# Ethnobotanical studies and conservation status of the medicinal flora of Bara Gali Forests, District Abbottabad, Pakistan

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## Research

## Abstract

*Background*: An ethnobotanical investigation was conducted in Bara Gali Forests, District Abbottabad, Pakistan, during different seasons of the year 2018. The study area entertaining rich biodiversity and traditional knowledge on medicinal plants, remain understudied, prompting this investigation to document ethnobotanical uses, assess conservation status, and bridge the knowledge gap on the region's unexplored medicinal flora.

*Methods*: This ethnobotanical survey was conducted by using semi-structured interviews, questionnaire surveys, and field observations. A total of 120 local informants of different age groups and genders representing farmers, herbalists, and traditional healers were selected through purposive sampling. Ethnobotanical indices such as Use Value (UV) and Relative Frequency of Citation (RFC) were used to evaluate the ethnobotanical data.

*Results*: A total of 132 Plant species belonging to 109 genera and 62 families were collected from the research area. Out of 132 species 87 genera and 109 species were dicotyledons followed by, 13 species of Monocotyledons, 6 species of Pteridophytes and 5 species of Gymnosperms. Maximum genera and species in case of dicots were recorded in family Asteraceae *i.e.,* 11 species. Regarding the plant parts used in herbal remedies, leaves were the predominant part with 40 species. The IUCN standard categories revealed that 52 species fell under the category of least concern (LC), 77 species were not evaluated (NE), and 3 species were classified as endangered (EN). To establish their indigenous or exotic status, various

floras of the world and the flora of Pakistan were consulted. The findings indicated that 115 species were indigenous, while 17 species were identified as exotic.

*Conclusions*: The region boasts a significant diversity of medicinal plants; however, their abundance has been significantly diminished due to unsustainable utilization and overexploitation.

*Keywords*: Diversity, Ethnobotany, Conservation studies, Vascular plants, Abbottabad, Bara Gali Forests.

## Background

Medicinal plants have been used for centuries in traditional medicine, particularly in rural areas of Pakistan. The Bara Gali Forests in District Abbottabad, Pakistan, are renowned for their rich biodiversity and cultural significance. Local communities rely heavily on these plants for healthcare, but this knowledge is largely undocumented. Despite the importance of medicinal plants in the region, there is a significant lack of systematic documentation and analysis of traditional knowledge regarding their uses, conservation status, and cultural significance. Existing studies focus primarily on individual plant species or limited geographical areas, leaving a substantial knowledge gap.

In Pakistan about 84% of people in were dependent on traditional herbal medicines in early 1950's but currently this practice is delimited to rural areas only. Medicinal plants are getting a countless prominence and acceptance in the contemporary world today. These traditional herbal medicines are thought to be harmless and have less side effects as paralleled to synthetic medicines. The plant-based medicines are also rich in vitamins and minerals apart from their medicinal ingredients. The worth of plants as a food and traditional medications against many ailments such as diarrhea, Bronchitis, fever, hepatitis, etc. has been recognized through a number of ethnobotanical studies all over the world. The use of such plants not only satisfy the nutrients requirement but has also certain health benefits counter to lifelong diseases such as stroke, heart diseases and certain kinds of cancer (Ibrahim *et al.* 2023b).

Human beings are dependent on medicines secondary to food. Traditional procedures of phytomedicines are used for a long time around the world particularly in advanced countries. Unluckily contemporary medications speedily substituting the old practices associated with numerous cultures around the world. However, still 80% population of the world depends on the traditional system of healthcare. Large populations of developing countries rely on traditional medicine in this context. In Pakistan due to limited health care services, high cost, inaccessibility of allopathic medicines coupled with poverty, majority of the people rely on traditional uses of medicinal plants. About 700 plant species are used as medicinal and aromatic plants (Gul *et al.* 2016).

Plants not only offer us valuable biochemical but can also provide us vital dietetic body. Research studies have shown that Plants are natural factories for making important secondary metabolites or phytochemicals which are biologically active constituents. These phytochemicals are the key components of modern synthetic drugs and can lead to the synthesis of new drugs. These plants also have healing possessions and are used against certain ailments due to secondary metabolites or phytochemicals. These phytochemicals are used to defend human body against ailments (Ibrahim *et al.* 2023a).

The medicinal flora of Baragali forests is rich in biodiversity, but faces significant threats from over-harvesting and habitat loss, necessitating urgent conservation efforts. Baragali forests have a unique combination of plant species, including endemic or rare species, making it an important area for ethnobotanical research. Moreover, Baragali forests is more accessible for researchers with better infrastructure, roads, and logistics, making it easier to conduct fieldwork.

This study aims to bridge this knowledge gap by documenting and analyzing the ethnobotanical uses, conservation status, and cultural significance of medicinal plants in Bara Gali Forests.

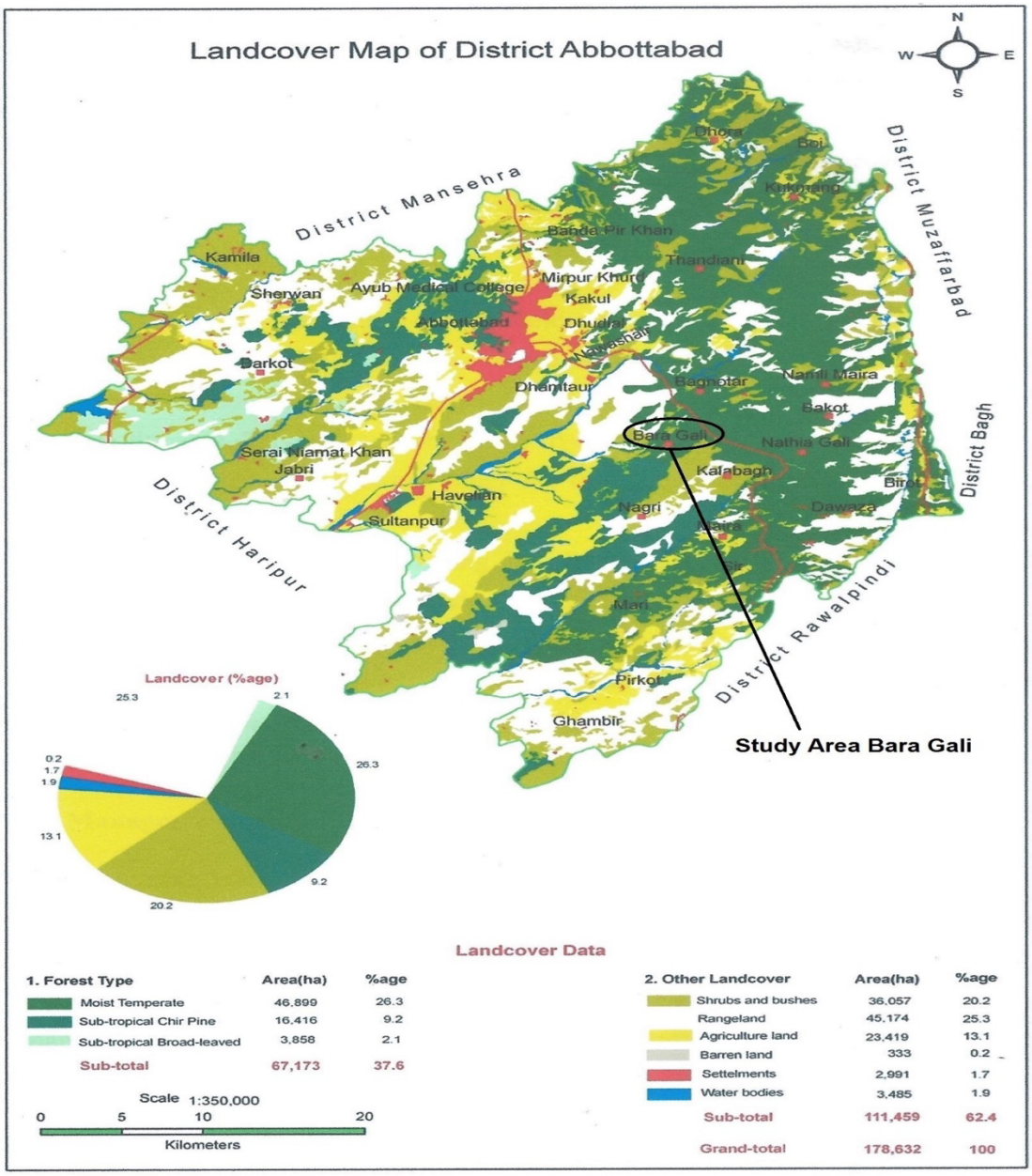
## Materials and Methods

### Study area

The Bara Gali Valley is located in the Galiyat region of District Abbottabad, perched at an elevation of 8000 feet. Positioned at 340 06/ N latitudes and 730 20/ E longitudes, Baragali experiences pleasant summers and cold, snowy winters. As per Champion's classification, the area falls under the moist temperate forest category. The minimum temperature in January averages -1.7°C, while the mean maximum reaches 32.41°C in June. Winter temperatures often drop below freezing point. The region is botanically rich, supporting a diverse range of species and habitats. Bragali Summer Campus, spanning 60 acres

along the main Nathiagali Murree road, is approximately 30 km from the main city of Abbottabad. The area is characterized by lush greenery, enveloped by dense forests, creating an exceptionally pleasant climate (Fig 1).

The Bara Gali Forests region in Abbottabad, Pakistan, supports varied agricultural activities, including wheat, maize, potato, and fruit cultivation, complemented by livestock farming and apiculture. The primary sources of water for these practices are rainfall, springs, streams, and irrigation canals. The local economy is largely driven by agriculture, with medicinal plants playing a important role, providing income through collection, traditional remedy preparation, and supply to pharmaceutical companies. The local dwellers rely on these activities for their livelihood.




Source: Pakistan Forest Institute Peshawar

Figure 1 Map of the study area Bara Gali Forests, District Abbottabad, Pakistan

**Field visits and plants collection**

This study employed a mixed-methods approach, by combining ethnobotanical surveys and semi-structured interviews with 120 local informants (farmers, herbalists, and traditional healers), Field observations and plant collection, Purposive sampling technique and the use of ethnobotanical indices such as Use Value, Frequency of Citation, Informant Consensus

Factor and Cultural Importance Index for data analysis. This comprehensive approach enables a thorough understanding of the medicinal plants' significance, conservation needs, and potential applications.

Field visits were arranged to various localities in the research area during. For trees and shrubs, branches or components were gathered, while entire herbs were collected, including both floral and vegetative parts. The data documentation was carried out on the spot and all the necessary information were noted. The collected specimens were arranged in alphabetic order and were grouped in respective families. For identification authentic sources were consulted using the previous documented floras including Polunin and Stainton (1990); Ali and Nasir (1989-1991); Stewart (1972); Nasir and Rafiq (1995); Nasir and Ali (1970-1989); Ali and Qaiser (1993-2017). Proper voucher specimens were prepared and submitted in the herbarium of Plant Biodiversity Center, University of Peshawar for future reference.

**Ethnobotanical data collection**

For collection of data related to the local uses of plants questionnaire were used. The questionnaire were translated from English language to the local languages of the informants. The four local languages spoken by the local people were Hindko, Pashto, Gojri and Pahari. The procedure was adopted like that of (Ullah, 2014; Ullah *et al.* 2023). The data were collected from 120 local informants including both men and women folk. The informants were classified into five age groups ranging between 25 to 70 years old. The approach to data collection involved the adoption of artifact and inventory methods, implementing ex-situ and in-situ sampling techniques in accordance with the methodology outlined by (Thomas and Shengji, 2003).

**Conservation status determination**

The assignment of conservation status to the plants in the study area was carried out using Version 8.1 of the IUCN guidelines (IUCN, 2010). This version was selected as it provides a standardized and widely recognized framework for assessing the conservation status of plant species, ensuring consistency and comparability with existing conservation assessments. The use of the specified version aligns with established practices within the field, promoting reliability and compatibility with broader conservation efforts. Conservation status was assessed using the IUCN Red List, supplemented by regional flora checklists, national conservation databases, and expert opinions to account for data gaps.

**Quantitative analysis**

The quantitative analysis of the data collected were carried out to find the validity of data. The two ethnobotanical indices such as Use value (UV) and Relative frequency citation (RFC) were determined by using the standard methods.

***Use value (UV)***

The UV index serves as a tool for assessing the relative significance of useful species, determined by the total number of reported uses per species. This index is indicative of the essential species within the local area. The approach of this index was analyzed by the below-given equation using the reference of (Lama *et al.* 2001)

$$\sum Ui/N=UV$$

“UV” representing the use values of individuals who had reported the use of plant, “Ui” is the number of the recorded use of particular plant taxa, and “N” is indicating the overall number of informants.

***Relative Frequency Citation (RFC)***

Relative Frequency Citation (RFC) is a metric used to assess the importance of a species within a specific context by calculating the ratio of the number of citations or mentions of that species to the total number of citations or mentions across sources or informants. This measure helps highlight the significance of a species within a given study or cultural setting. The index was calculated according to the equation of (Rehman *et al.* 2023a; Ayub *et al.* 2023):

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

FC" represents the number of reports by informants regarding the utilization of a specific taxon, while "N" denotes the total number of informants for a particular plant species.

## Results

**Family Importance value (FIV)**

***Pteridophytes (FIV)***

During the present research, 132 species belonging to 109 genera and 62 families were collected and identified. Out of 132 species, 6 species represented by 5 genera and 4 families were Pteridophytes. Maximum numbers of genera and species in Pteridophyte were represented by Adiantaceae i.e., 1 genus and 2 species then followed by, Dryopteridaceae, Equisetaceae and Pteridaceae having 1 genus and 1 species each (Table 1).

***Gymnosperm (FIV)***

The gymnosperms were represented by 5 genera and 5 species. The leading family was Pinaceae having 3 genera and 3 species followed by, Cupressaceae and Taxaceae represented by 1 genus and 1 species each (Table 1).

***Angiosperm (FIV)***

The monocotyledons were represented by 11 genera and 13 species belonging to 6 families. The maximum genera and species in monocotyledons were in Poaceae which have 6 genera and 6 species followed by Araceae 2 genera and 2 species. Alliaceae having 1 genus and 3 species the other two families Asparagaceae, Xanthorrhoeaceae were represented by 1 genus and 1 species each. Out of 132 species 87 genera and 109 species were dicotyledons belonging to 51 families. Maximum genera and species in case of dicots were recorded in Asteraceae i.e., 10 genera and 11 species of the total genera and species. Asteraceae was followed by Rosaceae 9 genera and 14 species , followed by Lamiaceae with 7 genera and 8 species while Apiaceae and Papilionaceae having 5 genera and 5 species each, then Polygonaceae with 4 genera and 6 species followed by Brassicaceae having 3 genera and 3 species . In dicot families Amaranthaceae, Papilionaceae, Ranunculaceae, Rutaceae, Ulmaceae and Verbenaceae were represented by 2 genera and 2 species each. The other families were represented by 1 genus and 2 (1.51%) species each are i.e., Ebenaceae, Fagaceae Geraniceae and Oleaceae. While Chenopodiaceae, Euphorbiaceae having 1 genus and 3 species each. The remaining families were represented by 1 genus and 1 species each including Acanthaceae, Berberidaceae, Boraginaceae, Buxaceae, Cactaceae, Cannabaceae, Campanulaceae, Caryophyllaceae, Celastraceae, Cornaceae, Cucurbitaceae, Cuscutaceae, Juglandaceae, Malvaceae, Mimosaceae, Myrtaceae, Oxalidaceae, Plantaginaceae, Phytolacaceae, Portulacaceae, Salicaceae, Saxifragaceae, Scrophulariaceae, Simaroubaceae, Thymeleaceae, Urticaceae, Valerianaceae, Vitaceae, Violaceae and Zygophyllaceae (Table 1).

**Diseases Treated**

The current research findings reveal that the residents of Baragali utilize a total of 91 distinct plant species for a variety of medicinal purposes. These applications include, but are not limited to, treating conditions such as diuretic effects (14 species), dysentery (8 species), anthelmintic properties (8 species), backache relief (8 species), astringent qualities (6 species), diarrhea management (6 species), stimulation (6 species), stomachic uses (6 species), laxative effects (5 species), carminative properties (4 species), cough remedy (4 species), asthma alleviation (4 species), relief from abdominal pain (3 species), allergy treatment (2 species), anti-acidic properties (2 species), antipyretic effects (2 species), aromatic uses (2 species), demulcent qualities (2 species), diaphoretic effects (2 species), emollient properties (2 species), improvement of eyesight (2 species), headache relief (2 species), jaundice treatment (2 species), emetic effects (1 species), epilepsy management (1 species), expectorant qualities (1 species), febrifuge effects (1 species), fever relief (1 species), hepatitis-A treatment (1 species), heart disease management (1 species), hypertension control (1 species), inflammation reduction (1 species), malaria treatment (1 species), menstruation regulation (1 species), relief from bone pain (1 species), management of cancer (1 species), cholera treatment (1 species), cold remedy (1 species), condiment uses (1 species), relief from constipation (1 species), cooling agent properties (1 species), cardiotonic effects (1 species), diabetes management (1 species), digestion improvement (1 species), sedative properties (1 species), treatment of skin diseases (1 species), relief from snake bites (1 species), toothache management (1 species), tumor treatment (1 species), vermifuge properties (1 species), and wound healing (1 species) (Table 1).

**Ethnobotanical Uses**

It was recorded during the present study that out of 132 species 79 genera and 88 species were used for fuel wood and 72 genera and 85 species were used for livestock grazing. For ornamental purposes 69 genera and 77 species were used and 25 genera and 28 species were used for timber wood. For furniture wood 14 genera and 19 species were used as represented in (Table 1).

Table 1. Botanical names, conservation status, and medicinal uses of the flora of Bara Gali, District Abbottabad, Pakistan

| Voucher No | Botanical Name | Family | Habit | Parts Used | Medicinal uses | Ethnobotanical uses | conservation status | UV | RFC |
|---|---|---|---|---|---|---|---|---|---|
| | **A. Pteridophytes** | | | | | | | | |
| S. Uddin 101 (CPB) | *Adiantum capillus-veneris* L. | Pteridaceae | H | **Fronds** | Expectorant, emollient, cough, diuretic and febrifuge. | L, O | Ind./LC | 0.34 | 0.13 |
| S. Uddin 102 (CPB) | *Adiantum incisum* L. | Pteridaceae | H | Fronds | Curing scorpion bites. | L, O | Ind./LC | 0.45 | 0.24 |
| S. Uddin 103 (CPB) | *Dryopteris ramosa* Hope. | Dryopteridaceae | H | Fronds | Diuretic, emetic, expectorant and curing scorpion bites. | F, L, O | Ind./NE | O.23 | 0.4 |
| S. Uddin 104 (CPB) | *Equisetum arvense* L. | Equisetaceae | H | Shoot | Hepatitis (A) tonic, fever, anti-acidic, diuretic and kidney stone. | L | Ind./LC | 0.35 | 0.35 |
| S. Uddin 105 (CPB) | *Pteris cretica* L. | Pteridaceae | H | Leaves | - | F, L, O | Ind./LC | 0.48 | 0.43 |
| S. Uddin 106 (CPB) | *Onychium japonicum* Thunb. | Pteridaceae | H | Whole plant | - | F, L, O | Ind./EN | 0.66 | 0.2 |
| | **B. Gymnosperms** | | | | | | | | |
| S. Uddin 107 (CPB) | *Juniperus communis* L. | Cupressaceae | T | Leaves | Bed bug repellent, carminative, skin disease and cancer. | F, Ti, Fr, O | E/LC | 0.56 | 0.34 |
| S. Uddin 108 (CPB) | *Abies pindrow* L. | Pinaceae | T | Oil | Astringent, diaphoretic, antiseptic, diuretic, leprosy, skin disease, ulcer and fever. | F, Ti, Fr, O | Ind./LC | 0.23 | 0.68 |
| S. Uddin 109 (CPB) | *Cedrus deodara* Roxb. ex D. Don. | Pinaceae | T | Bark | - | F, Ti, Fr, O | Ind./LC | 0.67 | 0.64 |
| S. Uddin 110 (CPB) | *Pinus wallichiana* A. B. Jacks. | Pinaceae | T | Whole | Diaphoretic, stimulant, asthma and cough. | F, Ti, Fr, O | Ind./LC | 0.45 | 0.78 |

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|---|---|---|---|---|---|---|---|---|---|
| S. Uddin 111 (CPB) | *Taxus fauna* Nan. Li & R. R. Mill. | Taxaceae | T | Fruit, wood | Blood purifier and facial acne. | F, Ti, Fr, O | Ind./EN | 0.72 | 0.43 |
| | **C. Angiosperms** | | | | | | | | |
| | **Monocot** | | | | | | | | |
| S. Uddin 112 (CPB) | *Allium cepa* L. | Amaryllidaceae | H | Bulb | Antiseptic and stimulant. | F, O | Ind./NE | 0.71 | 0.23 |
| S. Uddin 113 (CPB) | *Allium sativum* L. | Amaryllidaceae | H | Bulb | Diarrhea and in gastro intestinal diseases. | F, O | Ind./NE | 0.23 | 0.25 |
| S. Uddin 114 (CPB) | *Allium ascalonicum* L. | Amaryllidaceae | H | Bulb | Diaphoretic, expectorant, heart disease, hypertension and whooping cough. | F | Ind./NE | 0.94 | 0.43 |
| S. Uddin 115 (CPB) | *Acorus calamus* L. | Acoraceae | H | Rhizome | Dysentery, chronic diarrhea and rheumatism. | O | Ind./LC | 0.79 | 0.19 |
| S. Uddin 116 (CPB) | *Arisaema flavum* Forssk. Schott. | Araceae | H | Rhizome | Snake bites, scorpion sting, epilepsy, headache and expectorant sputum remedies. | – | Ind./NE | 0.19 | 0.37 |
| S. Uddin 117 (CPB) | *Polygonum multiflorum* L. | Polygonaceae | H | Leaves | - | L | Ind./NE | 0.92 | 0.12 |
| S. Uddin 118 (CPB) | *Cyperus rotundus* L. | Cyperaceae | H | Gel in leaves | Anthelmintic, diarrhea, menstruation, hair loss and vomiting. | L | E/LC | 0.89 | 0.52 |
| S. Uddin 119 (CPB) | *Arundo donax* L. | Poaceae | H | Leaves | - | F, L, O | Ind./LC | 0.45 | 0.34 |
| S. Uddin 120 (CPB) | *Bromus catharticus* Vahl. | Poaceae | H | Whole | - | F, L | Ind./NE | 0.23 | 0.68 |
| S. Uddin 121 (CPB) | *Cynodon dactylon* L. | Poaceae | H | Whole | Astringent, diuretic, tonic, dysentery, skin disease and refrigerant. | F, L | Ind./NE | 0.45 | 0.64 |
| S. Uddin 122 (CPB) | *Lolium temulentum* L. | Poaceae | H | Whole | - | F, L | Ind./LC | 0.67 | 0.78 |
| S. Uddin 123 (CPB) | *Piptatherum gracile* Benth. | Poaceae | H | Whole | - | F, L | Ind./NE | 0.37 | 0.43 |
| S. Uddin 124 (CPB) | *Poa annua* L. | Poaceae | H | Whole | - | F, L | Ind./LC | 0.5 | 0.05 |
| S. Uddin 125 (CPB) | *Alove vera* L. | Asphodelaceae | S | Gel | Asthma, carminative, cosmetics, piles, | O | Ind./NE | 0.46 | 0.39 |

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|---|---|---|---|---|---|---|---|---|---|
| | | | | | stomachic, sun burn and laxative | | | | |
| | **Dicots** | | | | | | | | |
| S. Uddin 126 (CPB) | *Adhatoda vesica* Nees. | Acanthaceae | S | Fruit | Intestinal worms and anthelmintic. | F, L, O | Ind./NE | 0.45 | 0.34 |
| S. Uddin 127 (CPB) | *Achyranthus aspera* L. | Amaranthaceae | H | Whole | Removing kidneys stone kidneys, diuretic, laxative and stomachic. | F, L | Ind./NE | 0.05 | 0.23 |
| S. Uddin 128 (CPB) | *Amaranthus viridis* L. | Amaranthaceae | H | Leaves | Emollient and anthelmintic. | _ | E/NE | 0.34 | 0.4 |
| S. Uddin 129 (CPB) | *Bonium persicum* Boiss. Fedtsch. | Apiaceae | H | Seeds | Carminative, stomachic, stimulant and vermifuge. | O | Ind./NE | 0.56 | 0.67 |
| S. Uddin 130 (CPB) | *Coriandrum sativum* L. | Apiaceae. | H | Leaves, Seeds | Emollient and anthelmintic. | O | E/NE | 0.6 | 0.70 |
| S. Uddin 131 (CPB) | *Foeniculum vulgare* Mill. | Apiaceae | H | Fruit, Leaves | Carminative, stimulant, diuretic and digestive. | O | E/LC | 0.7 | 0.53 |
| S. Uddin 132 (CPB) | *Trachyspermum ammi* L. | Apiaceae. | H | Seeds | Abdominal pain, indigestion and used for flu. | O | Ind./NE | 0.46 | 0.42 |
| S. Uddin 133 (CPB) | *Nerium indicum* Mill. | Apocynaceae, | H | Roots | - | Ti, Fr, O | Ind./NE | 0.46 | 0.35 |
| S. Uddin 134 (CPB) | *Hedera helix* Auct.non L. | Araliaceae, | T | Leaves | Stimulant, anthelmintic and diabetes. | Ti | E/LC | 0.7 | 0.65 |
| S. Uddin 135 (CPB) | *Anaphalis nepalensis* DC. | Asteraceae, | H | Whole | - | Ti | Ind./NE | 0.56 | 0.75 |
| S. Uddin 136 (CPB) | *Calendula arvensis* L. | Asteraceae | H | Leaves flower | Jaundice, toothache and stomachic. | O | E/NE | 0.57 | 0.63 |
| S. Uddin 137 (CPB) | *Calendula officinalis* L. | Asteraceae | H | Ligulae floret | Laxative and diuretic. | O | E/NE | 0.48 | 0.25 |
| S. Uddin 138 (CPB) | *Carduus edelbergii* L. | Asteraceae | H | Whole | - | O | E/NE | 0.2 | 0.76 |
| S. Uddin 139 (CPB) | *Conyza Canadensis* L. | Asteraceae | H | Leaves | - | L, O | Ind./NE | 0.79 | 0.55 |
| S. Uddin 140 (CPB) | *Helianthus annuus* L. | Asteraceae | S | Seeds | - | Ti | Ind./LC | 0.28 | 0.41 |
| S. Uddin 141 (CPB) | *Leucanthemum vulgare* Lam. | Asteraceae | H | Whole | Stimulant and blood purifier. | O | E/NE | 0.45 | 0.2 |
| S. Uddin 142 (CPB) | *Silybum marianum* L. | Asteraceae | H | Leaves | Laxative and diuretic. | O | Ind./LC | 0.68 | 0.24 |
| S. Uddin 143 (CPB) | *Sonchus asper* L. | Asteraceae | H | Milky latex | Stimulant, stomach disease and chest pain. | Ti | Ind./NE | 0.85 | 0.02 |

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|---|---|---|---|---|---|---|---|---|---|
| S. Uddin 144 (CPB) | *Taraxacum officinale* Webber. | Asteraceae | H | Flower, root | Diuretic, tonic, to cure jaundice and constipation. | _ | E/LC | 0.77 | 0.24 |
| S. Uddin 145 (CPB) | *Cichorium intybus* L. | Asteraceae | H | Whole plant | Tumors, purgative, diuretic tonic, mild laxative, kidney and liver disease. | Ti | E/LC | 0.71 | 0.31 |
| S. Uddin 146 (CPB) | *Berberis lycium* L. | Berberidaceae. | S | Root | Diuretic anti bilious, refrigerant, Stomachic, intestinal colic, expectorant, diarrhea. Internal wound, piles, jaundice and liver disorders. | F, L, Ti, O | Ind./NE | 0.67 | 0.51 |
| S. Uddin 147 (CPB) | *Cynoglossum glochidiatum* Wall.ex. Benth. | Boraginaceae | H | Whole plant | - | F, L, Ti, O | Ind./NE | 0.56 | 0.01 |
| S. Uddin 148 (CPB) | *Brassica campestris* L. | Brassicaceae | H | Seed | Cardio tonic and hair tonic. | F, L, O | Ind./NE | 0.59 | 0.4 |
| S. Uddin 149 (CPB) | *Brassica rapa* L. | Brassicaceae | H | Roots, leaves | Cardio tonic, hair tonic and massage. | F, L, O | Ind./NE | 0.67 | 0.54 |
| S. Uddin 150 (CPB) | *Capsella bursa-pastoris* L. | Brassicaceae | H | Leaves | Stimulant, diuretic, astringent and dropsy. | F, L, O | Ind./LC | 0.24 | 0.24 |
| S. Uddin 151 (CPB) | *Nasturtium officinale* R. Br. | Brassicaceae. | H | Leaves | Anticorbic, stomachic, appetizer, diuretic and chest problem. | F, L, O | Ind./LC | 0.21 | 0.3 |
| S. Uddin 152 (CPB) | *Sarcococca saligna* (D. Don.) Muell. | Buxaceae. | H | Seed | Diuretic, laxative, appetizer, diuretic and chest problem. | F, L, O | Ind./EN | 0.74 | 0.42 |
| S. Uddin 153 (CPB) | *Opuntia dillenii* Haw. | Cactaceae | H | Leaves, Fruits | Inflammation and purgative. | F, O | Ind./LC | 0.12 | 0.64 |
| S. Uddin 154 (CPB) | *Canabis sativa* L. | Cannabaceae | H | Flower in tops | Sedative, tonic, narcotic, anodyne and refrigerant. | F | Ind./EN | 0.76 | 0.65 |
| S. Uddin 155 (CPB) | *Campanula pallida* Wall. | Campanulaceae | H | Whole | - | F, L, O | Ind./EN | 0.63 | 0.70 |
| S. Uddin 156 (CPB) | *Silene vulgaris* L. | Caryophyllaceae | H | Fruits | - | F, L, O | Ind./LC | 0.36 | 0.3 |

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|---|---|---|---|---|---|---|---|---|---|
| | | | | leaves | | | | | |
| S. Uddin 157 (CPB) | *Gymnosporia royleana* Wall. ex. Lawson. | Celastraceae. | H | Roots | - | F, L | Ind./EN | 0.86 | 0.63 |
| S. Uddin 158 (CPB) | *Chenopodium album* L. | Amaranthaceae | H | Vegetive parts | Laxative, anthelmintic, jaundice and urinary problem. | F, L | Ind./EN | 0.23 | 0.74 |
| S. Uddin 159 (CPB) | *Chenopodium botrys* L. | Chenopodiaceae | H | Whole plant | Antiasthmatic | F, L | Ind./EN | 0.48 | 0.83 |
| S. Uddin 160 (CPB) | *Chenopodium murale* L. | Amaranthaceae | H | Roots | Diuretic, aphrodisiac, anthelmintic, abdominal pain, piles and sore eye | F, L | Ind./EN | 0.04 | 0.87 |
| S. Uddin 161 (CPB) | *Cornus macrophylla* L. | Amaranthaceae | H | Whole plant | - | F, L | Ind./LC | 0.67 | 0.6 |
| S. Uddin 162 (CPB) | *Cucumis sativus* L. | Cucurbitaceae | H | Fruit | Refrigerant | F, L, O | E/NE | 0.56 | 0.35 |
| S. Uddin 163 (CPB) | *Cuscuta reflexa* Roxb. | Convolvulaceae | H | Whole | Diuretic and anthelmintic. | F | E/NE | 0.48 | 0.85 |
| S. Uddin 164 (CPB) | *Diospyros kaki* L. | Ebenaceae | T | Fruit | Stimulate gastric activities and used in bone pain. | F, L, Ti, O | E/NE | 0.34 | 0.36 |
| S. Uddin 165 (CPB) | *Diospyros lotus* L. | Ebenaceae | T | Fruit | Chronic diarrhea, purgative, dysentery, carminative and blood disease. | F, L, Ti, O | Ind./LC | 0.68 | 0.53 |
| S. Uddin 166 (CPB) | *Euphorbia helioscopia* L. | Euphorbiaceae | H | Whole plant | Anthelmintic, constipation and cholera. | F, L, Tl, Fr, O | E/LC | 0.64 | 0.65 |
| S. Uddin 167 (CPB) | *Euphorbia hirta* L. | Euphorbiaceae | H | Latex | Wound healing and Aphrodisiac. | _- | E/LC | 0.73 | 0.76 |
| S. Uddin 168 (CPB) | *Euphorbia prostrata* L. | Euphorbiaceae | H | Whole plant | Skin disease. | F, L | E/LC | 0.43 | 0.35 |
| S. Uddin 169 (CPB) | *Desmodium elegans* DC. | Fabaceae | S | Wood | - | F, L, Tl, Fr, O | Ind./LC | 0.86 | 0.26 |
| S. Uddin 170 (CPB) | *Lespedeza juncea* L. | Fabaceae | S | Wood | - | F, L, Tl, Fr, O | Ind./NE | 0.65 | 0.84 |
| S. Uddin 171 (CPB) | *Trifolum repens* L. | Fabaceae | H | Roots | - | F, L, O | Ind./NE | 0.57 | 0.46 |
| S. Uddin 172 (CPB) | *Quercus dilatata* Lindle. ex. Royal. | Fagaceae | T | Roots | Astringent, diuretic, diarrhea, indigestion and asthma. | F, L, O | Ind./NE | 0.49 | 0.85 |

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|---|---|---|---|---|---|---|---|---|---|
| S. Uddin 173 (CPB) | *Quercus incana* Roxb. | Fagaceae | T | Nut, Bark | Astringent, diuretic, diarrhea, indigestion and asthma. | F, L, Tl, Fr, O | Ind./LC | 0.69 | 0.35 |
| S. Uddin 174 (CPB) | *Geranium lucidum* L. | Geraniaceae | H | Roots, leaves | - | F, L, O | Ind./NE | 0.91 | 0.64 |
| S. Uddin 175 (CPB) | *Geranium wallichianum* D. Don. | Geraniaceae | H | Roots leaves | Tonic and backache. | F, L, O | Ind./NE | 0.50 | 0.86 |
| S. Uddin 176 (CPB) | *Juglans regia* L. | Juglandaceae | T | Whole | Eczema and intestinal worms. | L | Ind./LC | 0.24 | 0.36 |
| S. Uddin 177 (CPB) | *Ajuga bracteosa* L. | Lamiaceae | H | Leaves | Astringent, tonic, diabetes and cough. | O | Ind./NE | 0.70 | 0.96 |
| S. Uddin 178 (CPB) | *Isodon rugosus* L. | Lamiaceae | H | Leaves | Sore throats | O | Ind./NE | 0.45 | 0.46 |
| S. Uddin 179 (CPB) | *Lamium album* L. | Lamiaceae | H | Root, leaves | - | F, L | Ind./LC | 0.76 | 0.79 |
| S. Uddin 180 (CPB) | *Mentha longifolia* L. | Lamiaceae | H | Whole | Stimulant, antiseptic and carminative. | L | Ind./LC | 0.46 | 0.60 |
| S. Uddin 181 (CPB) | *Mentha viridis* L. | Lamiaceae | H | Leaves | Refrigerant, diuretic and digestive. | F, L | Ind./LC | 0.46 | 0.35 |
| S. Uddin 182 (CPB) | *Origanum vulgare* L. | Lamiaceae | H | Leaves | Pain killer and cooling agent. | F, O | Ind./LC | 0.69 | 0.44 |
| S. Uddin 183 (CPB) | *Prunella vulgaris* L. | Lamiaceae | H | Flower | - | F, L, O | Ind./LC | 0.46 | 0.20 |
| S. Uddin 184 (CPB) | *Salvia moorcoftiana* Wall.ex Bth. | Lamiaceae | H | Leaves | Cold, cough, dysentery and wound. | F, L, Tl, Fr, O | Ind./NE | 0.76 | 0.30 |
| S. Uddin 185 (CPB) | *Malva neglecta* Wall. | Malvaceae | H | Flower | Dysentery and dry cough. | F, L, O | Ind./LC | 0.73 | 0.50 |
| S. Uddin 186 (CPB) | *Mirabilis jalapa* L. | Nyctaginaceae | H | Flower | Mature and boils. | F, L, O | E/NE | 0.56 | 0.3 |
| S. Uddin 187 (CPB) | *Myrtus communis* L. | Myrtaceae | S | Leaves | Antiseptic, anti-periodic and asthma. | F, L | Ind./LC | 0.87 | 0.10 |
| S. Uddin 188 (CPB) | *Jasminum humile* L. | Oleaceae | S | Flower | Decoction and ringworms. | F, L | Ind./NE | 0.45 | 0.09 |
| S. Uddin 189 (CPB) | *Jasminum officinale* L. | Oleaceae | S | Seed, flower | Diuretic, antiemetic, skin diseases, headache, mouth rash and nerve sedative. | F, L, Tl, Fr, O | Ind./NE | 0.68 | 0.62 |
| S. Uddin 190 (CPB) | *Oxalis corniculata* L. | Oxalidaceae | H | Whole plant | Refrigerant and antispasmodic. | F, L | Ind./NE | 0.46 | 0.23 |

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|---|---|---|---|---|---|---|---|---|---|
| S. Uddin 191 (CPB) | *Indigofera heterantha* Wall. ex. Brand. | Fabaceae | H | Leaves | Diuretic, carminative and abdominal pain. | F, L, O | Ind./NE | 0.70 | 0.53 |
| S. Uddin 192 (CPB) | *Robinia pseudoacacia* L. | Fabaceae | T | Bark, Roots | - | F, L, O | Ind./LC | 0.87 | 0.24 |
| S. Uddin 193 (CPB) | *Plantago lanceolata* L. | Plantaginaceae | H | Leaves | - | F, L | Ind./NE | 0.6 | 0.90 |
| S. Uddin 194 (CPB) | *Phytolacca latbenia* L. | Phytolaccaceae | H | Whole plant | - | F, L, O | Ind./NE | 0.45 | 0.40 |
| S. Uddin 195 (CPB) | *Bistorta amplexicaulis* D. Don. | Polygonaceae | H | Leaves | - | F, L | Ind./LC | 0.69 | 0.30 |
| S. Uddin 196 (CPB) | *Polygonum aviculare* L. | Polygonaceae | H | Flower, leaves | - | F, L | Ind./LC | 0.5 | 0.60 |
| S. Uddin 197 (CPB) | *Polygonum barbatum* L. | Polygonaceae | H | Whole plant | - | F, L | Ind./LC | 0.35 | 0.11 |
| S. Uddin 198 (CPB) | *Rheum emodi* L. | Polygonaceae | H | Rhizome | Astringent, tonic for backache and toothache. | F, L, O | Ind./NE | 0.37 | 0.21 |
| S. Uddin 199 (CPB) | *Rumex dentatus* L. | Polygonaceae | H | Leaves | Diuretic and demulcent. | F, L | Ind./LC | 0.65 | 0.15 |
| S. Uddin 200 (CPB) | *Rumex hastatus* L. | Polygonaceae | H | Leaves | Hepatitis, stomachic, antiseptic and purgative. | F, L | Ind./NE | 0.49 | 0.10 |
| S. Uddin 201 (CPB) | *Portulaca oleracea* L. | Portulacaceae | H | Leaves | Diarrhea | F, L | Ind./LC | 0.56 | 0.35 |
| S. Uddin 202 (CPB) | *Aguilegia pubiflora* L. | Ranunculaceae | H | Whole plant | - | F, L, O | Ind./NE | 0.54 | 0.64 |
| S. Uddin 203 (CPB) | *Caltha alba* L. | Ranunculaceae | H | Whole plant | Stimulate lactation and wound healing. | F, L | Ind./NE | 0.50 | 0.49 |
| S. Uddin 204 (CPB) | *Fragaria rubicola* Lindle. Ex. Lacaita. | Rosaceae | H | Fruit | - | F, L | Ind./NE | 0.8 | 0.40 |
| S. Uddin 205 (CPB) | *Prunus armeniaca* L. | Rosaceae | T | Fruit | Laxative and refrigerant. | F, L, TI, O | Ind./EN | 0.56 | 0.20 |
| S. Uddin 206 (CPB) | *Prunus cornuta* Wall. ex. Royal. | Rosaceae | T | Fruit | - | L | Ind./LC | 0.67 | 0.45 |
| S. Uddin 207 (CPB) | *Prunus domestica* L. | Rosaceae | T | Fruit | Laxative and refrigerant. | F, L, TI, O | E/NE | 0.35 | 0.68 |
| S. Uddin 208 (CPB) | *Prunus persica* L. | Rosaceae | T | Fruit | Demulcent and stomachic. | F, L, TI, O | E/NE | 0.01 | 0.75 |
| S. Uddin 209 (CPB) | *Pyrus communis* L. | Rosaceae | T | Fruit | Astringent and sedative. | F, L, TI, O | Ind./LC | 0.02 | 0.13 |
| S. Uddin 210 (CPB) | *Pyrus pashia* L. | Rosaceae | T | Fruit | - | F, L, TI, O | Ind./NE | 0.35 | 0.25 |
| S. Uddin 211 (CPB) | *Rosa brunoii* Lindle. | Rosaceae. | H | Leaves | - | F, L, TI, O | Ind./NE | 0.34 | 0.4 |
| S. Uddin 212 (CPB) | *Rosa indica* L. | Rosaceae | S | Leaves | Constipation | F, L, TI, O | E/NE | 0.9 | 0.34 |
| S. Uddin 213 (CPB) | *Rubus ellipticus* Sm. | Rosaceae | H | Fruit | - | L | Ind./NE | 0.67 | 0.2 |
| S. Uddin 214 (CPB) | *Rubus fruticosus* L. | Rosaceae | H | Fruit | Laxative | F, L, O | Ind./LC | 0.46 | 0.42 |
| S. Uddin 215 (CPB) | *Sorbaria tomentosa* Lindl. | Rosaceae | H | Whole plant | - | F, L, O | Ind./NE | 0.33 | 0.42 |

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|---|---|---|---|---|---|---|---|---|---|
| S. Uddin 216 (CPB) | *Spiraea canescens* D. Don. | Rosaceae | S | Leaves | - | F, L, O | Ind./NE | 0.87 | 0.54 |
| S. Uddin 217 (CPB) | *Skimmia laureola* DC. | Rosaceae | S | Leaves | - | F, L, O | Ind./NE | 0.89 | 0.37 |
| S. Uddin 218 (CPB) | *Zanthoxylum armatum* L. | Rutaceace | S | Fruit, stem | Corminative, diuretic, stimulant, aromatic, condiment and flavoring agent | F, L, Tl, Fr, O | Ind./NE | 0.67 | 0.58 |
| S. Uddin 219 (CPB) | *Salix alba* L. | Salicaceae | T | Bark, leaves | Decoction, refrigerant and febrifuge. | F, L, Tl, Fr, O | Ind./LC | 0.51 | 0.47 |
| S. Uddin 220 (CPB) | *Bergenia ciliata* Haw. | Saxifragaceae | H | Leaves | Dysentery, diarrhea, wounds and increasing milk in cattle. | L | Ind./NE | 0.3 | 0.56 |
| S. Uddin 221 (CPB) | *Verbascum thapsus* L. | Scrophulariaceae | H | Fruit, leaves | Dysentery | L | Ind./LC | 0.62 | 0.63 |
| S. Uddin 222 (CPB) | *Ailanthus altissima* Mill. | Simaroubaceae | T | Leaves | - | O | E/EN | 0.68 | 0.31 |
| S. Uddin 223 (CPB) | *Daphne mucronata* Royle. | Thymelaeaceae | S | Bark, flower | Rheumatism | - | Ind./NE | 0.89 | 0.60 |
| S. Uddin 224 (CPB) | *Celtis australis* L. | Cannabaceae | T | Fruit | Refrigerant, colic, amenorrhea and allergy. | Ti, Fr | Ind./LC | 0.67 | 0.47 |
| S. Uddin 225 (CPB) | *Ulmus wallichiana* Heybroek. | Ulmaceae | T | Fruit, seed | - | F, L, Tl, O | Ind./LC | 0.08 | 0.06 |
| S. Uddin 226 (CPB) | *Urtica dioca* L. | Urticaceae | H | Leaves | Irritation and allergy. | F, L, Ti | Ind./NE | 0.67 | 0.83 |
| S. Uddin 227 (CPB) | *Valeriana jatamansi* Jones. | Caprifoliaceae | H | Whole plant | - | F, L | Ind./NE | 0.06 | 0.50 |
| S. Uddin 228 (CPB) | *Phyla nudiflora* L. | Verbenaceae | H | Leaves | - | F, L, O | E/NE | 0.89 | 0.70 |
| S. Uddin 229 (CPB) | *Verbena officinalis* L. | Verbenaceae | H | Leaves | - | F, L, O | Ind./LC | 0.8 | 0.35 |
| S. Uddin 230 (CPB) | *Vitis jacquemontii* L. | Vitaceae | H | Fruit | Laxative | F, L, O | Ind./NE | 0.86 | 0.21 |
| S. Uddin 231 (CPB) | *Viola canescens* L. | Violaceae | H | Flower | Antipyretic, diaphoretic, cancer and skin disease. | O | Ind./NE | 0.57 | 0.35 |
| S. Uddin 232 (CPB) | *Tribulus terrestris* L. | Zygophyllaceae | H | Flower | Eye disease and increasing milk production. | O | Ind./LC | 0.88 | 0.71 |

**Habit**

On the basis of habit, 95 species were herbs, followed by trees with 22 species and shrubs were 15 species as shown in (Fig. 2 and Table 1).

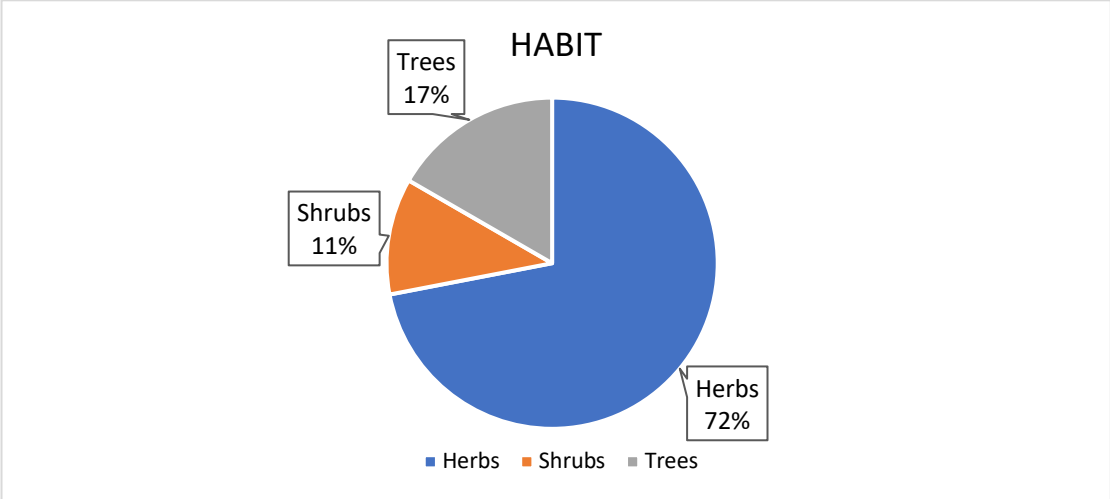


Figure 2. Habit wise distribution of the flora by the number of species of Bara Gali, Abbottabad, Pakistan

**Plants parts used**

Different parts of plants were used i.e., leaves of 40 species were used, in case of whole plant 25 species were used, fruit of 20 species were used, flower of 10 species were used, root of 9 species were used, Seed of 5 species were used, rhizome of 4 species were used, Bark of 4 species were used, bulb of 3 species were used, gel of 2 species were used and milky latex were 1 species were used as sown (Fig. 3 and Table 1).

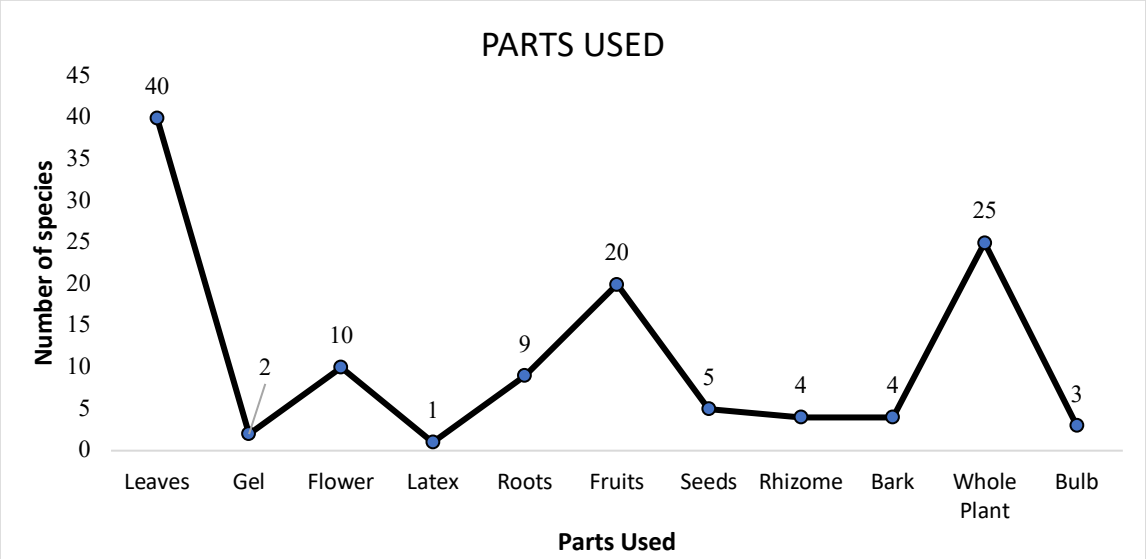


Figure 3. Graphical representation of Part used of medicinal flora of Bara Gali, Abbottabad, Pakistan

**Conservation Status**

All the 132 species were evaluated through IUCN standard categories for its conservation status. It was noted that 52 species were least concern (LC); 77 species were not evaluated (NE); 3 species were endangered (EN). Not vulnerable (VU); critically endangered (CR); extinct (EX) and near threatened (NT) were reported. These plants were evaluated for their indigenous and exotic status by consulting various floras of the world and Flora of Pakistan. The study revealed that 115 species were indigenous and 17 were exotic as shown (Fig. 4 and Table 1).

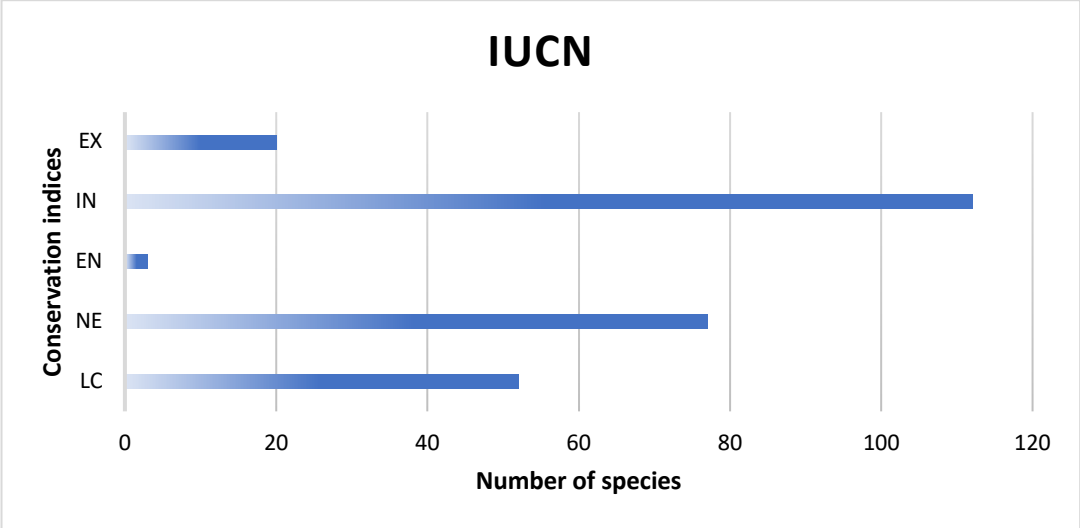


Figure 4. Conservation status of the flora of Bara Gali, Abbottabad, Pakistan

**Quantitative analysis**

***Use value (UV)***

In documented analysis the top use values were recorded for *Geranium lucidum* (0.91), *Cyperus rotundus, Skimmia laureola, Daphne mucronata*, and *Phyla nudiflora* (0.89), *Tribulus terrestris* (0.88), *Myrtus communis*, *Plantago lanceolata*, and *Spiraea canescens* (0.87), *Gymnosporia royleana*, *Desmodium elegans*, and *Vitis jacquemontii* (0.86), *Sonchus asper* (0.85), *Acorus calamus* and *Conyza canadensis* (0.79), *Taraxacum officinale* (0.77), *Cannabis sativa*, *Lamium album*, and *Salvia moorcoftiana* (0.76). However, the lowest values were documented for *Prunus persica* (0.01), *Pyrus communis* (0.02), *Chenopodium murale* (0.04), *Achyranthus aspera* (0.05), and *Valeriana jatamansi* (0.06). (Important species are given in Figs. 5 and 6)

***Relative Frequency Citation (RFC)***

The highest RFC was recoded for *Ajuga bracteosa* (0.96), *Chenopodium murale* (0.89), *Geranium wallichianum* (0.86), *Cuscuta reflexa* and *Quercus dilatata* (0.85), *Lespedeza juncea* (0.84), *Chenopodium botrys* and *Valeriana jatamansai* (0.83), *Lamium album* (0.79), *Pinus wallichiana* and *Lolium temulentum* (0.78), *Carduus edelbergii* (0.76). Although the lowest values resulted for *Cynoglossum glochidiatum* (0.01), Sonchus asper (0.02), Poa annua (0.05), *Ulmus wallichiana* (0.06), and *Jasminum humile* (0.09).

## Discussion

The present study revealed that the research area is rich in medicinal plants. The local people depends on these local medicinal plants to fulfill their basic primary health care needs. The people dwelling in the research area are mainly poor and earn their livelihood mainly through farming and livestock grazing. Therefore, they have limited access to modern synthetic drugs.

The medicinal plants have been used by human beings for a long time. The first published books on medicinal plants were Rig Veda (4500-1600 BC) and Ayurveda (2500-600 BC) in the Asian sub-continent. According to Ali and Qaiser (2009), a majority of people still use medicinal plants despite being in a technological era.

According to Irfan *et al.* (2018d), medicinal plants are any plants which offer temporary relief, has curative properties basing on ethnobotanical information, secondary metabolites, promoting health. Ethnomedicines refer to the use of plant's seeds, barriers, roots, leaves, bark or flowers for medicinal purposes (Irfan *et al.* 2018e; Ullah *et al.* 2022ab). Majority of people in Pakistan rely on medicinal plants for both major and minor diseases.

Plants based medicines is one of the ancient systems of therapeutic treatment in human history and could be considered one of the precursors of the modern pharmacological profession. Plants that have therapeutic uses can be found growing in many locations all over the world. (Ibrahim *et al.* 2023b).

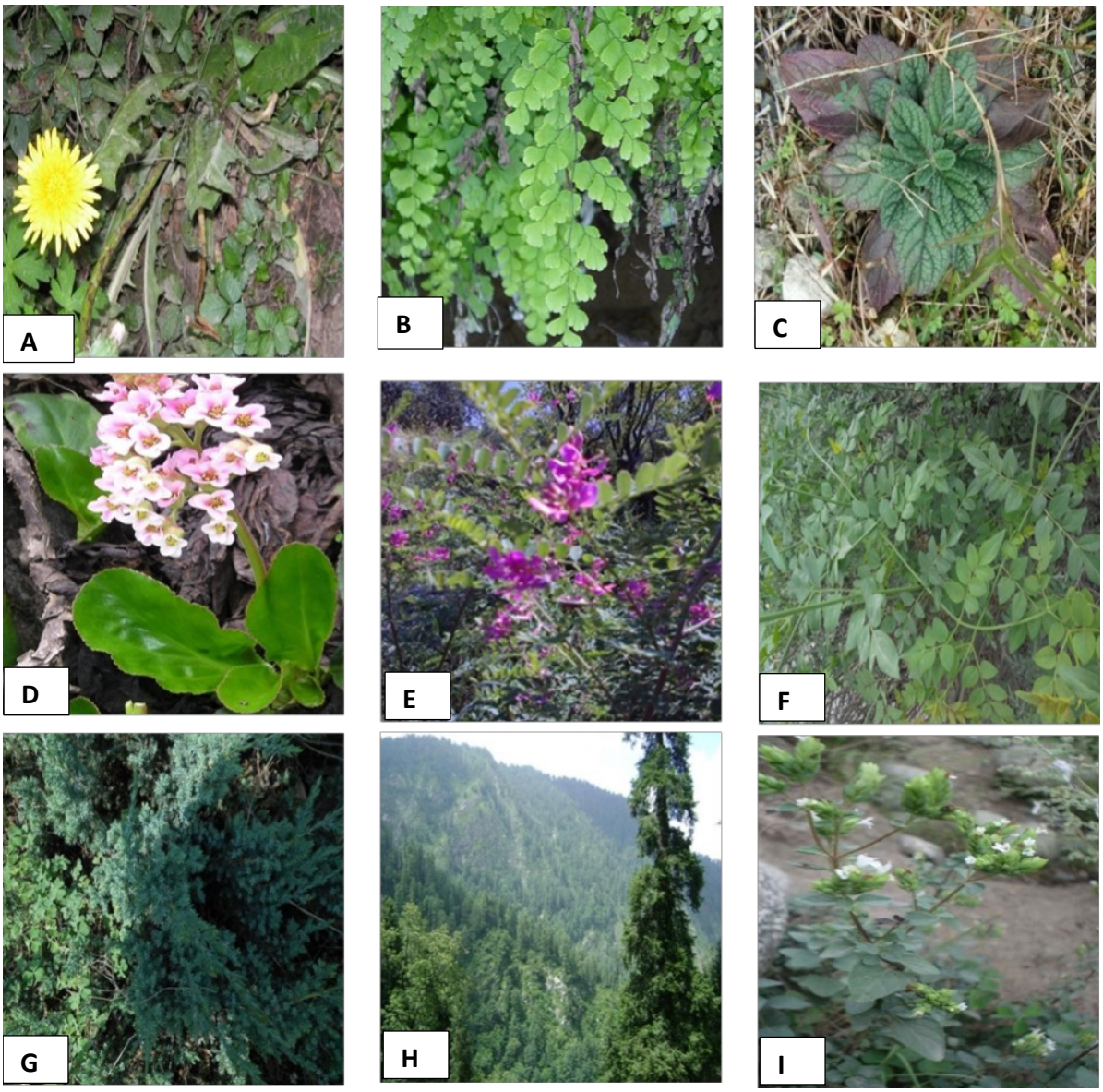


Figure 5. **A.** *Taraxacum officinate* L.; **B.** *Adiantum capillus* veneris L.; **C.** *Ajuga bracteosa* Wall.ex Benth.; **D.** *Bergenia ciliata* (Haw.) Sternb.; **E.** *Indigofera heterantha* Well. ex. Brand.; **F.** *Jasminum officinale* L.; **G.** *Juniperus communis* L.; **H.** *Abies pindrow* L.; **I.** *Origanum vulgare* L..

The young ones are unaware about such an indispensable practice. The objective of the current study was to transfer this sort of precious knowledge from old members of the community to young generation in document form (Khan *et al.* 2015; Khan et al., 2018; Irfan *et al.* 2018f). Previously Ali *et al.* (2016) reported 50 plants of medicinal value from Chail valley possesses diverse flora of Sino-Japanese region. Islam *et al.* (2016) surveyed 110 medicinal plants of District Swat, Pakistan. Khan *et al.* (2016) carried out studies on medicinal plant and conservation of biodiversity in the District of Abbottabad, Pakistan.

Tareen *et al.* (2016) documented ethnomedicinal utility of 100 species used by the local community of Harnai District, Baluchistan, Pakistan. Ullah *et al.* (2016) stated that regional flora provide base for conservation and ethnobotany.

Abbas *et al.* (2017) carried out study on 50 medicinal plants belonging to 33 families used in 13 diseases. Correspondingly, leaves were the frequently used parts, and decoction was the commonly used method for herbal medicine. Ali *et al.* (2017) carried out ethnomedicinal exploration and recorded 65 wild medicinal plants belonging to 35 families from Tirat Valley District Swat, Pakistan used in the indigenous system of medicine. Batool *et al.* (2017) reported traditional uses of 94 medicinal plants which belongs to 40 families used by the local inhabitants of Lakki Marwat.

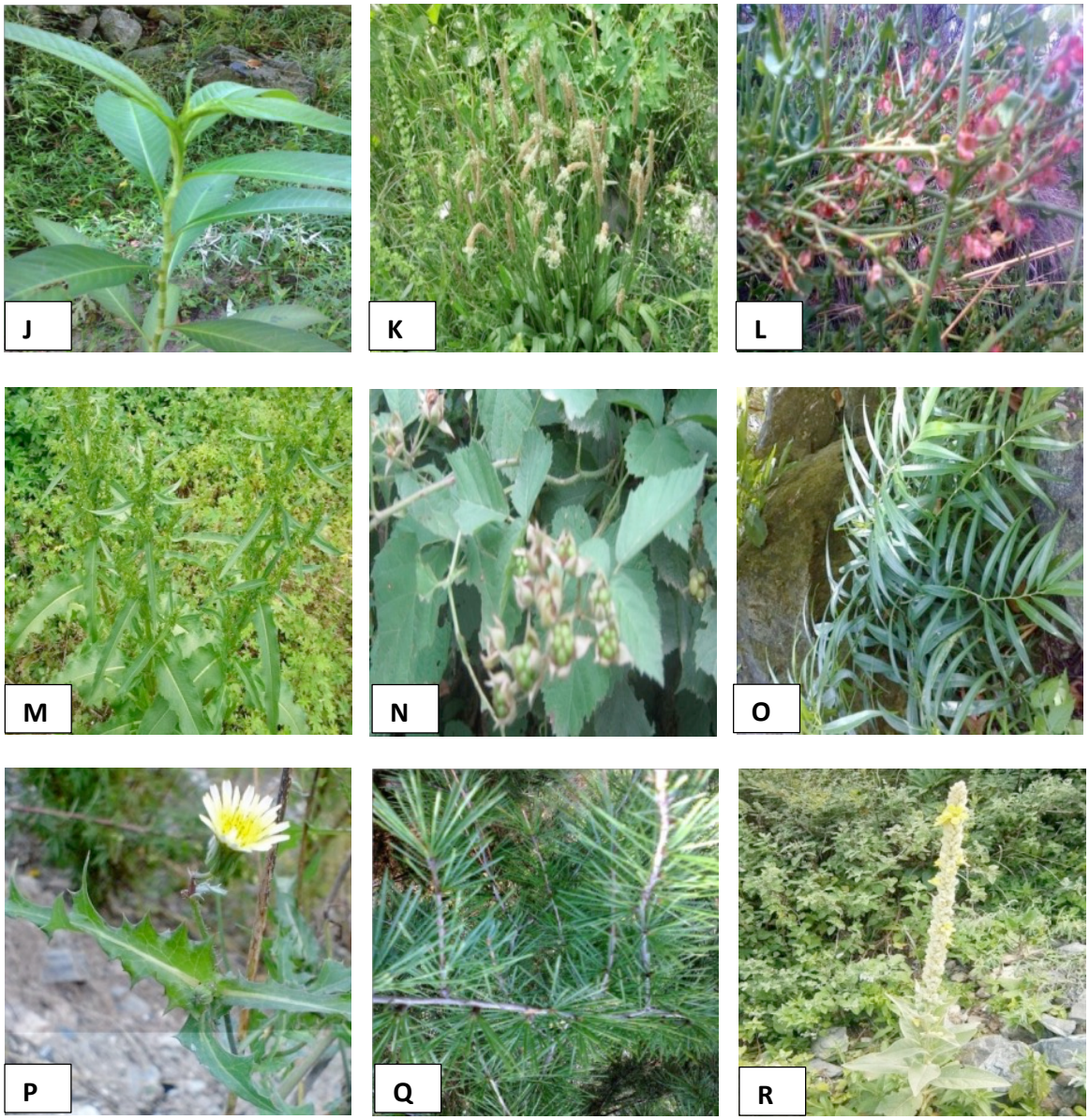


Figure 6. **J.** *Polygonum barbatum* L.; **K.** *Plantago lanceolata* L.; **L.** *Rumex hastatus* L.; **M.** *Rumex dentatus* L.; **N.** *Rubus fruticosus* L.; **O.** *Sarcococca saligna* (D. Don) Muell.; **P.** *Sonchus asper* (L.) Hill.; **Q.** *Taxus fuana* Nan. Li & R. R. Mill.; **R.** *Verbascum thapsus* L.

Hassan *et al.* (2017) carried out similar research on 46 medicinal plant species belonging from 31 families from District Dir Upper Pakistan. Iqbal *et al.* (2017) also carried out study on medicinal plants and prepared homeopathic medicines used for various diseases.

Ismail *et al.* (2017) analyzed a total of five plant species belonging to 4 families. The five medicinal plant species include Quercus dilatata, Hedera nepalensis, Fagonia cretica, Phytolacca latbenia and Withania coagulans. Karimi *et al.* (2017) reported 40 medicinal plants which were used for the treatment of the kidney pain from District Buner, Pakistan. Khan *et al.* (2017) stated that anthropogenic activities greatly influenced biodiversity.

The main reason of loss of biodiversity is over population, poverty, lack of awareness and education. Amjad *et al.* (2017) worked on the medicinal plant in Toli Peer National Park of Azad Jammu and Kashmir, Pakistan. They identified 121 species of medicinal plants belonging to 57 families and 98 genera and also recorded the methods by which herbal drugs were

prepared. Rauf *et al.* (2017) analyzed different medicinal plants for the purposes of many diseases from District Swabi Pakistan.

Shinwari *et al.* (2017) reported that traditional uses of herbal medicine for treatment of different human diseases in Northern Pakistan. They collected 61 medicinal plants belonging to 49 genera and 34 families. Tafti *et al.* (2017) conducted a study on traditional Persian medicine and prepared many remedies used for different diseases. Umair *et al.* (2017) carried out study on traditional uses of medicinal plants by the inhabitants of Hafizabad, Pakistan. Ethnobotanical data was collected through questionnaire and 166 local informants and 35 traditional health practioners from different localities were interviewed. Afza *et al.* (2018) analyzed the diversity of vascular plants which were present in Ayubia National Park and reported 250 plant species belongs to 79 families. Aziz *et al.* (2018) reported total of 64 medicinal plants belonging to 60 genera and 41 families from Mohmand Agency, Fata, Pakistan.

Conservation of biodiversity is essential for the human survival, notably through health, food and industry (Irfan *et al.* 2017). All forms of life-human, animal and plants are so closely interlinked that disturbance in one give rise to imbalance in the others (Ali *et al.* 2017; Iftikhar *et al.* 2019; Irfan *et al.* 2019). If species of plants and animals become endangered, they signify degradation in the environment, which may threaten man's own existence. The maintenance of biodiversity at all levels is fundamentally the maintenance of viable population of species or identifiable populations (Irfan *et al.* 2018). Approaches of biodiversity conservation should be concise with due consideration of national problems (Ullah *et al.* 2022; Sher *et al.* 2023).

Large numbers of livestock, increasing at a rate of 20% every 7 years, have burdened the carrying capacity of rangelands. In fact, the situation is so serious that most rangelands produce less than 30% of their capacity (Musa *et al.* 2022; Irfan *et al.* 2023; Sher *et al.* 2023). Overgrazing results in the loss of topsoil and water and wind erosion, leaving the soil vulnerable to loss of nutrients and desertification. Land degradation not only reduces production capacity but also results in a decrease in palatable species. Wildlife populations are also at risk when vegetation is reduced as prey species (Ullah *et al.* 2018; Ahmad *et al.* 2016; Ali *et al.* 2023).

## Conclusion

The ethnobotanical study of Bara Gali Forests, Abbottabad, reveals a rich diversity of flora with immense medicinal and cultural significance, with adequate plant species used for healthcare. Local communities possess valuable traditional knowledge, but overgrazing and unsustainable land-use practices threaten conservation. To address this, the study recommends implementing control measures, promoting rotational grazing, community-led conservation initiatives, sustainable harvesting practices, and education programs. Further research on bioactive compounds and policy support for sustainable land-use practices are also urged to ensure the long-term sustainability of the region's unique biodiversity and local communities' well-being.

## Declarations

***Ethics approval:*** The ethical committee reviewed and approved the research entitled "Diversity, Ethnobotany and conservation studies of the medicinal flora of Bara Gali, District Abbottabad, Pakistan" conducted at Centre of Plant Biodiversity, University of Peshawar, Peshawar, Pakistan. All participants provided oral prior informed consent.

***Consent for Publication:*** Not applicable

***Funding:*** Not Applicable

***Availability of data:*** All data are available with the first author on request.

***Competing Interests:*** The authors declared no competing interests.

Author's contribution: SB wrote the first draft of the manuscript; AU supervised the study; MI and Sara designed the project, GD, IA, SB, BK and Sara reviewed and revised the manuscript, MI, IU and MA did the statistical analysis.

## Literature cited

Abbas Z, Khan SM, Alam J, Khan SW, Abbasi AM. 2017. Medicinal plants used by inhabitants of the Shigar Valley, Baltistan region of Karakorum Range-Pakistan. Journal of Ethnobiology and Ethnomedicine 13(1):53-67

Afza R, Ahmad H, Saqib Z, Marwat KB, Khan J. 2018. Spatial analysis of vascular Flora of Ayubia National Park, KPK, and Pakistan. A classic example of most temperate Himalaya. Pakistan Journal of Botany 50(4):1499-1508.

Ahmad I, Irfan M, Ali I, Khan J, Saeed SH, Gulfaraz A. 2016. Checklist of some medicinal plants of District Lower Dir, Pakistan. Journal of Agricultural & Bio-Chemical Science 1(1):15-22.

Ahmad KS, Hameed M, Ahmad F, Mahroof K. 2017. Ethno pharmacological studies of indigenous plants in Kel village, Neelum Valley, Azad Kashmir, Pakistan. Journal of Ethnobiology and Ethnomedicine 13(1):59-68.

Ali A, Badshah L, Hussain F. 2016. Floristic composition, ecological characteristics of plants of Chail Valley, District Swat, Pakistan. Pakistan. Journal of Botany 48(3):1013-1026.

Ali A, Jan G, Irfan M, Jan FG, Ullah F. 2023. Quantitative Ethnomedicinal study of the Flora of Tehsil Lahor, District Swabi, Khyber Pakhtunkhwa, Pakistan. Ethnobotany Research and Applications 25:1-21. doi:10.32859/era.25.64.1-21.

Ali A, Rashid A, Sultan A, Irfan M. 2017. *Anisochilus carnosus* (L. f.) Wall. ex Benth. (Lamiaceae) - a new generic record for Pakistan. Plant Science Today 4(3):102-105.

Ali H, Qaiser M. 2009. The ethnobotany of Chitral valley, Pakistan with particular reference to medicinal plants. Pakistan Journal of Botany 41(4):2009-2041.

Ali K, Khan S, Khan N, Rahman W, Ullah IU, Ali F, Nisar K. 2017. Ethnobotanical and ecological study of Punica granatum in Dir district, Khyber Pakhtunkhwa, Pakistan. Regularity Mechanism in Bio Systems 8(4):656-661.

Ali M, Begum R, Ali K, Nisar M, Khan W, Hassan N, Khan N. 2017. Ethnobotanical survey of wild medicinal plants of Tirat Valley District, Swat, Khyber-Pakhtunkhwa. Journal of Biodiversity and Environmental Sciences, 11(3), 91-101.

Ali SI, Nasir YJ. 1989-1991. Flora of Pakistan; Department of Botany, University of Karachi: Karachi, 191-193.

Ali SI, Qaiser M. 1993-2017. Flora of Pakistan; Department of Botany, University of Karachi: Karachi. 194-222.

Amjad MS, Qaseem MF, Ahmad I, Khan SU, Chaudhari SK. 2017. Correction: Descriptive study of plant resources in the context of the ethnomedicinal relevance of indigenous flora: A case study from Toli Peer National Park, Azad Jammu and Kashmir, Pakistan. PLOS ONE 12(7): e0180917.

Ayub M, Shah GM, Irfan M, Ullah F, Ullah A. 2023. Ethnomedicinal Study of the Flora of Sellay Pattay Valley, District Malakand, Khyber Pakhtunkhwa, Pakistan. Ethnobotany Research and Applications 26:1–17.

Aziz M, Khan A, Adnan AH, Ullah M. 2018. Traditional uses of medicinal plants practiced the indigenous communities at Mohmand Agency, FATA and Pakistan. Journal of Ethnobiology and Ethnomedicines 14 (1):11-22.

Bano S, Khan S, Alam M, Alqarawi A, Allah A, Ahmad K. 2018. Eco-Floristic studies of native plants of the Beer Hills along the Indus River in the districts Haripur and Abbottabad, Pakistan. Saudi Journal of Biological Sciences 25(4):801-810.

Batool A, Shah A, Bahadur A. 2017. Ethnopharmacological relevance of traditional medicinal flora from semi tribal areas in Khyber Pakhtunkhwa, Punjab, Pakistan, Pakistan Journal of Botany 49 (2):691-705.

Bibi T, Ahmad M, Ahmad B, Muhammad I, Manzoor S. 2017. Ethnomedicinal uses of plants for childbirth and postpartum recovery in district Pishin, Northern Balochistan and Pakistan 6 (9):1730-1760

Champion SH, Seth SK, Khattak GM. 1965. Forest types of Pakistan. Pakistan Forest Institute, Islamabad.

GoP 1998. District Census Report of Abbottabad; Population Censes Organization Static Division Government of Pakistan: Islamabad 32:1-28.

Gul A., Alam J, Ahmad H, Shah GM, Hussain M, Dogan Y, Rahman KU. 2016. Traditional, medicinal and food uses of Pteridophytes of district Mansehra (Pakistan) and their some adjacent areas. International Journal of Biosciences 9(5):116-33.

Hassan N, Wang D, Shuaib M, Zhong Z, Nisar M, Khan W. 2017. Identification and ethno botanical survey of profitable medicinal plants used as remedy in Sangina Pakistan. International Journal of Herbal Medicine 5(4):117-123.

Ibrahim M, Akhtar N, Sara, Bahadar H. 2023a. Nutritional, elemental and phytochemical investigations of *Mentha longifolia* (L.) Huds. and Mentha Spicata L. from District Malakand, Pakistan.

Ibrahim M, Akhtar N, Sara, Bahadar H. 2023b. Ethno-pharmacological Evaluation of Plants Resources of District Malakand, Pakistan. Ethnobotany Research and Applications 25:1-15.

Iftikhar S, Ali W, Ullah S, Khan W, Irfan M. 2019. Comparative antibacterial potential of methanolic extract of the leaves of wild and cultivated *Ficus carica* L. International Journal of Botany Studies 4(4):139-143.

Iqbal M, Bibi Y, Raja N, Ejaz I, Hussain M, Yasmeen M, Imran F. 2017. Review on Therapeutic and Pharmaceutically Important Medicinal Plant *Asparagus officinalis* L. Journal of Plant Biochemistry and Physiology 5(4):180-240.

Irfan M, Ahmad I, Saeed SH. 2017a. Traditional medicinal plant knowledge of some spermatophytes of Samar Bagh Valley, Lower Dir district, Pakistan. Journal of Plant Science Today 4(4):151-153.

Irfan M, Ali I, Kashf RA. 2018b. Ethnobotanical survey of the flora of Maidan Valley, Lower Dir District, Khyber Pakhtunkhwa Province, Pakistan. Journal of Plant Science Today 5(2):68-71.

Irfan M, Ali, D, Jan, G, Murad, W. 2018a. Ethnobotanical survey of the flora of tehsil Balakot, District Mansehra, Khyber Pakhtunkhwa, Pakistan. Specialty Journal of Biological Sciences 4(3):7-14.

Irfan M, Jan G, Jan FG, Murad W, Rauf A, Alsayari, A, Almarhoon, ZM, Mabkhot YN. 2021. Ethnomedicinal and Traditional uses of the Ferns of Khyber Pakhtunkhwa, Pakistan. Brazilian Journal of Biology 84:1-20.

Irfan M, Khan I, Ali A, Khan R, Ali A, Jan G. 2018c. Ethnomedicinal uses of the plants of tehsil Laalqilla, district Lower Dir, Khyber Pakhtunkhwa, Pakistan. Journal of Applied Environmental & Biological Sciences 8(6):61-66.

Irfan M, Nabeela Ik, Kamil M, Ullah S, Khan S, Shah M, Murad W. 2018c. Ethnobotanical Survey of the Flora of Tehsil Balakot, District Mansehra, Khyber Pakhtunkhwa, Pakistan. Journal of Applied Environmental and Biological Sciences 8(8):1-13.

Irfan M, Nabeela, Kamil M, Khan NA, Ilyas M, Ali A, Ullah S, Shah M, Jan G, Murad W. 2018e. Ethnomedicinal and traditional knowledge of phanerogams of tehsil Munda, district Lower Dir, Khyber Pakhtunkhwa, Pakistan. International Journal of Biosciences 13(4):208-218. doi:10.12692/ijb/13.4.208-218.

Irfan M, Nabeela, Kamil M, Khan NA, Khan H, Khalil S, Ullah S, Shah M, Jan G, Murad W. 2018f. Ethnomedicinal plants uses of tehsil Khall, district lower Dir, Khyber Pakhtunkhwa, Pakistan. International Journal of Biosciences 13(4):219-229. doi:10.12692/ijb/13.4.219-229.

Irfan M, Nabeela, Kamil, M, Khan NA, Ali A, Ullah Z, Ilyas M, Khan U. 2018d. Ethnomedicinal applications of plant taxa by the local communities of tehsil Adenzai, district Lower Dir, Khyber Pakhtunkhwa, Pakistan. International Journal of Biosciences 13(5):40-49.

Irfan M, Nabeela, Khan H, Khan S. 2019. A Review of different Phytochemicals and Pharmacological activities evaluations of *Morus alba* (L.). Specialty Journal of Chemistry 4 (2):1-9.

Irfan M, Ullah F, Haq IU. 2023. Ethnomedicinal and Traditional uses of the Flora of District Lower Dir, Khyber Pakhtunkhwa, Pakistan. Ethnobotany Research and Applications 26:1-22.

Islam M, Ahmad H, Ali H, Alam J. 2016. New records of the genus *Pyrus* (Rosaceae) from Pakistan. Iranian Journal of Botany 22(2):82-87.

Ismail H, Rasheed A, Haq I, Jafri U, Ullah L, Dilshad N, Mirza E. 2017. Five Indigenous Plants of Pakistan with Antinociceptive, Anti-Inflammatory, Antidepressant, and Anticoagulant Properties in Sprague Dawley Rats. Evidence-Based Complementary and Alternative Medicine 1-10.

IUCN. Species Survival Commission [Online]. 2010. Version 8.1. Available from http://intranet.iucn.org/webfiles/doc/SSC/RedList/RedListGuidelines.pdf (accessed 9/01/2018).

Karimi M, Naghdi N. Naji-Haddadi S, Bahmani F. 2017. Medicinal plants used for kidney pain. Journal of Pharmaceutical Sciences and Research 9(5):542-546.

Khan K, Jan J, Irfan M, Jan FG, Hamayun M, Ullah F, Bussmann RW. 2023. Ethnoveterinary uses of medicinal plants amongst the tribal populations of District Malakand, Khyber Pakhtunkhwa, Pakistan. Ethnobotany Research and Applications 25:42:1-24.

Khan K, Shah U, Ahmad M, Khan H, Rahman SM, Iqbal IU, Aldubise Z. 2018. Exploration and local utilization of medicinal vegetation naturally grown in the Deusai plateau of Gilgit, Pakistan. Saudi Journal of Biology 25(2):326-331.

Khan M, Ahmad T, Rashid L. 2018. Ethnobotanical documentation of traditional knowledge about medicinal plants used by indigenous people in Talash valley of Dir Lower, Northern Pakistan. Journal Intercostal Ethnopharmacology 7(1):8-24.

Khan R, Mehmood US, Muhammad A, Mussarat S, Khan SU, Amina S. 2015. Medicinal plant from flora of Bannu used traditionally by North West Pakistan, s woman to cure gynecological disorders. Am-Euras. Journal of Agriculture and Environmental Sciences 15 (3):553-559.

Khan S, Khatoon W, Abbas S, Raza Q, Hussain G. 2016. Inventory of the Alpine Flora of Haramosh and Bagrote Valleys (Karakoram Range) District Gilgit, Gilgit-Baltistan, Pakistan. Pakistan Journal of Botany 48(4):1559-1572.

Khan W, Khan SM, Ahmad H, Shakeel A. 2017. Conservation and ecological gradient analyses of plant associations in the Thandiani forests of the Western Himalayas, Pakistan. Turkish Journal of Botany 41(3):253-264.

Maleki T, Akhani F. 2018. Ethnobotanical and ethnomedicinal studies in Baluchi tribes. A case study in Mt. Taftan, southeastern Iran. Journal of Ethnopharmacology 217(5):63-177

Musa M, Jan G, Jan FG, Hamayun M, Irfan M, Rauf A, Alsahammari A, Alharbi M, Suleria HAR, Ali, N. 2022. Pharmacological activities and gas chromatography-mass spectrometry analysis for the identification of bioactive compounds from *Justicia adhatoda* L. Frontiers in Pharmacology 13:922388. doi:10.3389/fphar.2022.922388.

Nasir E, Ali SI. 1970-1989. Flora of Pakistan; Pakistan Agriculture Research Council: Islamabad, 1-190.

Nasir YJ, Rafiq RA. 1995. Wild flowers of Pakistan; Oxford University Press: London, pp 1-250.

Polunin O, Stainton A. 1990. Flowers of the Himalaya; Oxford University Press: Bombay, Calcutta & Madras, pp 1-500.

Rauf A, Uysal S, Hadda B, Siddiqui BS, Khan H, Khan MA, Abu-Izneid T. 2017. Antibacterial, cytotoxicity, and phytotoxicity profiles of three medicinal plants collected from Pakistan. Marmara Pharmacology Journal 21(2):261-268.

Rehman S, Iqbal Z, Qureshi R, Alomar TS, Almasoud N, Younas M, Irfan M. 2023b. Ethno-Dentistry of Medicinal Plants Used in North Waziristan, Pakistan. International Dental Journal. 1-11

Rehman S, Iqbal Z, Qureshi R, Shah GM, Irfan M. 2023a. Ethnomedicinal plants uses for the treatment of respiratory disorders in tribal District North Waziristan, Khyber Pakhtunkhwa, Pakistan. Ethnobotany Research and Applications 25:1-16.

Sher J, Jan G, Israr M, Irfan M, Yousuf N, Ullah F, Rauf A, Alshammari A, Alharbi M. 2023. Biological Characterization of *Polystichum lonchitis* L. for Phytochemical and Pharmacological Activities in Swiss Albino Mice Model. Plants 12:1455. https://doi.org/10.3390/ plants12071455.

Shinwari S, Ahmad M, Lou Y, Ali W. 2017. Quantative Analysis of Medicinal plants consumption among of Shangla areas in Northern Pakistan. Pakistan. Pakistan Journal of Botany 49(2):725-734.

Stewart RR. 1972. An annotated catalogue of the vascular plants of West Pakistan and Kashmir; Fakhri Printing Press: Karachi, pp 1-1000.

Tafti L, Shariatpanahi D, Damghani SM, Javadi B. 2017. Traditional Persian topical medications for gastrointestinal diseases. Iranian Journal of Basic Medical Sciences 20(3):222-280.

Tareen N, Rehman M, Ahmad M, Shinwari ZK, Bibi S. 2016. Ethnomedicinal utilization of wild edible vegetable in District Harnai, Baluchistan Province. Pakistan Journal of Botany 48(3):1159-1171.

Thomas YA and Shengji P. 2003. Applied Ethnobotany, case study from the Himalayan region. People and Plants working paper 12:3-5. WWF, Godalming: UK.

Ullah A, Khan N, Muhammad Z. 2016. A checklist of Angiospermic Plants Sheikh Buddin National Park, District Dera Ismail Khan, KP, Pakistan. Journal of Life Science 4(1):18-24.

Ullah A. 2014. Biodiversity and ethnobotanical study of vascular plants in Mankial valley, Hindukush Range, Pakistan. Ph. D. Thesis, Department of Botany, University of Peshawar.

Ullah F, Irfan M, Saeed, M. 2023. Quantitative ethnomedicinal study of the Flora of district Swabi, Khyber Pakhtunkhwa, Pakistan. Ethnobotany Research and Applications, 26:1-26.

Ullah K, Alam J, Shah GM, Gul A, Irfan M. 2022a. Ethnomedicinal and traditional uses of the Ferns of Shishikoh valley, District Chitral, Pakistan. Plant Science Today 9(3): 687-692. doi: 10.14719/pst.1690.

Ullah K, Shah GM, Alam J, Irfan M, Qadir G, Ullah B. 2022b. Evaluation of Ethnoveterinary Medicinal Plants of Shishikoh Valley; Practices among the Local Community of District Chitral, Hindukush, Pakistan. Sylwan 166(2):102-121.

Ullah S, Gul J, Gul F, Khan S, Sher J. 2018. Antifungal and phytochemical screening of selected medicinal plants of Malamjaba, Swat, Pakistan. The Pharma Innovation 7(5):176-240.

Ullah S, Khan W, Ali W, Khan MS, Sajad MA, Nabeela, Irfan M. 2018. Antibacterial and antifungal potentials of the various solvents extract of *Quercus incana* fruits. International Journal of Biosciences 13(5):438-447. doi:10.12692/ijb/13.5.438- 447.

Umair M, Altaf M, Abbasi AM. 2017. An ethnobotanical survey of indigenous medicinal plants in Hafizabad district, Punjab-Pakistan. Plos One 12(6):177-312.

Waheed A, Ali B, Fahad M, Mohib N, Afsa S. 2018. Survey of medicinal plants and patterns of knowledge in District Swabi, Khyber Pakhtunkhwa, Pakistan. International Journal of Phytomedicines 10 (2):343-346.