
Amaranthus reteofleox L HU-1339	Amaranthaceae	Shadab	Herbs	Root	Decoction	Oral	Gonorrhea, kidney disorders, demulcent	22	0.17	0.64	14	59.09
Amaranthus spinosus L. HU-1340	Amaranthaceae	Ghota surme	Herbs	Shoot, root	Decoction	Oral	regulate menstrual flow, increase milk amount	20	0.15	0.65	13	55.00

Botanical name/ Voucher Number	Family name	Local name	Growth forms	Part used	Method of Preparation	Method of administration	Medicinal uses	FC	RFC	UV	UR	Fl%
Amaranthus viridis L. HU-1341	Amaranthaceae	Rhanzaka	Herbs	Aerial part	Juice	Oral	Constipation, repel intestinal worm	21	0.16	0.57	12	57.14
Androsace rotundifolia Hardwicke. HU-1341	Primulaceae	Ser gul	Herbs	Leaves, rhizome	Powder	Oral	Laxative, regulate menstrual flow	19	0.15	0.63	12	63.16
Arisaema flavum (Forsk.) Schott. HU-1342	Araceae	Sorganda	Herbs	Seed, rhizome	Powder, paste	Oral, topical	Narcotic, aphrodisiac, crack bone, swellings	21	0.16	0.62	13	57.14
Arisaema jacquemontii Blume. HU-1343	Araceae	Mangor boti	Herbs	Rhizome	Powder	Oral	Snakebite, expel intestinal worms	26	0.20	0.54	14	53.85
Artemisia absinthium Linn HU-1344	Asteraceae	Therkha	Herbs	Aerial part	Powder	Oral	Gastrointestinal disoders, diuretic, carminative, jaundice	37	0.28	0.62	23	56.76
Artemisia maritima L. HU-1345	Asteraceae	Mugvorta	Herbs	Aerial part	Decoction	Oral	Blood purifier, skin diseases, tonic, worm repellent	38	0.29	0.66	25	60.53
Berberis lycium Royle. HU-1346	Berberidaceae	Kuwaray	Shrub	Bark, Leaves	Decoction	Oral	Blood purifier, astringent, wound healing,hepatitis,jaundice	45	0.35	0.84	38	97.78
Bergenia ciliata (Haw.)Sternb. HU-1347	Saxifragaceae	Zakhm-e-hayat	Herbs	Rhizome, leaves	Decoction, juice	Oral	Kidney disorders, liver diseases, heart diseases, digestive disorders, pulmonary infection, hypermenorrhea	47	0.36	0.89	42	100.00
Boerhavia diffusa L. HU-1348	Nyctaginaceae	Pret boti	Herbs	Aerial part	Decoction	Oral	Gastrointestinal pain, hepatoprotective, gonorrhea, intestinal worm repellent	29	0.22	0.48	14	65.52

Botanical name/ Voucher Number	Family name	Local name	Growth forms	Part used	Method of Preparation	Method of administration	Medicinal uses	FC	RFC	UV	UR	Fl%
Boerhavia procumbens Banks ex Roxb. HU-1348	Nyctaginaceae	Wasao	Herbs	Aerial part	Decoction	Oral	Blood purifier, hepatitis, jaundice	28	0.22	0.46	13	60.71
Buddleja crispa Benth. HU-1349	Buddlejaceae	Velanai ghinde	Shrub	Aerial part	Decoction	Oral	Antispasmodic, regulate blood pressure	27	0.21	0.67	18	66.67
Bupleurum falcatum L. HU- 1350	Apiaceae	Pest boti	Herbs	Aerial part	Decoction	Oral	Malaria, fever, diarrhea, regulated menstrual flow	27	0.21	0.56	15	59.26
Cannabis sativa L. HU-1351	Cannabinaceae	Bhanga	Herbs	Leaves	Powder	Smoking	Narcotic, sedative, appetizer, chronic pain	31	0.24	0.55	17	67.74
Capparis decidua (Forssk.) Edgew. HU-1351	Capparidaceae	Kabar	Tree	Bark, fruit	Decoction, raw	Oral	Constipation, malaria, bad breath, expectorant, toothache	28	0.22	0.61	17	64.29
Caralluma tuberculata N.E. Brown, Gardn. HU-1352	Asclepiadaceae	Pamankai	Herbs	Aerial part	Raw	Oral	Malaria, diabetes	37	0.28	0.70	26	83.78
Cedrus deodara (Roxb.ex D. Don) G. Don. HU-1354	Pinaceae	Diyar	Tree	Stem	Oil	Topical	Skin diseases, leprosy, antiseptic	31	0.24	0.61	19	67.74
Chenopodium album L. HU-1355	Chenoppdiaceae	Surmay	Herbs	Leaves	Juice	Oral	Kidney pain	26	0.20	0.54	14	53.85
Chenopodium ambrosioides L. HU-1356	Chenoppdiaceae	Skha boti	Herbs	Aerial part	Decoction	Oral	Intestinal worm repellent	23	0.18	0.57	13	52.17
Chrozophora obliqua (Vahl) Adr. Juss. ex Spreng. HU-1357	Euphorbiaceae	Beian boti	Herbs	Aerial part	Decoction	Oral	Fever, whooping cough, dysentery	18	0.14	0.33	6	38.89
Citrullus colocynthis (L.) Schrad HU-1358	Cucurbitaceae	Maraghenia	Climber	Fruit	Sweet dish	Oral	Constipation, tonic	27	0.21	0.56	15	55.56

Botanical name/ Voucher Number	Family name	Local name	Growth forms	Part used	Method of Preparation	Method of administration	Medicinal uses	FC	RFC	UV	UR	Fl%
Clematis orientalis L. HU-1358	Ranunculaceae	Karbeske	Climber	Aerial part	Infusion	Oral	Throat infection, refrigerant, antiseptic, dog bite	29	0.22	0.59	17	55.17
Commelina paludosa Blume. HU-1359	Commelinaceae	Ebe boti	Herbs	Leaves, root	Decoction	Oral	Pain killer, laxative, inflamation, depressent	27	0.21	0.59	16	62.96
Cotoneaster nummularia Fisch. & C.A. Mey. HU-1359	Rosaceae	Sherawa	Shrub	Fruit	Decoction	Oral	Expectorant, appetizer, cooling agent	24	0.18	0.54	13	50.00
Daphne mucronata Royle. HU-1360	Thymilaceae	Sre dane	Shrub	Leaves	Poultice	Topical	Joints pain, swelling,	22	0.17	0.64	14	54.55
Daphne oleoides Schreb. HU-1360	Thymilaceae	Laighonai	Shrub	Leaves	Decoction	Oral, topical	Gonorrhea, anthelmintic,carbuncle	23	0.18	0.57	13	60.87
Dodonea viscosa (L.) Jacq. HU-1361	Sapindaceae	Ghoraskai	Shrub	Leaves	Poultice	Topical	Fractured leg	25	0.19	0.56	14	56.00
Ephedra gerardiana L. HU-1362	Ephedraceae	Muwa	Shrub	Shoot	Decoction	Oral	Respiratory disorders, antiseptic, cough, hemoptysis	46	0.35	0.87	40	100.00
Equisetum arvense L. HU-1363	Equisetaceae	Bandkay	Ferns	Shoot	Decoction	Oral	Acidity, diuretic, Kidney stone, tonic	31	0.24	0.58	18	64.52
Erigeron alpines L. HU-1364	Asteraceae	Gulgerai	Herbs	Whole plant	Powder	Oral	Fever, internal injuries, cough, cooling effect	21	0.16	0.52	11	61.90
Fragaria nubicola (Hook.f.) Lindl. HU-1365	Rosaceae	Jungali meva	Herbs	Fruit	Juice, raw	Oral	Regulate menstrual flow, laxative, crack on the tongue	23	0.18	0.52	12	52.17
Fritillaria imperialis L. HU-1366	Liliaceae	Gigar gul	Herbs	Bulb	Powder	Oral	Expectorants, and diuretics, enhance milk flow	26	0.20	0.54	14	53.85

Botanical name/ Voucher Number	Family name	Local name	Growth forms	Part used	Method of Preparation	Method of administration	Medicinal uses	FC	RFC	UV	UR	Fl%
Galinsoga parviflora Cav. HU-1367	Asteraceae	Pastekai	Herbs	Shoot	Juice	Topical	Wound healing, coagulate the blood	24	0.18	0.54	13	58.33
Galium aparine L. HU-1368	Rubiaceae	Babar boti	Herbs	Shoot	Herbal tea	Oral	Blood purifier, diuretic , Jaundice	26	0.20	0.54	14	57.69
Gentiana kurreo Royle. HU-1369	Gentianaceae	Sheen gul	Herbs	Root	Decoction	Oral	Carminative, blood purifier, indigestion	21	0.16	0.52	11	76.19
Geranium willianum D. Don ex Sweet. HU-1370	Geraniaceae	Rattanjot	Herbs	Whole plant	Powder	Oral	Spleen disorder, kidney disorder, stomach ulcer, back pain, throat infection	33	0.25	0.55	18	51.52
Heliotropium europaeum L. HU-1371	Boraginaceae	Kharpoonray	Herbs	Leaves	Paste	Topical	Scorpion sting,wasp sting, warts	19	0.15	0.42	8	47.37
Heliotropium strigosum Wild HU-1372	Boraginaceae	Kharpoonray	Herbs	Aerial part	Decoction	Oral	Gastrointestinal tract disorders, skin diseases	21	0.16	0.43	9	47.62
Heteropapus biennis (Ledeb.) Tamamsch. HU-1373	Asteraceae	Ster gul	Herbs	Aerial part	Decoction	Oral	Typhoid fever, bronchitis	22	0.17	0.59	13	54.55
Impatiens glandulifera Royle. HU-1374	Balsaminaceae	Khr gul	Herbs	Flower, shoot	Infusion, decoction	Oral	Tonic, cooling agent, expectorant, diuretic	23	0.18	0.48	11	56.52
Incarvillea emodi (Royle ex Lindl.) HU-1375	Bignoniaceae	Khurry	Herbs	Whole plant	Decoction	Oral	Hepatitis, diarrhea, dysentery	26	0.20	0.46	12	53.85
Indigofera heterantha Brandis. HU-1376	Papilionaceae	Segulai	Shrub	Leaves, bark	Powder, decotion	Oral	Expectorant, diuretic, dysentery, diarrhea, abdominal pain	31	0.24	0.55	17	54.84
Isodon rugosus (Wall. ex Benth.) HU-1377	Lamiaceae	Khezbee boti	Shrub	Shoot	Decoction	Drope	Toothache, earache	22	0.17	0.55	12	59.09

Botanical name/ Voucher Number	Family name	Local name	Growth forms	Part used	Method of Preparation	Method of administration	Medicinal uses	FC	RFC	UV	UR	Fl%
Juglans regia L. HU-1378	Juglandaceae	Mattak	Tree	Bark, fruit	Raw	Oral	Cleaning teeth, heart tonic, thermogenic	27	0.21	0.59	16	62.96
Lycopus europaeus L. HU-1379	Lamiaceae	Eblan	Herbs	Shoot	Decoction	Oral	Tuberculosis, lungs disorders	34	0.26	0.56	19	67.65
Malva neglecta Wallr HU-1380	Malvaceae	Teekalay	Herbs	Leaves	Decoction	Oral	Antispasmodic	21	0.16	0.52	11	61.90
Malva parviflora Linn. HU-1381	Malvaceae	Pachkay	Herbs	Leaves, root	Decoction, powder	Oral	Antispasmodic, sex tonic	23	0.18	0.48	11	60.87
Malva sylvestris Linn. HU-1382	Malvaceae	Malva	Herbs	Seed	Powder	Oral	Inflammation, urinary bladder disorders	22	0.17	0.50	11	50.00
Marrubium vulgare L. HU-1383	Lamiaceae	Makoh	Herbs	Whole plant	Decoction	Oral	Cough, lung troubles	23	0.18	0.57	13	56.52
Maytenus royleanus (Wall. ex Lawson) HU-1384	Celastraceae	Sagharzai	Shrub	Leaves	Powder	Oral	Joint pain, leg pain	24	0.18	0.58	14	66.67
Mentha arvensis L. HU-1384	Lamiaceae	Pudina	Herbs	Leaves	Powder	Oral	Indigestion, flatulence	36	0.28	0.53	19	58.33
Mentha longifolia (L.) L. HU-1385	Lamiaceae	Jungali velany	Herbs	Whole plant	Powder	Oral	Kidney stone, diarrhea, dysentery	35	0.27	0.54	19	62.86
Mentha spicata L. HU-1386	Lamiaceae	Sarkuri velany	Herbs	Leaves	Powder	Oral	Carminative, gastric problems	34	0.26	0.56	19	67.65
Mentha viridis (L.) L. HU-1387	Lamiaceae	Pudina	Herbs	Whole plant	Decoction	Oral	Cough, gastrointestinal disorders, carminative	34	0.26	0.56	19	67.65
Myrsine Africana L. HU-1388	Myrsinaceae	Manargooya	Shrub	Fruit, leaves	Powder, decoction	Oral	Intestinal worm repelent, hepatitis, jaundice	26	0.20	0.50	13	53.85
Nepeta hindostana (Roth) Haines HU-1389	Lamiaceae	Badrag boti	Herbs	Whole plant	Decoction	Oral	Cardiac tonic, angina pectoris, tachycardia	27	0.21	0.59	16	62.96

Botanical name/ Voucher Number	Family name	Local name	Growth forms	Part used	Method of Preparation	Method of administration	Medicinal uses	FC	RFC	UV	UR	Fl%
Nepeta podostachys Benth. HU-1390	Lamiaceae	Nry pakhe	Herbs	Aerial part	Decoction	Oral	Cardiac disorders, tachycardia	23	0.18	0.65	15	60.87
Olea ferruginea Royle. HU-1391	Oleaceae	Shawan	Tree	Fruit	Raw	Oral	Anti-diabetic, refrigerant	32	0.25	0.56	18	75.00
Onosma bracteatum Wall. HU-1392	Boraginaceae	Gaozaban	Herbs	Leaves	Decoction	Oral	Jaundice, constipation,urinary problems, tonic	27	0.21	0.59	16	66.67
Papaver dubium Linn. HU.1393	Papeveraceae	Gul-e-daudi	Herbs	Capsule	Herbal tea	Oral	Cough, analgesic, sedative	29	0.22	0.59	17	72.41
Peganum harmala L. HU-1394	Zygophyllaceae	Sponda	Herbs	Aerial part	Smoke, poultice	Topical	Antiseptic, antilice, crack bone, mastitis	42	0.32	0.83	35	95.24
Phlomis bracteosa Royle ex Benth. HU-1395	Lamiaceae	Gote pkhe	Herbs	Leaves, flower	Powder	Oral	Cough, cold,carminative,stimulant, laxative, toothache	25	0.19	0.60	15	76.00
Pimpinella diversifolia DC. HU.1396	Apiaceae	Tarpakhi	Herbs	Aerial part	Powder	Oral	Indigestion, gas trouble, leucorrhoea, gastrointestinal disorders	30	0.23	0.57	17	56.67
Pinus gerardiana Wall. ex Lamb. HU-1397	Pinaceae	Zanghozai	Tree	Seed	Raw	Oral	Tonic, energizer	29	0.22	0.62	18	65.52
Pistacia integerrima (J.L. Stewart ex Brandis) Rech.f. HU-1398	Anacardiaceae	Shne	Tree	Fruit	Raw	Oral	Flatulence, intestinal worms , diabetes	44	0.34	0.80	35	93.18
Plantago lanceolata L. HU-1399	Plantaginaceae	Khatakai	Herbs	Leaves	Paste	Topical, oral	Inflammation, sores, constipation,	33	0.25	0.55	18	69.70
Plumbago zeylanica L. HU-1400	Plumbaginaceae	Sheetar	Herbs	Root	Powder	Oral	Carminative, appetizer, diarrhea, piles, spleen enlargement	37	0.28	0.81	30	94.59

Botanical name/ Voucher Number	Family name	Local name	Growth forms	Part used	Method of Preparation	Method of administration	Medicinal uses	FC	RFC	UV	UR	Fl%
Potentilla erecta (L.) Raeusch. HU-1401	Rosaceae	Zergulai	Herbs	Whole plant	Powder	Oral	Dysentery, stomachache, diarrhea, hypermenorrhea	23	0.18	0.57	13	52.17
Pteris vittata L. HU-1402	Pteridaceae	Khajer ghonde	Ferns	Leaves	Paste	Topical	Fire burns, wounds healing	22	0.17	0.55	12	50.00
Punica granatum L. HU-1403	Puniacaceae	Walanghai	Shrub	Fruit	Raw	Oral	Refrigerant, diarrhea, dysentery, stomachache	40	0.31	0.85	34	90.00
Quercus baloot Griff. HU-1403	Fagaceae	Spera serhay	Tree	Fruit	Raw	Oral	Astringent, diuretic	29	0.22	0.52	15	65.52
Quercus dilatata Royle. HU-1404	Fagaceae	Seray	Tree	Bark	Decoction	Oral	Anthelmentic, gastrointestinal disorders,	30	0.23	0.53	16	70.00
Quercus incana Roxb. HU-1405	Fagaceae	Seray	Tree	Fruit	Powder	Oral	Diarrhoea, dysentery,	28	0.22	0.50	14	71.43
Rubus fruiticosus L HU-1406	Rosaceae	Gul	Shrub	Bark, leaves	Decoction	Oral	Diuretic, astringent, diarrhea, dysentery	32	0.25	0.47	15	65.63
Rhazya strictia L HU-1407	Apocynaceae	Mardor boti	Shrub	Leaves	Decoction	Topical	Acne, pimples, foot burn	38	0.29	0.76	29	89.47
Sageretia thea (Osbeck) M.C. Johnst. HU-1408	Rhamnaceae	Varekai boti	Shrub	Leaves, bark	Powder	Oral	Skin disorders, anti-cancer	33	0.25	0.67	22	69.70
Salvia glutinosa L. HU-1409	Lamiaceae	Ghr khatekay	Herbs	Root	Decoction	Oral	Abdominal pain, sore throat, sweating	24	0.18	0.54	13	58.33
Salvia moocroftiana Wall. HU-1410	Lamiaceae	Ghate pakhe	Herbs	Leaves, Shoot	Powder, poultice	Topical, oral	Boils, itchy skin, dressing of wounds, colds, cough	23	0.18	0.52	12	65.22
Salvia nubicola Wall. ex Sweet. HU-1411	Lamiaceae	Khezbee boti	Herbs	Shoot	Juice	Oral	Cold fever, liver disorders, dysentery	24	0.18	0.58	14	54.17

Botanical name/ Voucher Number	Family name	Local name	Growth forms	Part used	Method of Preparation	Method of administration	Medicinal uses	FC	RFC	UV	UR	Fl%
Schinus terebinthifolius Reddi HU-1412	Anacardiaceae	Sre dane	Shrub	Leaves	Decoction	Oral	Respiratory disorders, menstrual disorders, urinary tract infections, depression	29	0.22	0.52	15	58.62
Scutellaria edelbergii Rech. f. HU-1413	Lamiaceae	Veraki boti	Herbs	Leaves	Powder	Oral	Blood purification, analgesic, inflammation	26	0.20	0.54	14	61.54
Senecio chrysanthemoides DC. HU-1414	Asteraceae	Zergulai	Shrub	Rhizome	Powder	Oral	Respiratory disorders, asthma	23	0.18	0.52	12	60.87
Sophora mollis (Royle) Baker. HU-1415	Papilionaceae	Gher boti	Herbs	Leaves, seed	Powder, paste	Oral,topical	Intestinal worm, headache	24	0.18	0.58	14	70.83
Stellaria media (L.) Vill. HU-1416	Caryophyllaceae	Pest boti	Herbs	Whole plant	Poultice, decoction	Topical, oral	Crack bone, rheumatism, insect bites, lactagogue, demulcent	20	0.15	0.60	12	55.00
Tagetus erecta L. HU-1417	Asteraceae	Zendagula	Herbs	Shoot	Infusion	Oral,topical	Intestinal worms, kill liver flukes, mosquitoes replant,	28	0.22	0.46	13	57.14
Thymus linearis benth. HU-1418	Lamiaceae	Mrvezai	Herbs	Whole plant	Herbal tea	Oral	Inflammation, anelgesic, antispasmodic, feve	30	0.23	0.57	17	56.67
Thymus serpyllum L. HU-1419	Lamiaceae	Marvezai	Herbs	Whole plant	Herbal tea	Oral	Tonic, liver disorders, stomachache, carminative, antispasmodic	31	0.24	0.58	18	61.29
Torilis arvensis (Huds.) Link. HU-1420	Apiaceae	Khati boti	Herbs	Seed, root	Powder	Oral	Anthelmintic, expectorant, indigestion	28	0.22	0.54	15	57.14
Torilis japonica (Houtt.) DC. HU-1421	Apiaceae	Pest boti	Herbs	Seed, root	Powder, decoction	Oral	Anthelmintic, tonic, expectorant, hemorrhoids, anti-cancer	27	0.21	0.52	14	62.96

Botanical name/ Voucher Number	Family name	Local name	Growth forms	Part used	Method of Preparation	Method of administration	Medicinal uses	FC	RFC	UV	UR	Fl%
Trigonella corniculata (L.) L. HU-1422	Papilionaceae	Tore dane	Herbs	Fruit	Decoction	Topical	Body swelling, bruises	31	0.24	0.55	17	74.19
Tussilago farfara L. HU-1423	Asteraceae	Khataki gul	Herbs	Whole plant	Herbal tea	Oral	Respiratory disorders, cough, asthma, sputum with blood	42	0.32	0.79	33	92.86
Urtica dioica L. HU-1424	Urticaceae	Seezankiye	Herbs	Shoot	Herbal tea	Oral	Anti-diabetic, liver disorders, blood purification	23	0.18	0.57	13	60.87
Verbascum thapsus L. HU-1425	Scrophulariaceae	Jungali bhanga	Herbs	Leaves	Powder	Oral	Narcotic, Cough, diarrhea, abdominal pain	27	0.21	0.56	15	55.56
Vernonia cinerea (L.) Less HU-1426	Asteraceae	Devi	Herbs	Leaves	Powder	Oral	Anti-diabetic, inflammation,c ough	20	0.15	0.55	11	50.00
Veronia undulata Wall. HU-1427	Plantaginaceae	hen gulai	Herbs	Aerial part	Decoction	Oral	Stop bleeding, regulate menstrual flow, Blood purifier	29	0.22	0.52	15	44.83
Vincetoxicum hirundinaria Medicus. HU-1428	Asclepiadaceae	Gher Parwetia	Herbs	Aerial part	Juice	Topical	Boils, pimples	22	0.17	0.55	12	63.64
Viola canescens Wall.ex Roxb. HU-1429	Violaceae	Benefshah	Herbs	Whole plant	Decoction	Oral	Demulcent, refrigerant, antipyretic, diaphoretic, anti-cancer	37	0.28	0.70	26	83.78
Vola serpens Wall. ex Roxb. HU-1430	Violaceae	Verkayi boti	Herbs	Whole plant	Decoction	Oral	Hepatitis, jaundice	24	0.18	0.58	14	62.50

Abbreviations: RFC= Relative Frequency of Citation, FC= Frequency of Citations, UV= Use Values, UR=Use Reports, FL= Fidelity Level.

Table 3. Family importance value (FIV) of the medicinal flora of Shawal Valley, North Waziristan, Pakistan.

Family name	**No. of Species**	**FC(family)**	**FIV**
Lamiaceae	17	127	97.69
Asteraceae	9	110	84.62
Amaranthaceae	5	98	75.38
Apiaceae	4	115	88.46
Rosaceae	4	99	76.15
Fagaceae	3	67	51.54
Malvaceae	3	66	50.77
Papilionaceae	3	86	66.15
Pinaceae	3	64	49.23
Adiantaceae	2	65	50.00
Anacardiaceae	2	73	56.15
Araceae	2	47	36.15
Asclepiadaceae	2	59	45.38
Boraginaceae	3	67	51.54
Chenoppdiaceae	2	49	37.69
Nyctaginaceae	2	57	43.85
Plantaginaceae	2	62	47.69
Ranunculaceae	2	63	48.46
Thymilaceae	2	45	34.62
Violaceae	2	61	46.92
Apocynaceae	1	38	29.23
Balsaminaceae	1	23	17.69
Berberidaceae	1	45	34.62
Betulaceae	1	26	20.00
Bignoniaceae	1	26	20.00
Buddlejaceae	1	27	20.77
Cannabinaceae	1	31	23.85
Capparidaceae	1	28	21.54
Caryophyllaceae	1	20	15.38
Celastraceae	1	24	18.46
Commelinaceae	1	27	20.77
Cucurbitaceae	1	27	20.77

Family name	No. of Species	FC(family)	FIV
Ephedraceae	1	46	35.38
Equisetaceae	1	31	23.85
Euphorbiaceae	1	18	13.85
Gentianaceae	1	21	16.15
Geraniaceae	1	33	25.38
Hippocastannaceae	1	28	21.54
Juglandaceae	1	27	20.77
Liliaceae	1	26	20.00
Myrsinaceae	1	26	20.00
Oleaceae	1	32	24.62
Papeveraceae	1	29	22.31
Plumbaginaceae	1	37	28.46
Primulaceae	1	19	14.62
Pteridaceae	1	22	16.92
Puniacaceae	1	40	30.77
Rhamnaceae	1	33	25.38
Rubiaceae	1	26	20.00
Sapindaceae	1	25	19.23
Saxifragaceae	1	47	36.15
Scrophulariaceae	1	27	20.77
Urticaceae	1	23	17.69
Zygophyllaceae	1	42	32.31

Discussion

In the current study, we recorded 108 medicinal plants related to 54 plant families to cure 119 different diseases. Ethnomedicinal studies have been reported in previous literature from nearby tribal areas. Aziz *et al.* (2016) reported a total of 82 medicinal plants belonging to 42 families form Ladha, South Waziristan. Ullah *et al.* (2013) reported 50 medicinal plants belonging to 30 families from Wana District, South Waziristan. The highest number of plant species related to the family Lamiaceae, Asteraceae, Amaranthaceae, and Apiaceae. Similar results were reported by (Barkaoui *et al.* 2017; Miara *et al.* 2018; Taibi *et al.* 2020; Hussain *et al.* 2022). Herbs were the dominant growth forms used in herbal remedies preparations. Similar findings were reported by (Kadir *et al.* 2014; Faruque & Uddin 2014; Hussain *et al.* 2018; Rehman *et al.* 2022a). Because herbaceous plants contain bioactive compounds (Abbasi *et al.* 2013). Indigenous healers used all parts of plants in herbal remedies preparations, but leaves were used most frequently. Similar results were reported in previous literature (Kidane*et al.* 2018; Umair *et al.* 2019; Nguyen *et al.* 2020; Rehman *et al.* 2023).The utilization of leaves in remedies preparations was due to easier to collect and store (Skalli *et al.* 2019; Yebouk *et al.* 2020; Rehman *et al.* 2022b).

Traditional healers used various preparation methods, including decoction, powder, infusion, paste, and herbal tea, but the dominant mode of remedies preparation was decoction. Similar results were reported by (Merrouni & Elachouri (2020), Mechaala *et al.* (2021), and Zatout *et al.* (2021). We also found that the oral route of administration

was the most frequently used method in traditional medicine. Similar results were reported by Miara *et al.* (2018), Mrabti *et al.* (2019), Zatout *et al.* (2021), and Rehman *et al.* (2023). In the study area, digestive disorders are common, largely due to a shortage of pure water; especially in those living in hilly and remote areas. Our result agreed with Umair *et al.* (2017, 2019). The maximum relative frequency of citation value explains the knowledge that these medicinal plants are very well-known among the majority of traditional healers (Butt *et al.* 2015; Rehman *et al.* 2022b). The high UV of therapeutic plants in the study area is associated with their common distribution in the research area and the local people are well familiar with their therapeutic uses (Rehman *et al.* 2022c). In addition, it is not true that therapeutic plants with low use values are less significant, but it indicates that the indigenous information about these therapeutic plant species is at risk or that the availability of the certain therapeutic plant is less (Chaudhary *et al.* 2006; Mahmood *et al.* 2013). The UV shows the relative importance of the utilization of therapeutic plant species in a specific area (Hassan *et al.* 2019). The maximum RFC values record the traditional knowledge that these medicinal plants were well-known to maximum number of informants (Butt *et al.* 2015; Rehman *et al. 2022b*).The relative citation of frequency reveals the tribe's familiarity with the therapeutic properties of particular plants. It also indicates efficacy and ease of access with fewer side effects (Vitalini *et al.* 2013; Kayani *et al.* 2015). Fidelity level is used to determine the therapeutic plants that are most preferred by the local community for the treatment of particular ailments. It is a fact, that higher the fidelity level value, the higher will be the plant's utilization (Farnsworth 1988). The maximum FL value revealed the selection of respondents to cure the particular ailment (Karakose, 2022). Those plants used in the in the cure of a single ailment have FL levels of 100% when compared to those used in the administration of multiple disorders (Zakariya *et al.* 2021). Maximum FL value reveals the uniqueness and high utilization of a plant for a specific ailment (Sahil *et al.* 2014). The maximum FIV value was recorded for the family Lamiaceae. It was followed by Asteraceae (84.62%), Amaranthaceae (75.38%), Apiaceae (88.46%), Rosaceae (76.15%) and Fagaceae (51.54%) as shown in Table 3. Medicinally important plants of the family Lamiaceae, Asteraceae, Amaranthaceae, and Apiaceae are cited as significant in different pharmacological works (Shad *et al.* 2013; Kayani *et al.* 2014). The maximum FIV value explains that the plant species of a particular plant family are frequently used in curing different diseases as documented by the respondents. Drug detection in medicinal plants links multi-disciplinary access to joining phytochemical and pharmacological methods. Though, any therapeutic plant in the current study was not exposed to the complete pharmacological screenings.

Conclusion

This is the first survey to explore the indigenous therapeutic plants of the Shawal valley North Waziristan. A sum of 108 plants related to 54 families was documented to treat 119 human ailments. The data provided by our traditional informants show that traditional knowledge of therapeutic plant utilization is still alive in the Shawal valley. Unluckily, the therapeutic plant of the Shawal area is under threat of extinction as inhabitants are unaware of the conservation policies for future uses. Deforestation, overexploitation, and uprooted of therapeutic herbs, threatened the flora. Based on the current studies results, medicinal plants scoring high use value, relative citation of frequency, and fidelity level values must be further tested for their pharmacological and phytochemical research.

Declarations

List of abbreviations: Relative Frequency of Citation (RFC),UR, Use Report; Use Vaue (UV), Fidelity Level (FL), and FIV, Family Importance Value.

Ethics statement: Prior to the survey, we obtained oral informed consent from each participant.

Consent for publications: Not applicable.

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Conflicts of Interest: The authors declare that there are no conflicts of interest in this article.

Availability of data and materials: The figures and tables supporting the results of this study are included in the article, and the original data sets are available from the first author upon request.

Authors' contributions: The manuscript is written by SR. ZI and QR Supervised this work. RQ and GMS helped in data analysis. All the authors approved the final manuscript after revision.

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