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Qualitative and quantitative ethnobotanical evaluation of plant resources of Kiwai, Kaghan valley, district Mansehra, Pakistan

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Local plants of an area are highly valuable for people of that locality. Plant resources are actually part and parcel of traditions and culture of inhabitants due to their consumption in daily life. Aim of the present study was to explore the culturally significant floral diversity of a remote area with special reference to medicinal plants and quantification of local wisdom through statistical indices. The study was carried out in mountainous region of Kiwai located in Kaghan valley, district Mansehra, northern Pakistan. Questionnaire method was adopted and semi-structured interviews were also conducted for data collection. Two hundred informants were interviewed to report the ethnobotanical knowledge of targeted plants. Relative frequency citation (RFCs), consensus index (CI%) and use value (UVi) were calculated for results. Study reports 110 plants belonging to 98 genera and 53 families. Asteraceae was the dominant family with 10 plant species. Angiosperms (59%) were abundant in the study area followed by Gymnosperm (5%) and Pteridophytes (2%). Herbs (59%) were recorded abundant followed by trees (31%) and shrubs (10%). The most used parts were leaves (30%), stem (13%) and whole plant (11%). Common fever was the most cited disease by locals. RFC and CI% was highest for *Bergenia ciliata* and *Silybum marianum.* Use value of *Pinus roxburghii* was high with 0.045 value. Study area shows rich ethno-floral diversity. Peoples are not only using plants for medicinal purposes but also for a number of uses such as construction, fruit, vegetable, furniture and fodder.

Keywords: Ethnobotany, Indigenous people, Kiwai, Medicinal uses, Quantitative analysis, Traditional knowledge

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Worldwide, about 85% of the traditional medicines used in primary healthcare are extracted from plant species[1]. Plants' usages as traditional medicines give a real alternate in healthcare facilities for rural population of developing countries[2]. Plants resources are not only considered important just for human requirements but also for fitness and health care, since time immemorial.

Since ancient times, plant served as first medical source for the local communities for healing their diseases and disorders. Man learnt about the medicinal importance of plants through the trial and error techniques. The information about plant consumption has been passed from generation to generation and lead to expansion of traditional knowledge[3]. Native information about plant is as old as human culture. Ethnobotany is study of association among plants and people[4]. The ethnobotany gave major knowledge that led to separation of the active compounds from the recent past like morphine from opium, digitoxin, cocaine, codeine, and quinine. It is valuable to point out that a dozen of efficient expensive drugs discovered in the last 40 years are from the higher plants[5]. At this time, 25% of herbal medicines in latest pharmacopeia are plant based[6].

From ancient times, people have been relying on 'Mother Nature' for basic needs. Diversity around them always fascinates them[7]. All over the World, 80% of the human population still depends on plant resources for the cure of diseases and health problems and this knowledge is inherited generation after generations[8]. The main reason might be poverty and lack of access to modern medicines[9,10]. The natural chemical compounds of plants are screened and isolated in laboratories for the purpose of medicines and discovery of new medicines[7]. In Pakistan, total 6000 wild plants have been reported, out of these, 600 plants are used for medical purposes[11].

Pakistan is the region that falls in temperate zone where four types of seasons exist due to geographic and climatic condition. It has rich floral diversity especially in northern part. Majority of people in Pakistan depend upon medicinal plants for the

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purpose of cure and healing wounds for their minor and in some major diseases[12]. This is the first ever report on ethnobotany of Kiwai which is located in northern areas of Pakistan and is union council of Tehsil Balakot, District Mansehra, KPK. The area is mountainous region, having high altitude and rich in floral diversity. Local people have been utilizing native plants for variety of purposes over many generations.

In this study an attempt has been made to explore floristic diversity of the study area, document the medicinal importance of plants and also the quantification of the local wisdom through statistical indices.

Materials and Methods

Study area

Geography

Study area Kiwai is located in northern part of Pakistan. The study area is mountainous and hilly with high altitude.Kaghan Valley is located between latitudes 34°-14 ' and 35°-11 ' N and longitudes 72°-49 ' to 74°-08' E. Climatically, the study area falls in these environmental zones: Sub-tropical Chir-Pine, moist temperate, dry temperate, sub alpine birch forest, alpine and snow-covered peaks. The highest peaks of the valley are Malika Parbat (5,291m), Musa Ka Musalla (4,046 m) and Makra Top (3,885 m)[15].

Climate

The climate of study area is moderate in summer and severe in winter. There is significant precipitation during the year. Still the driest month has plenty of precipitation in the form of rainfall. The average yearly temperature is 12.6° ^{0}C. The average rainfall is 893 mm. The driest month is November. There is 21 mm of rainfall in November. A large amount of rainfall occurs in July, with an average of 126 mm. With an average of 21.5° ^{0}C, July is the hottest month. In January, the mean temperature is 1.8°C. It is the lowest standard temperature of the entire region[16].

Field surveys

Field surveys were done during January to July for data and specimens' collection. Total 200 informants were interviewed for data collection. Data were taken about local name of plants, habit, uses, part used, recipes and flowering period.

Plant material

Plant specimens were collected from field, identified, dried, pressed, poisoned, mounted on herbarium sheets, labelled and deposited in Herbarium of Botany Department of Government Post Graduate College, Mansehra.

Statistical indices for therapeutic usage

Relative Frequency Citation (RFC)

To assess the traditional uses and medicinal values of each species in the area, the Relative frequency of citations formula was.

$$RFCs = FCs/N$$

Where, FCs= No. of local informants who use the plant species traditionally and

N= Total Number of informants of the survey.

Consensus Index (CI %)

Percentage of indigenous informants regarding their traditional knowledge of plant species used for any specific purpose was calculated by Consensus Index (CI%)[17,18], Which indicates citation by percent of informants.

$$CI = \frac{n}{N} \times 100$$

Where n = number of informant citing medicinal plant species while

N = Total number of informants in the study.

Use Value (UVi)

Use value (UV) determines the relative importance on uses of plant species. It is calculated using the following formula:

$$UVi = \frac{\sum Ui}{Ni}$$

Where, "UV'' indicates use value of individual species, "U'' is the number of uses recoded for that species and "N'' represents the number of informants who reported that species.

Results

In present study total 110 plant species belonging to 98 genera and 48 families have been documented from different localities of Kiwai, Kaghan Valley, Mansehra (Fig. 1).

Habit

A total of 65 (59%) plant species were herbaceous, 34 (31%) species were trees while 11 (10%) were shrubby and thorny in nature (Fig. 1).

Floral diversity of plants of the study area.

Ninety three percent (93%) plants of the study area are Angiosperms, 5% Gymnosperms and 2% Pteridophytes (Fig. 2). Study revealed 81% plants were wild and 19% are cultivated in the study area

Family distribution

Total 53 families were reported from the study area (Fig. 3). The most encountered medicinal plant families were Asteraceae (10 species), Rosaceae (8 species), Fabaceaea and Lamiaceae (7 species each) while the rest of the families were with variable number of 4 or less species

Traditional uses of plants

Study also illustrate that inhabitants of Kiwai use these 110 plant species for their first aid, curing diseases, as vegetable, fruit, fuel, fodder and also for thatching, furniture making and construction purposes. Percentages of traditional uses of documented plants are mentioned in Figure 4. A detailed inventory about botanical names, local names, family, habit, part used, uses and locality is given in Table 1.

Most cured disease

Our study reported 85 diseases being cured by using local plants in the study area. According to informants' report, fever is the leading disease cured by 19 plant species.

Parts used

The most widely used parts were leaves (31%), seed (14%), fruits and whole plant (10%) (Fig. 5).

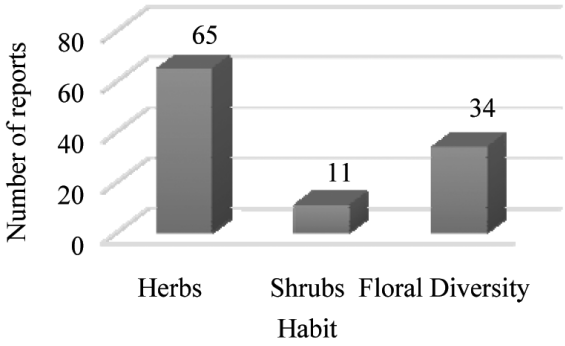

Fig. 1 — Habit of documented plants

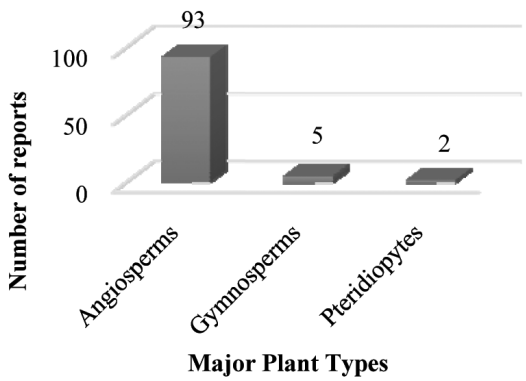

Fig. 2 — Major plant types reported from the study area

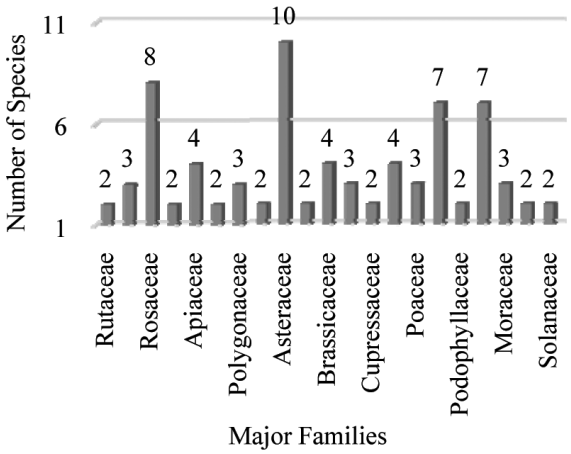

Fig. 3 — Major families of study area with number of reported species

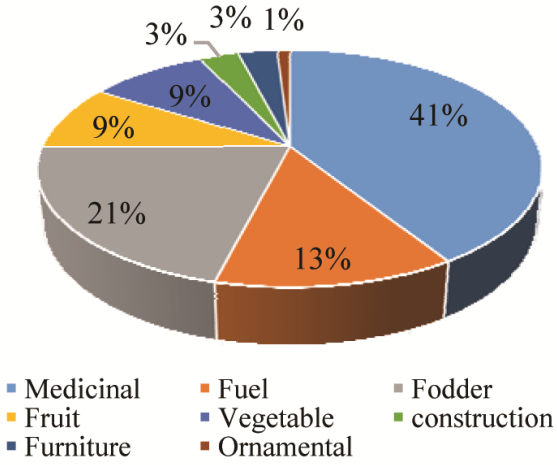

Fig. 4 — Uses of major plant types of the study area

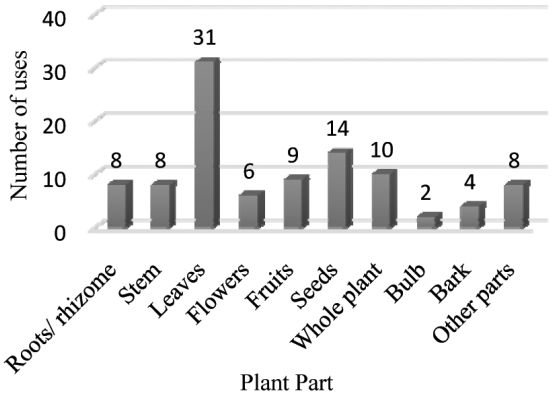

Fig. 5 — Percentage of plants parts used by local inhabitants

Table 1 — Documented plant species with their botanical names, local names, family, habit, part used and uses.

S. NO	Botanical Name	Local Name	Family	Habit	Parts Used	Uses
1	*Abies pindrow* Royle.	Kachal	Pinaceae	Tree	Shoots and leaves	Cough, asthma, chest infection, ornamental, furniture, fuel
2	*Acacia nilotica* Linn.	Kikar	Fabaceae	Tree	Leaves and stem	Digestion, construction, fuel wood and fodder
3	*Achillea millefolium* L.	Sultanibuti	Asteraceae	Herb	Leaves, stem and seeds	Wound healing, fever, headache, analgesic, salaad and chatni, fodder, tooth – picks
4	*Achyranthes aspera* L.	Phutkanda	Amaranthaceae	Herb	Leaves and roots	Cough, asthma
5	*Aconitum heterophyllum* Wall. Ex Royle	Patrees	Ranunculaceae	Herb	Bulb, root	Pulmonary diseases, abdominal pain, pneumonia, stomach disorder
6	*Adiantum capillus-veneris* L.	Kakwaa	Pteridiaceae	Herb	Whole plant	Burning of liver, Hepatitis, diuretic, Shine hairs, cough
7	*Aesculus indica* Wall. ex Camb.	Bana khor	Sapindaceae	Tree	Root Bark, seeds,leaves, stem	Migraine, Ulcer, Dysentery, Influenzas, fuel wood, furniture, fodder
8	*Ailanthus altissima* (Mill.) Swingle	Daravva	Simaroubaceae	Tree	Leaves and seeds	For flour making, fodder
9	*Ajuga bracteosa* L.	Kori booti	Lamiaceae	Herb	Roots and leaves	Fever, diarrhea, sore throat
10	*Allium cepa* L.	Piyaz	Amaryllidaceae	Herb	Leaves and bulb	For high blood pressure
11	*Allium sativum* L.	Thoom	Amaryllidaceae	Herb	Cloves, bulb	Condiment component, kidney, stomach, blood circulation
12	*Amaranthus viridis* L.	Chaleri/ Gunhaar	Amaranthaceae	Herb	Whole plant	Diarrhea, Dysentery, Fodder, vegetable
13	*Androsace rotundifolia* Hardwick in Asiat.	Golpattiphool	Primulaceae	Herb	Leaves and flowers	Menstrual problems, fodder
14	*Angelica glauca* Edgew.	Chora	Apiaceae	Herb	Roots and Rhizome	Stomach, gastric problems, to remove foul breath
15	*Arctium lappa*	Cheeron	Asteraceae	Herb	Roots	Vegetable
16	*Arisaema flavum* (Forsk.) Scott.	Sanpbooti/ soorganda	Araceae	Herb	Bulb, seeds	Asthma, Tonsils, tonic, fodder
17	*Artemisia absinthium* L.	Chaauu	Asteraceae	Herb	Leaves	Burning of liver, menstrual disorder, fodder
18	*Berberis lyceum* Royle.	Sumbal	Berberidaceae	Shrub	Root bark and leaves	Cancer, Wound healing, edema formation, intestinal colic, eye disease, throat infection, tooth ache, arthritis
19	*Bergenia ciliata* (Haw.) Sternb	But Pewa	Saxifragaceae	Herb	Rhizome, root and leaves	Stomach ulcer, Dysentery, Diuretic, Kidney stones, Periodic fever
20	*Bistorta amplexicaulis* D. Don Green	Masloonri	Polygonaceae	Herb	Rhizome and leaves	Tonic, dysentery, back ache, fever
21	*Brassica campestris* L.	Sarson	Brassicaceae	Herb	Seeds and leaves	Vegetable, fodder, leucorrhoea, menstrual disorder, body weakness
22	*Broussonetia papyrifera* (L.) L Herit ex Vent	Jangli Toot	Moraceae	Tree	Fruit and leaves	Edible fruit, diuretic, stimulant, stomach, tonic, laxative
23	*Bryonia alba* L.	Changarh	Cucurbitaceae	Herb	leaves, roots, flowers	Laxative, stomach problems, intestinal diseases, wound healing, arthritis, liver diseases
24	*Cannabis sativa* L.	Bhang	Cannabaceae	Herb	Leaves, stem, flowers	Pregnancy problems, stomach, Analgesic.

(Contd.)

Table 1 — Documented plant species with their botanical names, local names, family, habit, part used and uses. (Contd.)

S. NO	Botanical Name	Local Name	Family	Habit	Parts Used	Uses
25	*Capsella bursa-pastoris* L.	Dilwalibuti/ Chambaraka	Brassicaceae	Herb	Whole plant	Fodder, Wound healing
26	*Cedrus deodara* (Roxb. ex D. Don) G. Don	Diyaar	Pinaceae	Tree	Leaves, heart wood, Stem	Carminative, asthma, pulmonary disorder, antiseptic, Construction, Furniture, decoraton,fuel wood
27	*Celtis australis* L.	Butt kurl	Cannabaceae	Tree	Leaves and stem	Fodder and fuel wood
28	*Celtis* sp	Kandar	Cannabaceae	Tree	Flower	Burning of liver
29	*Chenopodium album* L.	Bathwaa	Amaranthaceae	Herb	Whole plant	Laxative, Anti helminthic, Toothache, blood purifier, fodder, vegetable
30	*Cichorium intybus* L.	Kasni	Asteraceae	Herb	Flower, stem and leaves	Fever, fodder
31	*Convulvulus arvensis* L.	Makaiiwali bill	Convulvulaceae	Herb	Leaves and flowers	Fodder, menstrual problem
32	*Coriandrum sativum* L.	Danhia	Apiaceae	Herb	Seeds and leaves	Stomach tonic and digestive disorder
33	*Crataegus monogyna* Jacq.	Sinjli/kala angoor	Rosaceae	Tree	Flower, fruits and leaves	Diabetes, cardiac problems, chest pain, irregular heartbeat
34	*Cuminum cyminum* L.	Zeera	Apiaceae	Herb	Seed	Condiments, flavoring agent, carminative
35	*Cupressus sempervirens* L.	Saru	Cupressaceae	Tree	Whole plant	Antimicrobial, cough, anti-helminthic, Fuel wood, aesthetic value
36	*Cynodon dactylon* (Linn) Pers.	Khabal	Poaceae	Herb	Whole plant	Wound healing, Diuretic, stop nose bleeding,Diarrhea, Fodder, Aesthetic Value
37	*Daphne mucronate* Royle.	Kutaylal	Thymelaeaceae	Shrub	Leaves and stem	Fuel wood, for making brooms, thatching
38	*Datura stramonium* L.	Datura	Solanaceae	Herb	Whole plant	Stomach, intestinal pain, dandruff, antibacterial, toothache, fever
39	*Diospyrus lotus* L.	Amlok	Ebenaceae	Tree	Fruit, stem	Constipation, influenzas, fruit, fuel wood
40	*Dryopteris serrato-dentata* (Bedd.) Hayatai	Kunji	Dryopteridaceae	Herb	Root and leaves	Fever and vegetable
41	*Eucalyptus globulus* Labill.	Gond	Myrtaceae	Tree	Stem and leaves	Diabetes, fuel wood
42	*Euphorbia heliscopia* L.	Dodal	Euphorbiaceae	Herb	Leaves, Stem, Latex	Cholera, skin eruption,abdominal pain, fodder
43	*Ficus carica* L.	Phugwari	Moraceae	Tree	Fruit, leaves and stem	Edible fruit, fuel wood, bronchitis, fodder, body weakness
44	*Foeniculum vulgare* Mill	Saunf	Apiaceae	Herb	Seeds and fruit	Fruit juice for eyesight improvement, oil is vermicide, condiments,abdominal pain, stomach
45	*Fragaria nubicola* Lindl.	Budhimewa	Rosaceae	Herb	Leaves, Fruit	Diarrhea, dysentery, sore throat, Fruit, Fodder
46	*Fraxinus excelsior* L.	Sum/ Aaroonch	Oleaceae	Tree	Stem	Fuel wood
47	*Galium aparine* L.	Khan mirch	Rubiaceae	Herb	Whole plant	Kidney stone, Urinary problem, fodder, cancer, vegetable
48	*Geranium wallichianum* L.	Ratan jog	Geraniaceae	Shrub	Roots, Leaves	Body aches, Backbone or back ache, arthritis, ureter inflammation, Fodder

(Contd.)

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S. NO	Botanical Name	Local Name	Family	Habit	Parts Used	Uses
49	*Hedera helix* L.	Bill	Araliaceae	Herb	Berries, leaves	Ornamental, cough, bronchitis, sore throat, skin problems
50	*Helianthus annuus* L.	Gul Muki/ SoorajMukhi	Asteraceae	Herb	Flower, seeds and leaves	Diuretic, pulmonary diseases, edible seeds and oil, malarial fever, dye
51	*Hypericum perforatum* L.	Jangli Patti	Hypericaceae	Herb	Leaves	Wounds healing, body pain, back ache, antibiotic
52	*Indigofera hebepetala* Bth.	Torki/ Kainthi	Fabaceae	Shrub	Stem, Root and leaves	Laxative, Diuretic, ulcer, skin diseases, fuel wood, Fodder
53	*Indigofera heterantha* Wall.ex. Brand	Kainthi	Fabaceae	Shrub	Whole plant	Wound healing, Jaundice, fodder, thatching
54	*Isodon rugosus* (Schrad. ex Benth.) Spach	Chittboota	Lamiaceae	Shrub	Leaves	Jaundice, Fodder, irritation and itching
55	*Juglans regia* L.	Khor	Juglandaceae	Tree	Leaves, bark, fruit	Fruit, cleaning teeth, mouth ulcer, improve memory, Furniture, Fuel wood
56	*Lonicera hispida* Pall.	Loonri	Caprifoliaceae	Tree	Whole plant	Antibacterial, antiallergic, rheumatism, Fuel wood, fodder, vegetable
57	*Malus domestica* Borkh	Saib	Rosaceae	Tree	Fruit and leaves	Nutritive, anemia, improve immune system, Fruit, fodder, fuel wood
58	*Malva neglecta* Wall.	Sonchal	Malvaceae	Herb	Whole plant	Hepatitis, headache, vegetable, fodder
59	*Melia azedarach* L.	Daraik	Meliaceae	Tree	Apical meristem, seeds oil	Diabetes, Skin diseases
60	*Mentha longifolia* L.	Janglipodina	Lamiaceae	Herb	Leaves and stem	Gas trouble, vomiting, condiments, beverages,Chatni, fever, Carminative
61	*Mentha spicata* L.	Podina	Lamiaceae	Herb	Whole plant	Stomachache, vomiting, chatni, condiments
62	*Morus alba* L.	Shiatoot	Moraceae	Tree	Fruit, bark, leaves and root	Vermifuge, sore throat, fuel wood, fodder, fruit
63	*Nasturtium officinale* R. Br.	Tara mera	Brassicaceae	Herb	Stem and leaves	Diuretic, stomach problems, vegetable
64	*Olea ferruginea* Royle.	Kahu/Zaitoon	Oleaceae	Tree	Leaves, fruit	Blood pressure, Improve blood circulation,Furniture wood, fuel wood, fodder
65	*Origanum vulgare* L.	Panday koochni/patti	Lamiaceae	Herb	Leaves	Body pain, arthritis, throat infection, flavoring agent, antibacterial, skin problems, infections, analgesic
66	*Oxalis corniculata* L.	Khatkurla/khatla	Oxalidaceae	Herb	Whole plant	Wound healing, jaundice, dysentery, anemia, stomach disorders, fodder, vegetable
67	*Paeonia emodi* Wall. Ex HK.	Mamaikh	Paeoniaceae	Herb	Roots	Back ache, epilepsy, Dysentery, body aches, arthritis, weakness, arthritis
68	*Parthenium hysterophorus* L.	Gandibooti	Asteraceae	Herb	Whole plant	Green manure, diarrhea, urinary tract infection, malaria, weed
69	*Phaseolus vulgaris* L.	Lobia/Moth	Fabaceae	Herb	Seeds and leaves	Anemia, diabetes, nutritive, reduce fat/ obesity

(Contd.)

Table 1 — Documented plant species with their botanical names, local names, family, habit, part used and uses. (Contd.)

S. NO	Botanical Name	Local Name	Family	Habit	Parts Used	Uses
70	*Pinus roxburghii* Sarg.	Chir	Pinaceae	Tree	Resin, leaves and Cone	Diuretic, stimulant, stomach aches, facial acne, Cough, vermifuge, remove unwanted hairs from body, construction and fuel wood
71	*Pinus wallichiana* A.B. Jackson	Biyaar	Pinaceae	Tree	Stem	Construction, furniture, fuel
72	*Pisum sativum* L.	Matar	Fabaceae	Herb	Seeds and leaves	Vegetable
73	*Plantago lanceolata* L.	Chamchpatra	Plantaginaceae	Herb	Leaves and seeds	Wound healing, on burns, Vermifuge, vegetable
74	*Plantago major* L.	Tarypatroo	Plantaginaceae	Herb	Whole plant	Jaundice, wound healing
75	*Platanus orientalis* L.	Chinar	Platanaceae	Tree	Whole plant	Abdominal pain, analgesic, Ornamental, Construction, furniture, dye,
76	*Plectranthus rugosus* Wall ex Benth	Peemar	Lamiaceae	Herb	Leaves	Fever, diabetes
77	*Podophyllum emodi* Wall.	Ban Khakrii	Podophyllaceae	Herb	Rhizome and seeds	Anti-helminthic, purgative, liver, fodder, fruit
78	*Podophyllum hexandrum*	Ban Khakrii	Podophyllaceae	Herb	Rhizome, seed and fruit	Anti-helminthic, purgative, jaundice, liver, tonic, fruit
79	*Populus ciliata* L.	Safaida	Salicaceae	Tree	Stem	Fuel wood
80	*Prunus armeniaca* L.	Khubani/Haari	Rosaceae	Tree	Seeds and fruit	Improve brain memory, blood clotting, fruit
81	*Prunus domestica* L.	Aaloocha	Rosaceae	Tree	Leaves and fruit	Pulmonary disease, jaundice, constipation, improve circulation system, edible fruit
82	*Prunus persica* (L) Batsch	Aaruu	Rosaceae	Tree	Apical meristem, Fruit	Pulmonary diseases, carminative, fruit
83	*Pyrus communis* L.	Batang	Rosaceae	Tree	Fruit	Constipation, fruit, Maintain blood pressure, fodder, agriculture tools and fuel wood
84	*Pyrus pashia* Ham. ExD. Don.	Batangi	Rosaceae	Tree	Fruit, leaves and stem	Abdomen pain, laxative, diarrhea, tonic, edible fruit,fuel wood
85	*Quercus baloot* Griffith.	Reen/Shah baloot	Fagaceae	Tree	Bark, galls and stem	Sore throat, tonsils, skin problems, construction, fuel wood, fodder
86	*Ranunculus muricatus* L.	Makhanbooti	Ranunculaceae	Herb	Whole plant	Fever, asthma
87	*Raphanus sativus* L.	Mooli	Brassicaceae	Herb	Whole plant	Diarrhea, diuretic, abdominal bloating, carminative, vegetable
88	*Rheum austral* D. Don.	Chatiyal	Polygonaceae	Herb	Rhizome and leaves	Rheumatism, arthritis, kidney stone, wound healing, stomach, ulcer
89	*Robinia pseudo-acacia* L.	Kikar/ Behashtidarakht	Fabaceae	Tree	Stems and leaves	Fuel wood, fodder
90	*Rumex dentatus* L.	Hola	Polygonaceae	Herb	Leaves and roots	Burning of liver, constipation, vegetable, reduce itching cause by *Urtica* sp., Abdominal pain of animals, fodder, Condiments.
91	*Salix nigra* Marshall	Bees	Salicaceae	Tree	Stem, leaves, bark	Purgative, fodder, wound healing, fuel wood, fever, diarrhea

(Contd.)

Table 1 — Documented plant species with their botanical names, local names, family, habit, part used and uses. (Contd.)

S. NO	Botanical Name	Local Name	Family	Habit	Parts Used	Uses
92	*Saussurea lappa* (Dcne.) C.B. Clarke.	Kuth	Asteraceae	Herb	Roots	Ulcer, asthma, Dysentery, cholera, fever, pneumonia
93	*Silybum marianum* Gaertn.	Oonthkathara/ kandiari	Asteraceae	Shrub	Roots and leaves	Liver diseases, cancer, Hepatitis, vegetable
94	*Skimmia laureola* (DC.) Osbeck	Nera	Rutaceae	Shrub	Leaves	Evils repel, small pox, insect repellent
95	*Solanum nigrum* L.	Kachmach	Solanaceae	Herb	Fruit, leaves	Diarrhea, dysentery, vegetable, edible fruit, fodder
96	*Solanum tuberosum* L.	Aalu	Solanaceae	Herb	Leaves and Tuber	Diuretic, sedative, antispasmodic, nutritive, vegetable, fodder
97	*Sonchus asper* (L.) Hill.	Hand	Asteraceae	Herb	Stem and flowers	Diuretic, jaundice, constipation
98	*Taraxacum officinale* Weber ex .Wigger	Hand	Asteraceae	Herb	Root and leaves	Diabetes mellitus, kidney disorder, tuberculosis, ulcer, constipation, fever and skin diseases
99	*Thuja orientalis* L.	Challai	Cupressaceae	Tree	Leaves, root bark, stem	Excessive menses, burning of skin, cough, dysentery, burns, skin diseases, evil repellent
100	*Thymus serpyllum* L.	Ban jumainriin	Lamiaceae	Herb	Whole plant	Influenza, fever, throat infection
101	*Trifolium repens* L.	Shattal	Fabaceae	Herb	Leaves	Vermifuge, Vegetable, fodder
102	*Triticum aestivum* L.	Karank/ Gandam	Poaceae	Herb	Whole plant	Flour, nutritive, sore throat
103	*Urtica dioica* L.	Carry	Urticaceae	Herb	Whole plant	Fever, Fracture, Vegetable, fodder
104	*Valeriana jatamansi* (Jones ex runb) DC	Mushakbala	Velerianaceae	Herb	Whole plant	Diabetes, Blood pressure, Pulmonary diseases, sedative, fodder, fever
105	*Verbascum thapsus* L.	Gady-kan/ Jangli Tambaku	Scrophulariaceae	Herb	Leaves and flowers	Stimulant, wound healing, skin problems
106	*Viburnum cotinifolium* Wall. ex DC., Prodr	Guch	Adoxaceae	Shrub	Fruit, leaves, stem, bark, seeds	Body pains, anemia, fruit, fuel wood
107	*Viola odorata* L.	Banafsha	Violaceae	Herb	Whole plant	Diuretic, purgative, fodder, cough, sore throat
108	*Zanthoxylum armatum* DC.	Timber	Rutaceae	Shrub	Stem, bark, seeds and leaves	Tooth ache, stomach pain,fever, condiments, carminative, maswaak, walking stick, sore throat
109	*Zea mays* L.	Makaii	Poaceae	Shrub	Leaves, grains and hair of fruit	Abdominal pain, liver and bladder disorder, tonic,sugar, fodder
110	*Ziziphus jujuba* L.	Ber	Rhamnaceae	Tree	Fruit	Cough, fever, horse throat, edible fruit

Data on quantitative ethno-medicinal uses

Quantitative value indices were calculated in this study to analyze the ethno-medicinal information (Table 2).

Relative Frequency Citation (RFC)

Bergenia ciliata has highest RFC value (0.105) followed by *Silybum marianum* (0.1), *Valeriana jatamansi* (0.095) and *Saussurea lappa* (0.09) (Fig.6).

Use Value (UV)

Maximum use value was recorded for Pinus roxburghii (0.045), while Berberis lyceum, Cedrus deodar, Origanum vulgare, Paeonia emodi and Zanthoxylum armatum shared the second place (0.044) (Fig. 7).

A direct relation was observed between RFC and Use Value. In other words, the uses of a certain plant species rise with a rise in the sum of informants (Fig. 8).

Table 2 — Various quantitative analysis values for collected plant species

S.NO	Botanical Name	RFC	UV	CI%
1	*Abies pindrow* Royle.	0.045	0.03	4.5
2	*Acacia nilotica* Linn.	0.055	0.02	5.5
3	*Achillea millefolium* L.	0.005	0.035	0.5
4	*Achyranthes aspera* L.	0.02	0.01	2
5	*Aconitum heterophyllum* Wall.exRoyle	0.05	0.02	5
6	*Adiantum capillus-veneris* L.	0.035	0.025	3.5
7	*Aesculus indica* Wall. ex Camb.	0.015	0.035	1.5
8	*Ailanthus altissima* (Mill.) Swingle	0.015	0.01	1.5
9	*Ajuga bracteosa* L.	0.01	0.015	1
10	*Allium cepa* L.	0.055	0.02	5.5
11	*Allium sativum* L.	0.065	0.005	6.5
12	*Amaranthus viridis* L.	0.02	0.02	2
13	*Androsace rotundifolia* Hardwick in Asiat.	0.005	0.01	0.5
14	*Angelica glauca* Edgew.	0.03	0.015	3
15	*Arctium lappa*	0.01	0.005	1
16	*Arisaema flavum* (Forsk.) Scott.	0.025	0.02	2.5
17	*Artemisia absinthium* L.	0.015	0.015	1.5
18	*Berberis lyceum* Royle.	0.045	0.04	4.5
19	*Bergenia ciliata* (Haw.) Sternb	0.105	0.025	10.5
20	*Bistorta amplexicaulis* D.Don Green	0.015	0.02	1.5
21	*Brassica campestris* L.	0.015	0.025	1.5
22	*Broussonetia papyrifera* (L.) L Herit ex Vent	0.01	0.03	1
23	*Bryonia alba* L.	0.005	0.03	0.5
24	*Cannabis sativa* L.	0.02	0.015	2
25	*Capsella bursa-pastoris* L.	0.02	0.01	2
26	*Cedrus deodara* (Roxb. ex D. Don) G.Don	0.03	0.04	3
27	*Celtis australis* L.	0.015	0.01	1.5
28	*Celtis* sp	0.005	0.005	0.5
29	*Chenopodium album* L.	0.015	0.03	1.5
30	*Cichorium intybus* L.	0.015	0.01	1.5
31	*Convulvulus arvensis* L.	0.025	0.01	2.5
32	*Coriandrum sativum* L.	0.02	0.01	2
33	*Crataegus monogyna* Jacq.	0.01	0.02	1
34	*Cuminum cyminum* L.	0.03	0.015	3
35	*Cupressus sempervirens* L.	0.02	0.025	2
36	*Cynodon dactylon* (Linn) Pers.	0.03	0.03	3
37	*Daphne mucronate* Royle.	0.02	0.015	2
38	*Daturastramonium* L.	0.01	0.03	1
39	*Diospyrus lotus* L.	0.015	0.02	1.5
40	*Dryopteris serrato-dentata* (Bedd.)Hayatai	0.015	0.01	1.5
41	*Eucalyptus globulus* Labill.	0.015	0.01	1.5
42	*Euphorbia heliscopia* L.	0.02	0.02	2
43	*Ficus carica* L.	0.035	0.025	3.5
44	*Foeniculum vulgare* Mill	0.04	0.025	4
45	*Fragaria nubicola* Lindl.	0.015	0.025	1.5
46	*Fraxinus excelsior* L.	0.01	0.005	1
47	*Galium aparine* L.	0.01	0.025	1
48	*Geranium wallichianum* L.	0.015	0.025	1.5
49	*Hedera helix* L.	0.005	0.025	0.5
50	*Helianthus annuus* L.	0.005	0.025	0.5
51	*Hypericum perforatum* L.	0.01	0.02	1
52	*Indigofera hebepetala* Bth.	0.005	0.03	0.5
53	*Indigofera heterantha* Wall.ex. Brand	0.01	0.02	1
54	*Isodon rugosus* (Schrad. ex Benth.) Spach	0.045	0.02	4.5
55	*Juglans regia* L.	0.03	0.03	3
56	*Lonicera hispida* Pall.	0.01	0.03	1
57	*Malus domestica* Borkh	0.025	0.03	2.5

(Contd.)

Table 2 — Various quantitative analysis values for collected plant species (Contd.)

S.NO	Botanical Name	RFC	UV	CI%
58	*Malva neglecta* Wall.	0.015	0.02	1.5
59	*Melia azedarach* L.	0.025	0.01	2.5
60	*Mentha longifolia* L.	0.015	0.035	1.5
61	*Mentha spicata* L.	0.025	0.02	2.5
62	*Morus alba* L.	0.02	0.025	2
63	*Nasturtium officinale* R. Br.	0.015	0.015	1.5
64	*Olea ferruginea* Royle.	0.035	0.025	3.5
65	*Origanum vulgare* L.	0.005	0.04	0.5
66	*Oxalis corniculata* L.	0.02	0.035	2
67	*Paeonia emodi* Wall.Ex HK.	0.075	0.04	7.5
68	*Parthenium hysterophorus* L.	0.015	0.025	1.5
69	*Phaseolusvulgaris* L.	0.015	0.02	1.5
70	*Pinus roxburghii* Sarg.	0.03	0.045	3
71	*Pinus wallichiana* A.B. Jackson	0.035	0.015	3.5
72	*Pisum sativum* L.	0.02	0.01	2
73	*Plantago lanceolata* L.	0.03	0.02	3
74	*Plantago major* L.	0.04	0.01	4
75	*Platanus orientalis* L.	0.035	0.03	3.5
76	*Plectranthus rugosus* Wall ex Benth	0.02	0.01	2
77	*Podophyllum emodi* Wall.	0.035	0.025	3.5
78	*Podophyllum hexandrum*	0.02	0.03	2
79	*Populus ciliata* L.	0.035	0.005	3.5
80	*Prunus armeniaca* L.	0.045	0.015	4.5
81	*Prunus domestica* L.	0.035	0.025	3.5
82	*Prunus persica* (L.)Batsch	0.04	0.015	4
83	*Pyrus communis* L.	0.025	0.025	2.5
84	*Pyrus pashia* Ham.ExD.Don.	0.03	0.03	3
85	*Quercus baloot* Griffith.	0.015	0.03	1.5
86	*Ranunculus muricatus* L.	0.02	0.01	2
87	*Raphanus sativus* L.	0.015	0.025	1.5
88	*Rheum australe* D.Don.	0.085	0.03	8.5
89	*Robinia pseudoacacia* L.	0.015	0.015	1.5
90	*Rumex dentatus* L.	0.06	0.035	6
91	*Salix nigra* Marshall	0.02	0.03	2
92	*Saussurea lappa* (Dcne.) C.B. Clarke.	0.09	0.03	9
93	*Silybum marianum* Gaertn.	0.1	0.02	10
94	*Skimmia laureola* (DC.) Osbeck	0.02	0.015	2
95	*Solanum nigrum* L.	0.02	0.025	2
96	*Solanum tuberosum* L.	0.015	0.03	1.5
97	*Sonchus asper* (L.) Hill.	0.01	0.015	1
98	*Taraxacum officinale* Weber ex .Wigger	0.03	0.035	3
99	*Thuja orientalis* L.	0.02	0.035	2
100	*Thymus serpyllum* L.	0.005	0.015	0.5
101	*Trifolium repens* L.	0.035	0.015	3.5
102	*Triticum aestivum* L.	0.04	0.015	4
103	*Urtica dioica* L.	0.075	0.02	7.5
104	*Valeriana jatamansi* (Jones ex runb) DC	0.095	0.03	9.5
105	*Verbascum thapsus* L.	0.015	0.015	1.5
106	*Viburnum cotinifolium* Wall. ex DC., Prodr	0.035	0.02	3.5
107	*Viola odorata* L.	0.015	0.025	1.5
108	*Zanthoxylum armatum* DC.	0.04	0.04	4
109	*Zea mays* L.	0.03	0.025	3
110	*Ziziphus jujuba* L.	0.04	0.02	4

Consensus Index

Maximum CI (Fig. 9) was observed in *Bergenia ciliata* (10.5) followed by *Silybum marianum* and *Valeriana jatamansi* (10).

Discussion

Plants have been utilized by people from ancient times for different purposes such as preparing traditional remedies for various ailments, fodder for

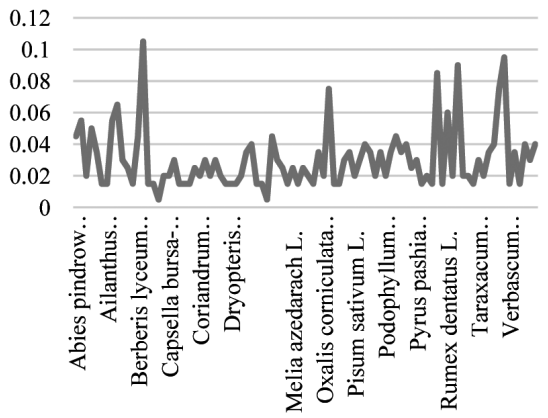

Fig. 6 — Plant species with highest Relative Frequency of Citation (RFC)

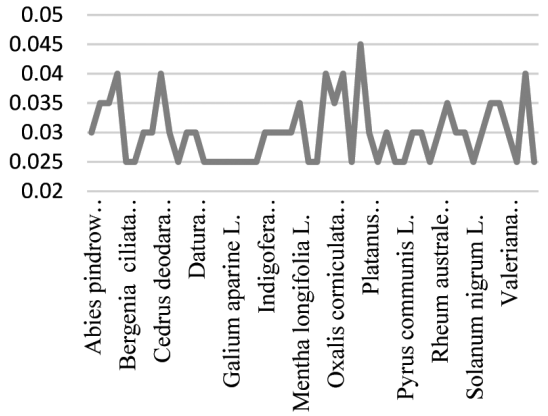

Fig. 7 — Plant species with Highest Use Value (UV)

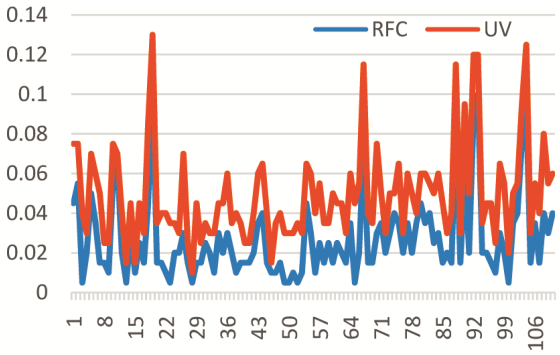

Fig. 8 — Relation between RFCs and UVs

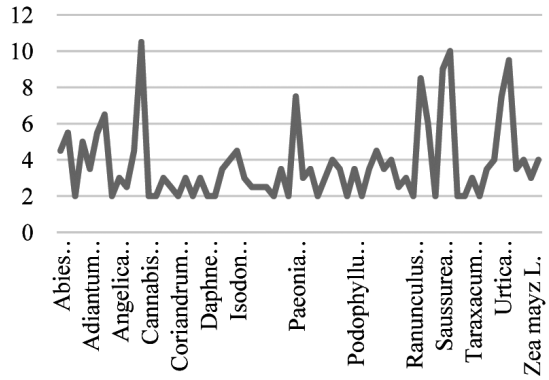

Fig. 9 — Plant species with Highest CI

livestock and construction[19]. Ethnobotany is considered as potentially the most authoritative approach to study plants as natural assets and their administration by local people. Other than documenting medicinal uses of local plants, ethnobotanical knowledge helps taxonomists, ecologists, pharmacologists, wildlife managers and conservation organizationsin their efforts for improving the wealth of area[20].

Local people of an area have unique wisdom and understanding about the consumption of plants. As they are easily available and affordable as compared to costly pharmaceuticals, rural people rely on local medicinal plants for treating their ailments they prefer medicinal plants[21].

In this study, an attempt has been made to explore the floristic diversity of Kiwai, tehsil Balakot, district Mansehra, by documenting the medicinal importance of plants and the quantification of the local wisdom through statistical indices. Climatically, the study area falls in these environmental zones: Sub-tropical Chir-Pine, moist temperate, dry temperate, sub alpine birch forest, alpine and snow-covered peaks[15].

A total of 110 plant species were reported in this study being used by inhabitants of Kiwai, belonging to 98 genera and 53 families for medicines, construction and economic purposes. Our findings are in close agreement with various other researchers conducted in different part of Pakistan[15]. They documented 102 important plant species of 61 families and 93 genera from Kaghan Valley along with their botanical name, local name, part used and economic uses. The plants were used commonly as fuel wood, fodder, medicinal, edible, shelter making, vegetables, furniture and construction wood.

In the present study, reported plant species were commonly used for curing different diseases like ulcer, diabetes, gas, diarrhea, constipation, indigestion, cancer, burning of liver. A total of 56 plant species were documented from Kaghan Valley being used by local inhabitants for the cure of gas trouble, constipation, ulcer, indigestion, stomach burn, diarrhea, nausea, hemorrhoids. Major plant species were *Achillia millifolium, Thymus serpyllum, Carthamus oxycantha, Paeonia emodii, Aconitum heterophyllum, Dioscorea bulbifera, Plantago sp,*

Punica granatum, Viola odorata, Fraxinus excelsior, Artemisia absinthium and *Berberis lyceum*[22].

In this study, leaves were found to be the widely used part of the plant for medicinal purposes followed by seeds, fruits and whole plant. The same findings have been reported from district Rawalakot (Azad Jammu and Kashmir), Lower Kurram (Kurram Agency) and Swat Valley[19,23,24,]. Herbaceous flora was dominating the vegetation in our study area as reported in other studies like Manoor valley and Poonch valley[7,25]. In the present study, Asteraceae was found to be the abundant family in the area. Similarly, from Malakand district, Sarban Hills and Tormik Valley, Karakoram range., family Asteraceae was reported as the leading family, with maximum number of medicinal plant species to cure diseases[25-27]. Likewise, traditional uses of many plants were found to be in concord with other studies. Such as the dried parts of *Berberis lyceum* is used for wound healing also reported from northern Pakistan[19], lower Kurram, Kurram Agency[20] and Chagharazai Valley, District Buner[19-21]. *Achyranthus aspera* recipe decoction is in accordance with the information of a study conducted in district Abbottabad[9].

In the present study, ethno-botanical data was analyzed through statistical analyses such as Use Value (UV), Relative Frequency Citation (RFC) and Consensus Index (CI%). A direct relation was observed between RFC and Use Value. In other words, the uses of a certain plant species rise with a rise in the sum of informants. Same results were reported in an ethnobotanical survey of District Charsadda, KP, Pakistan[28].

The ethnobotanical application of plants in the area is possibly due to the fact that this area is remote and people are poor, devoid of modern facilities so they rely on these plant species for fodder, fuel wood, construction wood, furniture, cure of diseases, and thatching. These people have unique ethnobotanical wisdom. Similarly, geographic barriers make the area culturally more reserved.

Conclusion

This study is the pioneer in the establishment of an inventory of plant resources from union council Kiwai, District Mansehra. The area is rich in flora, having an enormous number of plant species used for medicinal, constructive and economic purposes. Around 200 informants were interviewed about the local use of each plant species. Fever is the leading disease of the study area followed by stomach disorders, wound infection and throat infection. The data were quantitatively analyzed through Relative Frequency Citations (RFCs), Consensus Index (CI%) and the Use Value (UVi). RFCs is highest of *Bergenia ciliata* (0.105) following by *Silybum marianum* (0.1) and *Valeriana jatamansi* (0.095). CI% results revealed that most respondent percentage was for *Bergenia ciliate* that is 10.5 followed by *Silybum marianum having* 10 CI% and *Valeriana jatamansi* with 9.5 CI%. The plants with most UVi were *Pinus roxburghii* having 0.045 while *Berberis lyceum*, *Cedrus deodaraa*, *Origanum vulgare*, *Paeonia emodi* and *Zanthoxylum armatum* having 0.04 UVi. Our study also concludes that study area is rich in flora, useful for medicinal as well other purposes like fruit, vegetable, construction, furniture and fodder for cattle.

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Conflict of Interests

Authors show no conflict of interest.

Author Contributions

A Akhtar: Field visits and manuscript preparation; AH Shah: Research planning and supervision; T Jabeen: Statistical analysis and manuscript review; K R Khan: Manuscript review; and M Farooq: Manuscript review.

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