Quantitative study on medicinal plants traded in selected herbal markets of Khyber Pakhtunkhwa, Pakistan

Sikandar Shah, Sheharyar Khan, Sulaiman, Murad Muhammad, Lal Badshah, Rainer W. Bussmann and Wahid Hussain

Research

Abstract

**Background:** This study is the first large-scale medicinal plant survey in the herbal markets of seven Districts of Khyber Pakhtunkhwa, Pakistan. The study provides the first significant catalogue on medicinal plants trade, price patterns, routes and utilization.

**Methods:** Based on semi structured questionnaires, interviews and group discussions with 210 informants (92.86% men and 7.14% women) and personal observations were conducted.

**Results:** A total of 161 plant species and three species of fungi were documented. Among the plants with highest Use Value, *Allium cepa* were used as anthelmintic and carminative, *Bergenia ciliata* for bladder stones and *Brassica campestris* for dandruff and angina. The reported data were analyzed using various ethnobotanical indices such as Use Value (UV), Use Report (UR), Relative Frequency of Citation (RFC) and Cultural Importance Values (CIV). The most cited used plant part was seeds (22.90%), followed by fruits (19.88%), leaves (15.67%) and root (10.24%). The UV ranged from 0.18 (*Seriphidium kurramnse*) to 0.86 (*Allium cepa, Bergenia ciliata, Brassica campestris, Carum carvi, Coriandum sativum and Plantago major*). RFC ranged from 0.976 (*Allium cepa, Piper nigrum and Punica granatum*) to 0.076 (*Nymphaea alba and Seriphidium kurramnse*). The highest mean Cultural Importance (mCI) value was recorded for *Allium cepa* (0.842) and lowest for *Ferula assa-foetida, Terminalia chebula* and *Croton tiglium* having each (0.083).

**Conclusions:** The current research confirmed that Khyber Pakhtunkhwa province is an interesting area for traditional plant use that should be studied in more detail.

**Keywords:** Quantitative study, medicinal plants, herbal markets, Khyber Pakhtunkhwa, Pakistan

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Background

Medicinal plants are popular among consumers worldwide, although plant use has been documented back to the Paleolithicum (Petarakou et al. 2019) and has been common for millennia (Astutik et al. 2019). In developing countries plant based natural medicines are widely used in basic health care systems (Shah et al. 2020). Medicinal plants remain
of importance as main healthcare for approximately 85% of the world’s population (Fitzgerald et al. 2019; Rasethe et al. 2019.). The World Health Organization (WHO) estimated that 65-80% of people from emerging countries depend on natural medications (Tariq et al. 2020). About 25% of all synthetic drugs are still based on plant compounds (Bauer and Brönstrup 2014), and plants can supply low-cost medicinal care to developing countries (Djordjevic 2017; Sharif et al. 2018), as well as developed nations. Often a large number of species are traded in herbal markets (Ahmad et al. 2018; Hoareau and DaSilva 1999), which in turn are influenced by ecological conditions, socio-economic features, development strategies and transportation systems (Botha et al. 2004). The herbal business is quickly increasing globally (Kanwal and Sherazi 2017; Cunningham and Long 2019). Europe alone imports about US$ 1 billion worth in medicinal and aromatic plants annually from Asia and Africa (Sher and Hussain 2009). Because of the growing acceptance of herbal medicines, such trade is thought to increase significantly by the year 2050 (Khan et al. 2011). Ethnobotanical documentation can have ecological and economic implications, guiding strategic decisions on the sustainable development of agriculture through the introduction of new species for cultivation, and facilitating the protection of wild species from overexploitation (Patsch 2019). Pakistan has a rich tradition in medicinal plant use (Salim et al. 2019), out of 600 species used as medicines, 300 species are accessible in markets (Shinwari et al. 2002; Sulaiman et al. 2020).

The current study was designed to document the traded plant species along with their traditional uses and prices in the herbal markets in seven districts of Khyber Pakhtunkhwa (Banu, Dir, Kurram, Mardan, Peshawar, Swabi and Swat).

**Materials and Methods**

**Study Area and Topography**

The primary data were gathered from the districts Banu, Dir, Kurram, Mardan, Peshawar, Swabi and Swat of Khyber Pakhtunkhwa, Pakistan, a province located in the North West region of the country. Geographically, the region stretches between 33° 6’ 54.9684” N and 71° 5’ 43.9260” E, incorporating an area of 101521 km² (Figure 1). The province is bordered on the north-east by Gilgit-Baltistan (Northern areas), on the north-west by Afghanistan, on the east by Azad Kashmir, on the west and south by the former Federally Administered Tribal Areas (FATA), now merged into the province, and the capital area of Islamabad and Punjab on the west (Rahman and Dawood 2018). Khyber Pakhtunkhwa has hilly and plain areas, distinct cultural differences, temperature variation, vegetation cover, seasonal variation, snow fall and rain patterns. Peshawar is the provincial center and business hub of the province (Sulaiman et al. 2020). Topographically the province comprises the Hindu Raj, eastern Hindu Kush, and a portion of the lesser Himalayas, with large steppes bordered by mountains (Khan 2015). The Northern areas (NA) are cold and snowy in wintertime and pleasant in summer, while the southern part is dry in summer and cold in winter (Ali et al. 2018). Temperatures of the province greatly fluctuate with altitude, with both temperature and elevation rising from south-north and fall from north-south respectively.

The highest peak is Tirich Mir located in the Hindu Kush range (7690m) (Dawood 2017). Banu (1227 km²), Mardan (1632 km²), Peshawar (1257 km²) and Swabi (1543 km²) are located in the plains and are the most populated districts of the province covering almost half of the province population while Dir (5282 km²), Kurram (3380 km²), and Swat (5337 km²) are the districts with dense forests, and high altitudes.

**Study Design**

Data on harvesting, therapeutic uses and trade of plants were assessed in the seven districts of Khyber Pakhtunkhwa province, Pakistan. These sites were selected because of their physical topographies like, altitude, climate, diversity of plants, geographical location, range of plateaus, herbal plants production, utilization and large markets with more than 80 species traded.

**Markets survey and data collection**

Ethnomedicinal data, trade and price patterns were collected from March 2018 to April 2020. The information was collected through a purposive sampling method using open ended questionnaires. Face to face interviews and group discussions with different respondents like, collectors, healers, local dealers and traders were conducted in each district. Each herbal market was visited 3-5 times. The information was collected from all those participants who contributed their prior informed consent (Bussmann et al. 2007). Data regarding local names, herbal plants production sites, export, import, sales, utilization, parts traded, trade name, market price, uses, demand and supply and diseases treated were documented. The demographics of participants are given in Supplementary Table 1.

**Plant identification**

Plants traded in the markets were photographed and collected for identification. The taxa were identified available literature and flora of Pakistan (Ali and Nasir 1989-1992; Ali and Qaiser 1993-2015; Nasir and Ali 1970-1989) at the herbarium Department of
and vouchers were deposited in the herbarium Department of Botany, University of Peshawar Khyber Pakhtunkhwa Pakistan.

Figure 1. Map of the study area

Table 1. Topographic details of selected Districts

| Districts | Population | Area (Km²) | Tehsils | Latitude | Longitude | No of Interviewees |
|-----------|------------|------------|---------|----------|-----------|--------------------|
| Banu      | 1,167,892  | 1,227 km²  | 5       | 32° 59'9.9906"N | 70° 36'14.999'E | 30                 |
| Dir Lower | 1,435,917  | 1,582 km²  | 2       | 34° 50'9.9906"N | 71° 54'16.43"E  | 30                 |
| Dir Upper | 946,421    | 3,699 km²  | 6       | 35° 20'8.22"N   | 72° 24.854"E    |                    |
| Kurrum    | 619,553    | 3,330 km²  | 3       | 33° 49'7"N      | 70° 10'24"E     | 30                 |
| Mardan    | 2,373,961  | 1,632 km²  | 5       | 34°11'56.01"N   | 72°11'23.21"E   | 30                 |
| Peshawar  | 4,269,079  | 1,257 km²  | 4       | 34°0'54.49"N    | 71°31'29.69"E   | 30                 |
| Swabi     | 1,624,616  | 1,543 km²  | 4       | 34°7'26.66"N    | 72°27'40.75"E   | 30                 |
| Swat      | 2,309,570  | 5,337 km²  | 7       | 34°46'18.29"N   | 72°21'36.54"E   | 30                 |

Quantitative Statistical Analysis

Data collected from markets survey were subjected for statistical analysis to evaluate their medicinal significance. Use Value (UV), Use Report (UR), Relative Frequency of Citation (RFC), Cultural Importance Index (CI).

Use Value

The relative importance of specific plant taxa can be determined by Use value. The use value is calculated by using its standard formula:

\[ UV = \frac{UVi}{Ni} \]

Where \( UVi \) represent the sum of the uses documented for species and \( Ni \) refers to the frequency of informants cited the species (Ferreira et al. 2009; Vitalini et al. 2013).
Use Reports and Relative Frequency of Citation
RFC highlights important taxa of an area used for many diseases (Ism'hand et al. 2020). The data collected from the markets were evaluated for Relative Frequency of Citation (RFC) to know the local importance of each species:

$$RFC = \frac{FC}{N} \quad (0 < RFC < 1).$$

It is assumed by dividing number of informants mentioning the species (FC), by total number of informant’s (N) participated in the study (Pardo-de-Santayana et al. 2007; Yaseen et al. 2015)

Cultural importance Index
The Cultural Importance of each taxon in every district was calculated by Cultural Importance Index (CI). It is calculated using the Cultural importance formula:

$$CI = \frac{URi}{Ni}$$

Where UR is the Use Report in each district for each species and Ni is the number of respondents in every district. The mean cultural significance (mCI) for each species was calculated from cultural importance values (Abbasi et al. 2013; Kaur and Vashistha 2018; Najem et al. 2019).

Jaccard Similarity Index
The similarity and differences among the data obtained from seven districts were analyzed through Jaccard index (JI). It is calculated from Jaccard index formula:

$$J(A,B) = \frac{(A \cap B)}{(A \cup B)}$$

Which is the ‘number in both districts’ divided by the number in either district, and multiplied it with 100 (Abbas et al. 2020; Kayani et al. 2015.).

Results and Discussion
Demographic details of respondents
In the current study a total of 210 informants from various professions and cultural backgrounds participated in the survey. These included herbalists (34.29%), local people (18.09%), local dealers (16.67%), healers (15.72%), collectors (10%) and traders (5.23%). Among the total respondent’s 92.86% were men and 7.14% women, due to the cultural restrictions that prohibit women from talking to strangers. The data as collected in various seasons of the year from informants of different age groups: 56.20% from 40-60 years, 27.14% from 20-40 years and 16.66% of the informants were older than 60 years (Table 2). The majority of the respondents (31.42%) possessed a school diploma (basic 4 years course). In the current study it was observed that the participation of men in the herbal plant trade was far higher than that of women, and thus, only few women (15) could be interviewed. Most participants had more than 15 years of trade experience (53.80%), 29.53% from 11-15 years, and 16.67% had less than 5 years of experience.

Table 2. Demographic information of respondents of selected Districts

| Parameter’s profession | Classes | Frequency of respondents in each class | Percentage |
|------------------------|---------|---------------------------------------|------------|
| Gender                 | Male    | 195                                   | 92.86      |
|                        | Female  | 15                                    | 7.14       |
| Age classes            | 20-40 years | 57                               | 27.14      |
|                        | 40-60 years | 118                              | 56.20      |
|                        | Above 60 years | 35                              | 16.66      |
| Educational background | Illiterate | 27                                 | 12.86      |
|                        | Matriculate | 15                                | 7.14       |
|                        | Intermediate | 42                               | 20         |
|                        | Diploma holder | 66                               | 31.42      |
|                        | Graduate  | 53                                    | 25.23      |
|                        | Post-graduate | 7                                | 3.34       |
| Respondents profession | Collectors | 21                                 | 10         |
|                        | Healers | 33                                    | 15.72      |
|                        | Herbalists | 72                                 | 34.29      |
|                        | Local dealers | 35                               | 16.67      |
|                        | Local people (Nonprofessional) | 38                           | 18.09      |
|                        | Traders (Large scale) | 11                               | 5.23       |
| Experience in relevant field | 5-10 years | 35                                | 16.67      |
|                        | 11-15 years | 62                                | 29.53      |
|                        | More than 15 years | 113                             | 53.80      |
**Taxonomic classification of medicinal plants**

In the present survey, 164 medicinal taxa from 76 families that were traded and utilized as traditional herbal medicine against various ailments were documented in herbal markets of the study area. This included 72 families of Angiosperms (159 species), two families of Gymnosperms (two species) and two families of fungi (three species) (Table 3). The most important plant family was Fabaceae (14 species), followed by Aphanthaceae (12 species), Asteraceae and Lamiaaceae each with 10 species, Zingiberaceae (5 species), Brassicaceae, Combretaceae, Lauraceae, Polygonaceae and Solanaceae with 4 species each (Figure 2). Each taxon was documented along with its market price (US dollars), status (local, imported), uses and trade number (CGP). The most common plant life form traded in the markets was herbs (52.44%), tailed by trees (28.04%), shrub (13.41%) and climber (6.10%).

**Plants parts traded**

The most traded plant parts were seeds (22.90%), followed by fruits (19.88%), leaves (15.67%), roots (10.24%), bark and rhizome (4.82%) as given in (Figure 3). The lesser used parts traded and utilized were corm, latex, pericarp, petals, sap and stigma (0.60%) respectively.

**Availability, trade and price patterns of medicinal plants**

During data collection, availability and average price of each taxon in each district was also documented. A total of 133 species were traded in markets of Peshawar, followed by 128 species in Mardan and Swat, 123 species in Swabi, 118 species in Dir, 109 species in Bannu and 85 species in Kurram. Due to far location of district Kurram from the business hub (Peshawar), only 86 plants were found. Swat and Kurram are the areas located on maximum distance from the provincial hub.

Among the seven districts, Swat and Kurram were the most important medicinal plant collection sites, i.e. the localities where most species for trade were collected. The species found with the highest trade price per kg (US$ 1400 in Kurram) was Crocus sativus, followed by Ferula assa-foetida (US$ 180; imported), Morchella deliciosa and Morchella esculenta, (US$ 11, both) and Orchis mascula (US$ 98.5). These species were not utilized locally as commonly as others, probably due to their high price and international export potential. The lowest price was recorded for Seriphidium kurrasense (0.2$) in Kurram. Currently, the trade and utilization of Senna alexandrina and Artemisia absinthium has increased due to their use throughout the country as anti-COVID-19 herbs. According to the informants most of their revenue came from the sale of Allium cepa, Allium sativum, Brassica campestris, Carum carvi, Camellia sinensis, Coriandrum sativum, Cymbopogon citratus, Foeniculum vulgare, Helianthus annuus, Tamarindus indica, Trachyspermum ammi, Olea ferruginea and Zingiber officinale. Because of their easy availability, low price, daily life uses and high medicinal values these plants were traded and utilized in vast quantity throughout the province. Seriphidium kurrasense (Kurram), Garcinia indica (Peshawar), Terminalia bellirica (Swat), Teucrrium stocksianum (Kurram), Nymphaea alba (Peshawar), Oniconium violaceum (Swat), Murraya koenigii (Peshawar) and Calvatia gigantea (Dir), were collected and traded only in one market respectively. The highest Jaccard Index values such as 78.26 between Mardan and Dir, 76.35 between Peshawar-Mardan and 76.05 between Peshawar-Dir indicated that a large number of plants traded were similar between two districts.

**Therapeutic plant uses**

The current research showed insights into the wide utilization of plants by the inhabitants of various districts of Khyber Pakhtunkhwa. The species with high UV and RFC values had everyday use, e.g. Allium cepa (bulb) was utilized as anthelmintic, carminative and for wasp bites (Swat). The oil of Brassica campestris was used for dandruff and angina (Mardan), and for chest pain (Kurram). The dry seeds of Coriandrum sativum were used as anti-cholesterol, flavouring agent and for indigestion (Banu and Swabi). Camellia sinensis (leaves) were used in high blood pressure, and to treat obesity (Peshawar and Mardan), Ficus carica (fruit) was used against diabetes, amnesia and infertility. The leaves of Lawsonia inermis were used against skin problems; Mentha arvensis leaves served as remedy for digestive disorders; Plantago ovata seeds for constipation and dysentery. Carum carvi was used for digestive disorders, Cymbopogon citratus for obesity, Foeniculum vulgare for stomach problems, Helianthus annuus for body weakness, Tamarindus indica for constipation, Trachyspermum ammi as carminative, Olea ferruginea against hair loss, Zingiber officinale to remedy fever, Morchella esculenta to treat infertility Piper nigrum for fever and Astragalus tribulifolius was used for heat stroke. Artemisia absinthium, Senna alexandrina and Seriphidium kurrasense were used against COVID-19, which was a novelty in dicating the quick reaction of local plant users to confront new health threats. Seriphidium kurrasense was locally collected and consumed only in Kurram.
Table 3. Medicinal plants and fungi traded in the selected Herbal Markets of Khyber Pakhtunkhwa, Pakistan.

| Family          | Scientific name                  | Part(s) traded | Habit | Plant status | Price of each plant in US $/Kg | Medicinal uses                                      | UV   | UR  | RFC | mCI |
|-----------------|----------------------------------|----------------|-------|--------------|--------------------------------|-----------------------------------------------------|-------|-----|-----|-----|
| Acanthaceae     | Acanthus mollis L. Tukhme Ullangan SAL-1 | Leaves         | C     | L            | 21.0 - 21.0 - 20.3 - 20.9 - 20 - | Diarrhea, antisepticx                               | 0.41  | 30  | 0.342 | 0.249 |
| Acoraceae       | Acorus calamus L. Sakawaja SAR-2   | Rhizome        | H     | L            | 2.0 - 1.7 - 1.5 - 1.3 - 1.3 | Dyspepsia/hr., Flatulence                           | 0.46  | 51  | 0.523 | 0.424 |
| Amaranthaceae   | Dysphania botrys (L.) Mosykin & Clemants Kharwa SDL-3 | Leaves   | H     | L            | 1.2 - 1.2 - 1.2 - 1.2 - 1.2 | Diuretic                                           | 0.59  | 69  | 0.552 | 0.382 |
| Amaryllidaceae  | Allium cepa L. Khushk Pyaaz SAB-4  | Bulb           | H     | L            | 1.2 - 1.2 - 1.0 - 1.2 - 1.2 | Anthelmintic, Anteriosclerosis, carminative, wasp biting|x | 0.86  | 177 | 0.976 | 0.842 |
| Amaryllidaceae  | Allium sativum L. Oaga SAB-5       | Bulb           | H     | L            | 16 - 16.7 - 16.5 - 16.5 - 16.0 - 15.0 | Feverx, intestinal worms, Ear ache<sup>2</sup>, hypertension<sup>x</sup> | 0.73  | 146 | 0.952 | 0.694 |
| Anacardiaceae   | Mangifera indica L Amchoor SMF-6   | Powder         | T     | L            | 1.0 - 0.8 - 1.6 - 1.3 - 1.3 - 1.0 | Candidiasis, digestive agent<sup>x</sup>              | 0.74  | 128 | 0.809 | 0.699 |
| Apiaceae        | Anethum graveolens L. Soya SAL-7   | Leaves         | H     | L            | - - 0.4 - 0.6 - 0.5 - | Bone fracture                                     | 0.46  | 27  | 0.276 | 0.299 |
| Apiaceae        | Carum carvi L. Toora zera SDS-8    | Seeds          | H     | L            | 7.0 - 7.0 - 6.9 - 7.2 - 7.4 - | Indigestion<sup>1</sup>, colic<sup>2</sup>, Carminative, flavoring agent<sup>x</sup> | 0.86  | 167 | 0.923 | 0.794 |
| Apiaceae        | Centella asiatica (L.) Urb. Brahmi booti SCL-9 | Leaves | H     | L            | - 3.6 - - - - - 3.0 | Anxiety, Burns<sup>3</sup> | 0.46  | 20  | 0.204 | 0.333 |
| Apiaceae        | Conium maculatum L. Dhanya SCF-10  | Fruit          | H     | L            | 2.0 - 2.2 - 2.0 - 1.9 - 1.9 - 2.0 - 1.6 | High cholesterol, indigestion<sup>1</sup>, colic<sup>2</sup>, carminative | 0.86  | 175 | 0.79  | 0.833 |
| Apiaceae        | Cuminum cyminum L. Speena Zeera SCS-11 | Seeds         | H     | L            | 4.0 - 4.0 - 3.9 - 4.0 - 4.0 - 4.0 - 5.0 | Insufficient break milk, colic problems<sup>x</sup> | 0.72  | 135 | 0.642 | 0.642 |
| Apiaceae        | Daucus carota L. Tukhme gajar SDS-12 | Seeds         | H     | L            | 2.0 - 2.1 - - - 2.4 - 2.4 - 2.0 | Anemia, eye diseases<sup>3</sup> | 0.50  | 38  | 0.342 | 0.253 |
| Apiaceae        | Ferula assa-foetida L. Henja SFR-13 | Latex          | H     | I            | - - - - 180.0 - | Hysteria<sup>x</sup>, expectorant, | 0.16  | 5   | 0.142 | 0.083 |
| Genus                          | Species                        | Part   | L  | 1.9 | 2.0 | 1.6 | 1.4 | 2.0 | 1.5 | laxative<sup>1,3</sup>, pneumonia | 0.71 | 136 | 0.9 | 0.646 |
|-------------------------------|--------------------------------|--------|----|-----|-----|-----|-----|-----|-----|-----------------------------------|------|------|-----|--------|
| *Foeniculum vulgare* Mill.   | Sonf / Kaga                    | Seeds  | L  | 2.0 | 1.9 | 2.0 | 1.6 | 1.4 | 2.0 | Colic, stomachache<sup>3</sup>, colic pain, carminative<sup>3</sup> |      |      |     |        |
| *Pastinaca sativa* L. Saqqal  | Fuss Jafari                    | Root   | L  | 17.0| 17.9| 17.3| 16.4| -   | -   | Diuretic, arthritis               | 0.44 | 31   | 0.333| 0.258  |
| *Petroselinum crispum* (Mill.)| Fuss SPR-15                    | Root   | L  | 39.0| -   | 39.0| -   | -   | -   | 41.9 Anemia, ear diseases, body pain<sup>2</sup> | 0.30 | 14   | 0.219| 0.466  |
| *Pimpinella anisum* L. Suwa  | Ajwain SPR-17                  | Seeds  | L  | -   | 1.7 | 1.4 | 1.4 | -   | -   | Lice, insecticidal                | 0.45 | 25   | 0.261| 0.277  |
| *Trachyspermum ammi* (L.) Sprague | Ajwain STS-18                | Seeds  | L  | 1.5 | 2.8 | 1.3 | 1.1 | 1.4 | 1.3 | Blocked nose<sup>2</sup>, carminative, antiseptic | 0.78 | 117  | 0.714| 0.556  |
| Apocynaceae                   | *Gymnema sylvestre* (Retz.) R. Br. ex Sm. | Leaves | L  | -   | 6.0 | -   | 6.0 | 6.0 | -   | 5.0 Diabetes                        | 0.54 | 19   | 0.166| 0.158  |
| *Rauvolfia serpentina* (L.) Benth ex Kurz | Aasrool SRR-20           | Root   | L  | 7.0 | 7.8 | -   | 7.1 | 9.6 | -   | 6.0 Heart attack<sup>3</sup>, high blood pressure | 0.57 | 61   | 0.509| 0.406  |
| *Wrightia antidysenterica* (L.) R.Br. Andar jotalkh | SBB-21                    | Bark   | I  | 11.0| 10.8| -   | 8.4 | 7.8 | 11.4| 11.3 Mouth sores inflammation<sup>2</sup> | 0.23 | 32   | 0.642| 0.177  |
| *Arecaceae*                   | *Areca catechu* L. Gul-e-separi SAF-22 | Fruit  | I  | 5.7 | 5.0 | 5.7 | -   | 5.4 | 5.0 | 6.0 Amenorrhoea, Dysuria<sup>2</sup>, body tonic<sup>3</sup> | 0.60 | 56   | 0.438| 0.310  |
| *Asclepiadaceae*              | *Calotropis gigantea* (L.) Dryand. Spalmay / Gule madar SCB-23 | Bark   | I  | 4.0 | 4.8 | -   | 3.0 | 3.4 | -   | 3.4 Eye diseases, malaria<sup>2,3</sup> | 0.46 | 30   | 0.309| 0.199  |
| *Asparagaceae*                | *Asparagus racemosus* Willd. Satawar SAR-24 | Roots  | L  | 8.0 | 10.0| -   | 9.6 | 9.6 | 9.4 | 8.3 Vaginal rejuvenation, Cystitis<sup>2,3</sup>, constipation | 0.44 | 35   | 0.371| 0.194  |
| *Asphodelaceae*               | *Aloe vera* (L.) Burm. f. Khushk aloe vera SAS-25 | Sap    | L  | 4.0 | 4.1 | 3.8 | 3.0 | 4.0 | 4.0 | Skin<sup>2,3</sup>, acne<sup>2</sup>, smooth skin, antiseptic<sup>3</sup> | 0.76 | 119  | 0.738| 0.566  |
| Family          | Species Description                  | Part(s) | Active Constituents | Uses                                                                 | Dosage | Standard Dosage | Efficacy |
|-----------------|--------------------------------------|---------|--------------------|----------------------------------------------------------------------|--------|-----------------|----------|
| Asteraceae      | Anacyclus pyrethrum (L.) Lag. Akarkara | H Root  | L -                | 27.0 19.2 23.7 - 0 - 20 - 4.0 - 1.7 - 0 - 1.0 - 2.0 5.0 - 9.0 - 0 |         | 39.0 16 0.195 0.177 |          |
|                 | Artemisia absinthium L. Absanthen   | H Leaves| L -                | 2.0 0.4 - 1.7 - 0 - 2.0 4.0 - 5.0 - 3.9 - 10.2 9.0 - 1.4 0 |         | 0.41 21 0.242 0.174 |          |
|                 | Carthamus oxyacantha M. Bieb.       | H Seeds | L 5.0             | 2.0 0.4 - 5.2 - 0 - 0 9.0 0 |         | 0.24 8 0.157 0.088 |          |
|                 | Centratherum anthelminticum (L.) Gamble | H Seeds | L 3.9             | 4.1 3.5 3.9 5.4 5.0 3.5 0 |         | 0.72 138 0.890 0.647 |          |
|                 | Cichorium intybus L. Kasni           | H Leaves| L 2.0             | 2.3 2.5 1.9 1.7 2.3 1.4 0 |         | 0.58 84 0.680 0.399 |          |
|                 | Helianthus annuus L. Narparas        | H Oil   | L 5.0             | 7.0 7.0 5.0 5.0 7.0 5.0 0 |         | 0.73 150 0.976 0.618 |          |
|                 | Matricaria chamomilla L. Kamilla     | H Flower | L 8.5             | - 7.0 - 10.2 9.0 - 0 |         | 0.52 32 0.290 0.266 |          |
|                 | Rudbeckia hirta L. Beekh-e-susan    | H Root   | L 7.0             | 6.0 6.1 5.8 5.1 6.0 5.0 0 |         | 0.43 32 0.347 0.152 |          |
|                 | Senipidium kurramnse (Qazilb.) Y.R. Ling Gul | S Whole | L -                | 0.2 - 0 - 1.0 0.9 0 |         | 0.18 3 0.076 0.1 |          |
|                 | Berberis taveum L. Kary/ Ziar laryg | S Roots  | L 1.0             | 1.2 1.5 1.0 0.7 0.9 1.0 0 |         | 0.71 128 0.852 0.609 |          |
|                 | Berberis vulgaris L. Zinshak         | S Root   | L 14.8 15.3 - | 14.4 12.5 15.0 10.0 |         | 0.56 67 0.566 0.371 |          |
| Boraginaceae    | Borago officinalis L. Gaozuban       | H Seeds  | I -                | - - 1.8 2.3 - 0 |         | 0.2 6 0.142 0.099 |          |
|                 | Cordia myxa L. Lasaora              | T Fruit  | L -                | - - 4.0 - 4.2 2.0 |         | 0.47 18 0.180 0.199 |          |
|                 | Onosma echioides L. Ratan Jot        | H Root   | L -                | 5.0 4.8 4.8 4.3 0 |         | 0.20 13 0.3 0.108 |
| Genus                  | Scientific Name                                      | Part       | Strength (L) | Slight (L) | Mild (L) | Moderate (L) | Severe (L) | Description                                      | Strength (K) | Slight (K) | Mild (K) | Moderate (K) | Severe (K) | Description                                      | Strength (B) | Slight (B) | Mild (B) | Moderate (B) | Severe (B) | Description                                      | Strength (D) | Slight (D) | Mild (D) | Moderate (D) | Severe (D) | Description                                      |
|-----------------------|------------------------------------------------------|------------|--------------|------------|----------|--------------|------------|-------------------------------------------------|--------------|------------|----------|--------------|------------|-------------------------------------------------|--------------|------------|----------|--------------|------------|-------------------------------------------------|--------------|------------|----------|--------------|------------|-------------------------------------------------|--------------|------------|----------|--------------|------------|-------------------------------------------------|--------------|------------|----------|--------------|------------|-------------------------------------------------|
| Brassicaceae          | Brassica campestris L. Rai SBS-41                    | H Oil L    | 2.1          | 2.4        | 0.9      | 1.0          | 1.5        | 1.5                                              | Dandruff, hair fall, angina², chest pain⁴             | 0.86        | 174       | 0.961   | 0.828                     |                                        |                                                          |              |            |          |              |            |                                                            |
| Brassica           | Brassica juncea L. Rai zard SBS-42                   | H Oil L    | 2.1          | 2.4        | 0.8      | 1.0          | 1.5        | 1.5                                              | Telanus, dandruff, hair fall⁴, neuralgia⁵           | 0.74        | 148       | 0.952   | 0.704                     |                                        |                                                          |              |            |          |              |            |                                                            |
| Lepidium sativum L.  | Aalam SLS-43                                         | H Seeds L  | 1.7          | 1.9        | 1.1      | -            | 0.9        | -                                                | Anorexia, cough, carminative⁴,⁵                     | 0.65        | 89        | 0.847   | 0.593                     |                                        |                                                          |              |            |          |              |            |                                                            |
| Strychnum sito L.     | Khub kalan SSS-44                                     | H Seeds L  | -            | 4.5        | 3.5      | -            | -          | 4.3                                              | Ascaris, anthelmintic⁶                               | 0.26        | 29        | 0.519   | 0.241                     |                                        |                                                          |              |            |          |              |            |                                                            |
| Burseraceae          | Canarium strictum Roxb. Dama SCR-45                  | T Resin L  | -            | -          | -        | 4.8          | -          | -                                                | Tumor, inflammation⁵                                | 0.42        | 8         | 0.090   | 0.133                     |                                        |                                                          |              |            |          |              |            |                                                            |
| Cactaceae            | Opuntia dilleni (Ker Gawl.) Haw. Tohar SOF-46        | S Fruit L  | -            | -          | -        | -            | 0.3        | -                                                | Liver injury, anemia⁵                                | 0.30        | 7         | 0.109   | 0.116                     |                                        |                                                          |              |            |          |              |            |                                                            |
| Caprifoliaceae       | Nardostachys jatamansi (D. Don) DC Balchar SCR-47    | S Root I   | -            | -          | 14.9     | 14.4         | 13.7       | -                                                | Alzheimer, epilepsy⁷, headache                        | 0.28        | 17        | 0.280   | 0.188                     |                                        |                                                          |              |            |          |              |            |                                                            |
| Caricaceae           | Carica papaya L. Pappeela SCF-48                     | H Leaves L | 1.2          | -          | 1.3      | 0.6          | 1.3        | 1.0                                              | Dengue⁶, skin peeling, antiviral⁸                    | 0.61        | 76        | 0.585   | 0.506                     |                                        |                                                          |              |            |          |              |            |                                                            |
| Casuariaceae         | Casuarina equisetifolia L. Mai khurd SCF-49          | T Fruit L  | 7.4          | -          | 7.2      | 7.2          | 7.1        | 6.5                                              | Improve eye sight, immune system                    | 0.48        | 30        | 0.295   | 0.199                     |                                        |                                                          |              |            |          |              |            |                                                            |
| Clusiaeae            | Garcinia indica (Thouras) Chosiy Kokum SGS-50        | T Seeds L  | -            | -          | -        | 12.0         | -          | -                                                | Obesity                                             | 0.42        | 9         | 0.1     | 0.3                      |                                        |                                                          |              |            |          |              |            |                                                            |
| Colchicaceae         | Colchicum luteum Baker Suranjan shirin SCC-51        | H Corn L   | 12.0         | 12.0       | 12.7     | 10.2         | 15.9       | 10.3                                             | Swelling, sexual disability⁹, joint pain⁰            | 0.60        | 62        | 0.490   | 0.295                     |                                        |                                                          |              |            |          |              |            |                                                            |
| Combretaceae         | Anogeissus latifolia (Roxb. ex DC ) Wall. Gule dhao SAF-52 | T Flower L | -            | 7.8        | -        | 8.4          | -          | 7.0                                              | Blood disorders                                    | 0.43        | 24        | 0.261   | 0.444                     |                                        |                                                          |              |            |          |              |            |                                                            |
| Terminalia chebula   | Retz. Harid/Myrobalan STS-53                         | T Seeds L  | 2.4          | 2.4        | 2.4      | 2.4          | 1.8        | 2.0                                              | Asthma, stomach problems                            | 0.20        | 15        | 0.342   | 0.083                     |                                        |                                                          |              |            |          |              |            |                                                            |
| Terminalia bellirica | (Gaerfn.) Roxb. Bheda                                 | T Fruit L  | -            | -          | -        | -            | -          | 3.2                                              | Gray hair, ascaris                                  | 0.38        | 7         | 0.085   | 0.233                     |                                        |                                                          |              |            |          |              |            |                                                            |
| STF-54          | Terminalia arjuna (Roxb.) Wight & Arn. Arjun ki Chaal STB-55 |
|----------------|------------------------------------------------------------|
| T              | Bark                                                       |
| L              | 3.5 - - - 3.8 - 3.6 -                                     |
|                | Kidney stones, angina pectoris                           |
|                | 0.42 16 0.180 0.177                                      |

**Convovulaceae**

| CHW-56         | Casscata reflexa Roxb. Afliyoon/Dooder                     |
|----------------|------------------------------------------------------------|
| T              | Whole Plant                                               |
| L              | 2.5 - - - 2.8 - 1.8 - 2.0                                  |
|                | Emmenagogue, Eczema                                        |
|                | 0.54 41 0.357 0.341                                      |

| SIS-57         | Ipomoea nil (L.) Roth. Tukhm-e-neel                        |
|----------------|------------------------------------------------------------|
| T              | Whole Plant                                               |
| L              | 8.6 8.4 - - - 9.0 - 8.0 - 9.0                              |
|                | Ascariis, asthma                                           |
|                | 0.55 44 0.380 0.293                                      |

**Cucurbitaceae**

| SCF-58         | Cucumeropsis mannii Naudin Chaw rhag SCF-58               |
|----------------|------------------------------------------------------------|
| T              | Fruit                                                      |
| L              | 7.2 7.8 - - - 9.0 - 9.0 - 8.8 - 10.0 -                     |
|                | Lotion                                                     |
|                | 0.27 27 0.476 0.149                                      |

| SMF-59         | Diospyros lotus L. Tour antlok SDF-60                     |
|----------------|------------------------------------------------------------|
| T              | Fruit                                                      |
| L              | 0.5 0.5 0.2 0.5 0.5 - 0.4 - 0.7                           |
|                | Sedative, fever, chest pain, cough                         |
|                | 0.71 138 0.91 0.656                                      |

**Ebenaceae**

| SMF-62         | Croton tiglium L. Jamalkola SCC-81                        |
|----------------|------------------------------------------------------------|
| T              | Seeds                                                      |
| I              | 3.0 - - - 3.0 - 3.0 - 3.4                                  |
|                | Constipation, stomach problems                             |
|                | 0.4 10 0.119 0.083                                       |

| SMF-62         | Mallotus philippensis (Lam.) Müll. Arg. Kambela            |
|----------------|------------------------------------------------------------|
| T              | Fruit                                                      |
| L              | - - - - - 0.2 - 0.2 - 0.2 - 0.2                           |
|                | Ascariis, stomach pain, alexeteric                         |
|                | 0.43 13 0.142 0.433                                      |

| SDF-63         | Rizinus communis L. Tukhm e arand SRS-63                   |
|----------------|------------------------------------------------------------|
| S              | Seeds                                                      |
| L              | 5.0 5.7 - 5.4 6.0 - 2.4 - 2.4                             |
|                | Liver diseases, melisma                                    |
|                | 0.5 29 0.276 0.241                                      |

**Fabaceae**

| SDF-64         | Acacia modesta Wall. Cheer SAQ-64                         |
|----------------|------------------------------------------------------------|
| T              | Gum                                                       |
| L              | 12.8 12.0 - 14.4 12.0 12.0 6.3 -                          |
|                | Relaxant, Fatigue, red eyes                               |
|                | 0.66 107 0.761 0.594                                     |

| SAD-65         | Albizia lebbeck (L.) Benth. Tukhm-e-saras SAS-65          |
|----------------|------------------------------------------------------------|
| T              | Seeds                                                     |
| L              | 5.0 - - - 7.2 8.0 4.0 5.4                                  |
|                | Urticaria, asthma                                          |
|                | 0.54 49 0.428 0.326                                      |

| SAR-116        | Astragalus tribulifolius Benth. ex Bunge Gondkalesa        |
|----------------|------------------------------------------------------------|
| H              | Gum                                                       |
| L              | 8.0 8.3 4.4 3.0 5.8 2.4                                   |
|                | Cooling, heat stroke, adaptogenic                          |
|                | 0.78 136 0.823 0.755                                     |

| SBRG-66        | Butea monosperma (Lam.) Taub. Kamar kas SBRG-66           |
|----------------|------------------------------------------------------------|
| T              | Root, Gum                                                 |
| L              | 5.2 6 - 7.0 4.8 4.8 6.4 5.0 -                            |
|                | Back pain, Kidney diseases, postpartum                     |
|                | 0.70 80 0.619 0.380                                      |

| SCF-67         | Cassia fistula L. Amaltas                                  |
|----------------|------------------------------------------------------------|
| T              | Fruit                                                     |
| L              | 0.9 1.6 0.5 0.8 0.7 1.8 2.0 -                            |
|                | Constipation, abdominal disorders                          |
|                | 0.70 131 0.880 0.623                                     |
| Plant Name                                      | Part Used | Uses                                                                 | Effects                                                                 |
|------------------------------------------------|-----------|----------------------------------------------------------------------|-------------------------------------------------------------------------|
| Cullen corylifolium (L.) Medik. Babchi SC-68   | Seeds     |                                                                      | Leprosy                                                                 | 0.46 | 13 | 0.133 | 0.144 |
| Glycyrrhiza glabra L. Mutthi Aslosos SGR-69    | Root      |                                                                      | Cough<sup>a</sup>, female body tonic after delivery                   | 0.23 | 23 | 0.47  | 0.109 |
| Medicago sativa L. Peshtary SML-70             | Leaves    |                                                                      | Anorexia, Laryngitis, tonic<sup>c</sup>                               | 0.24 | 16 | 0.314 | 0.177 |
| Mimosa pudica L. Lajwanti bareek SSS-71        | Seeds     |                                                                      | Dysentery, colic pain, chest pain<sup>d</sup>                         | 0.51 | 27 | 0.247 | 0.3    |
| Mucuna pruriens (L.) DC. Konche Sufaid SMS-72 | Seeds     |                                                                      | Parkinson’s disease, erectile dysfunction<sup>e</sup>                | 0.55 | 25 | 0.214 | 0.277 |
| Senna alexandrina Mill. Sana Mukhii SSL-73    | Leaves    |                                                                      | Enhance immunity, lungs infection, Anti COVID-19                     | 0.75 | 159 | 0.966 | 0.883 |
| Senna tora (L.) Roxb. Tukhm-e-panaw SSS-74    | Seeds     |                                                                      | Eye infections, reduce weight                                         | 0.45 | 14 | 0.147 | 0.155 |
| Tamarindus indica L. Imli STF-75               | Fruit     |                                                                      | Heat stroke, constipation<sup>f</sup>, abscess, carminative<sup>f</sup> | 0.71 | 150 | 0.952 | 0.713 |
| Trigonella foenum-graecum L. Mulhuzya STS-76  | Seed      |                                                                      | Allergy, fever<sup>g</sup>, child urination                           | 0.35 | 64 | 0.828 | 0.304 |
| Vachellia nilotica (L.) P.J.H. Hurter & Mabb. Gul-e-babol SVG-77 | Gum   |                                                                      | Join pain, leucorrea, chordae, constipation<sup>h</sup>               | 0.60 | 50 | 0.390 | 0.237 |
| Fagaceae                                       | Fruit     |                                                                      | Astringent, chilblains, halitosis                                    | 0.37 | 18 | 0.228 | 0.199 |
| Geraniaceae                                    | Rhizome   |                                                                      | Diarrhea, backache, oral ulcer                                       | 0.42 | 8  | 0.090 | 0.037 |
| Grossulariaceae                                | Powder    |                                                                      | Hair growth, skin care                                               | 0.46 | 29 | 0.3   | 0.193 |
| Hypoxidaceae                                   | Rhizome   |                                                                      | Excessive masturbation, premature ejaculation                         | 0.22 | 8  | 0.168 | 0.122 |
| Family     | Species                          | Part       | SCF  | SCB  | SCB  | SLC  | SSA  | SSS  | SML  | SSR  | STA  | STL  | SCB  | SCF  |
|------------|----------------------------------|------------|------|------|------|------|------|------|------|------|------|------|------|------|
| Iridaceae  | *Crocus sativus* L.              | Stigma     | SCF  | 12.0 | 12.0 | 1200.0 | 1400.0 | 1200.0 | 1200.0 | 1200.0 | 1200.0 | 6.0 | 5.4 | 0.62 |
|            | *Juglans regia* L.              | Fruit      | SJF  | 6.0  | 6.0  | 5.2  | 8.0  | 8.0  | 6.0  | 13.0 | 13.8  | 0.4 | 14.0 | 0.69 |
|            | *Gmelina philippensis* Cham.     | Fruit      | SGR  | 3.6  | 3.1  | 2.5  | 2.4  | 2.4  | 3.0  | 3.0  | 3.0  | 4.0  | 4.0  | 0.69 |
|            | *Salvia hispanica* L.           | Leaves     | SGR  | 1.0  | 1.6  | 0.5  | 1.0  | 0.9  | 1.0  | 1.0  | 1.0  | 0.6  | 0.67 | 0.71 |
|            | *Salvia officinalis* L.          | Leaves     | SSR  | 1.2  | 1.8  | 2.5  | 1.5  | 1.0  | 1.0  | 1.0  | 1.0  | 0.6  | 0.72 | 1.10 |
|            | *Salvia pratensis* L.            | Leaves     | SSR  | 1.2  | 1.8  | 2.5  | 1.5  | 1.0  | 1.0  | 1.0  | 1.0  | 0.6  | 0.72 | 1.10 |
|            | *Teucrium stocksianum* Boiss.   | Stems      | STA  | 1.2  | 1.8  | 2.5  | 1.5  | 1.0  | 1.0  | 1.0  | 1.0  | 0.6  | 0.72 | 1.10 |
|            | *Thymus serphyllum* L.           | Leaves     | STL  | 1.2  | 1.8  | 2.5  | 1.5  | 1.0  | 1.0  | 1.0  | 1.0  | 0.6  | 0.72 | 1.10 |
| Lauraceae  | *Cinnamomum camphora* (L.) J.  | Leaves     | SCB  | 9.0  | 8.8  | 8.9  | 8.9  | 8.9  | 10.0 | 0.4  | 0.4  | 0.4  | 0.4  | 0.4  |
|            | *Cinnamomum verum* J. Presl     | Bark       | SCB  | 5.0  | 4.6  | 5.3  | 4.2  | 5.9  | 4.8  | 4.8  | 4.8  | 0.6  | 0.6  | 0.6  |
|            | *Laurus nobilis* L.             | Leaves     | SCB  | 1.2  | 1.8  | 2.5  | 1.5  | 1.0  | 1.0  | 1.0  | 1.0  | 0.6  | 0.72 | 1.10 |

**Notes:**
- Infertility, azoospermia
- Heart disease
- Atherosclerosis
- Asthma
- Bronchitis
- Heart disease
- Atherosclerosis
- Asthma, digestive disorders
- Anorexia, carminative, antiseptic
- Dental health, kidney problems, skin allergy
- Candidiasis
- Menstrual cycle disorders
- Menstrual cycle disorders
- Rheumatism, eye diseases
- Anorexia, carminative, antiseptic
- Stomach problems, reduce obesity
- Severe coughing, Cold
- Stomach problems, reduce obesity
- Flatulence, dandruff
- Atherosclerosis
- Heart disease
- Atherosclerosis
- Asthma
- Bronchitis
- Heart disease
- Atherosclerosis
- Asthma, digestive disorders
- Anorexia, carminative, antiseptic
- Dental health, kidney problems, skin allergy
- Candidiasis
- Menstrual cycle disorders
- Menstrual cycle disorders
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- Stomach problems, reduce obesity
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- Bronchitis
- Heart disease
- Atherosclerosis
- Asthma, digestive disorders
- Anorexia, carminative, antiseptic
- Dental health, kidney problems, skin allergy
- Candidiasis
- Menstrual cycle disorders
- Menstrual cycle disorders
- Rheumatism, eye diseases
- Anorexia, carminative, antiseptic
- Stomach problems, reduce obesity
- Severe coughing, Cold
- Stomach problems, reduce obesity
- Flatulence, dandruff
| Family        | Species                          | Part       | Yield | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|--------------|----------------------------------|------------|-------|---|---|---|---|---|---|---|---|---|----|
| Litsea glutinosa (Lour.) C.B. Rob. Maida lakir | SLL-97 | Bark | i | - | - | - | 3.4 | - | - | 3.4 | 3.4 | Arthritis¹, external bleeding, bruises |
| Linaceae     | Linum usitatissimum L. Alsi SLB-98 | Seed | H | 1.0 | 1.3 | - | 1.1 | 0.8 | 1.0 | 1.0 | Thyroid problems, constipation, blemishes² |
| Lythraceae   | Lawsonia inermis L. Nakreezy SLL-99 | Powder | S | 0.8 | 1.0 | 2.0 | 0.8 | 0.8 | 1.0 | 1.3 | Baldness³, Skin problems, coloring agent⁴, skin cooling |
| Malvaceae    | Bombax ceiba L. Mochars SBF-100   | Flower | T | 5.0 | 4.8 | - | 6.6 | 4.8 | 4.8 | 5.2 | Impotence, infertility |
|              | Helicteres isora L. Marror Phali SHF-101 | Fruit | S | - | - | - | - | 6.0 | 6.0 | - | Diarrhea, abdominal disorders |
| Meliaceae    | Azadirachta indica A. Juss. Tukhm-e-neem SALS-102 | Leaves, seeds | T | 1.6 | 3.0 | - | 1.2 | 1.0 | 1.2 | 0.7 | Acne, blackheads, hepatitis⁵, body lice |
| Menispermaceae | Tinospora cordifolia (Willd.) Miers Gelo STB-103 | Bark | C | - | 2.0 | - | 2.7 | 3 | 3.5 | 3.6 | Fever, gout, dengue |
| Moraceae     | Ficus carica L. Inzar SFF-104     | Fruit | T | 3.0 | 2.9 | 4.0 | 3.5 | 3.6 | 3.2 | 2.0 | Diabetes, amnesia, infertility, carminative⁶ |
|              | Ficus palmata Forsk. Zangali Inzar SFF-105 | Fruit | T | 9.6 | - | 8.0 | - | 14.3 | 10.0 | 16.0 | 5.0 | Constipation, gall bladder disease |
| Moringaceae  | Moringa oleifera Lam. Suhanjana SML-106 | Leaves | T | 6.2 | 5.4 | - | 5.8 | 6.0 | 5.8 | 6.0 | Immune system, obesity, water retention |
| Myristicaceae | Myristica fragrans Houtt. Jaifal SMS-107 | Seeds | T | 10.0 | 10.0 | 8.0 | 6.9 | 7.8 | 6.6 | 6.2 | 8.3 | Drowsiness, dry mouth⁷, carminative in children⁸ |
| Myrtaceae    | Syzygium aromaticum (L.) Merr. & L.M. Perry. Lawang SSF-108 | Fruit | T | 13.0 | 12.0 | 12.5 | 8.4 | 7.8 | 7.0 | 8.7 | Toothache⁹, flavoring agent ¹⁰ |
| Nymphaeaceae | Nymphaea alba L. Kanwali ka Phool SNF-109 | Aerial parts | H | - | - | - | 1.2 | - | - | - | Anxiety, acne |

¹ Arthritis ² Thyroid problems ³ Baldness ⁴ Skin problems ⁵ Hepatitis ⁶ Body lice ⁷ Diabetes ⁸ Constipation ⁹ Gall bladder disease ¹⁰ Flavoring agent
| Family          | Scientific Name                  | Common Name          | T | Oil | L | 2.0 | 1.5 | 3.9 | 1.4 | 1.2 | 1.5 | 0.8 | Disease/Condition                                      | Score | Percent | p-Value |
|-----------------|----------------------------------|----------------------|---|-----|---|-----|-----|-----|-----|-----|-----|-----|--------------------------------------------------------|-------|---------|---------|
| Oleaceae        | Olea ferruginea Wall. ex Aitch Zaitoon | SOO-110              | T |     |   | 2.0 | 1.5 | 3.9 | 1.4 | 1.2 | 1.5 | 0.8 | Hair fall, fever\textsuperscript{a}, back pain, carminative\textsuperscript{a} | 0.50  | 68      | 0.638   |
|                 |                                  |                      | H | Root |   | 96.0| 98.5| 96.0| 96.0| 96.0| 96.0| 96.0| Sexual diseases, libido male                           | 0.43  | 19      | 0.209   |
|                 |                                  |                      | C | Pods |   | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | Flavoring agent, Intestinal gas\textsuperscript{a}, fever | 0.45  | 14      | 0.147   |
| Orchidaceae     | Orchis mascula (L.) L. Salab Misri | SDR-111              |   |     |   |     |     |     |     |     |     |     | Back pain, carminative                                | 0.50  | 56      | 0.652   |
|                 |                                  |                      |   |     |   |     |     |     |     |     |     |     | Fever, carminative                                    | 0.50  | 56      | 0.652   |
|                 |                                  |                      |   |     |   |     |     |     |     |     |     |     | Fever, carminative                                    | 0.50  | 56      | 0.652   |
| Paeoniaceae     | Paeonia emodi Royle. Mamaikh      | SPL-113              | H | Leaves | L | 2.3 | 1.0 | 0.9 | 2.0 | 1.5 | 2.0 | 2.0 | Biliousness, convulsion                               | 0.48  | 25      | 0.247   |
|                 |                                  |                      | H | Leaves | L | 2.4 | 2.9 | 2.4 | 2.1 | 2.5 | 3.2 | 3.0 | Skin diseases, insufficient breast milk                | 0.59  | 86      | 0.685   | 0.477 |
| Papaveraceae    | Fumaria officinalis L. Shahtara   | SFL-114              | H | Leaves | L | 3.7 | 3.9 | 4.5 | 1.9 | -   | 2.8 | 2.3 | Coughing, sleep disorders, anodyne\textsuperscript{a}  | 0.70  | 145     | 0.976   | 0.690 |
|                 |                                  |                      | H | Seeds, Pods | L | 1.9 | 1.9 | 1.3 | 1.8 | 2.3 | 2.3 | 2.3 | Convalescence, asthenospermia, eye diseases            | 0.50  | 47      | 0.333   | 0.260 |
| Pedaliaceae     | Sesamum indicum L. Sulaid Tal     | SSS-117              | H | Seeds | L | 2.6 | 2.9 | 2.4 | 2.1 | 2.5 | 3.2 | 3.4 | 3.4 | Flavoring agent, asthenospermia                        | 0.47  | 32      | 0.319   | 0.266 |
| Phyllanthaceae  | Phyllanthus emblica L. Khushk Aamla | SPF-118              | T | Fruit | L | 4.0 | 3.1 | 4.8 | 3.4 | 3.0 | 4.1 | 3.2 | 3.2 | Fever, carminative, cough\textsuperscript{a}            | 0.78  | 160     | 0.976   | 0.771 |
| Pteridaceae     | Dryopteris erythrosora (L.) Sm.  | SPS-119              | H | Seeds | L | 3.0 | 2.2 | 3.0 | 10.8| 2.0 | 3.0 | 3.8 | Healing of cuts, Constipation, anti-cholesterol        | 0.86  | 171     | 0.942   | 0.813 |
|                 |                                  |                      | H | Seeds | L | 3.0 | 2.4 | 3.0 | 10.8| 1.9 | 4.0 | 4.0 | Constipation, dysentery, anti-cholesterol              | 0.86  | 171     | 0.942   | 0.813 |
| Plantaginaceae  | Plantago major L. Ishphagol bareek SPS-122 | H | Seeds | L | 3.0 | 2.2 | 3.0 | 10.8| 2.0 | 3.0 | 3.8 | Healing of cuts, Constipation, anti-cholesterol        | 0.86  | 171     | 0.942   | 0.813 |
|                 |                                  |                      | H | Seeds | L | 3.0 | 2.4 | 3.0 | 10.8| 1.9 | 4.0 | 4.0 | Constipation, dysentery, anti-cholesterol              | 0.86  | 171     | 0.942   | 0.813 |
| Poaceae         | Cymbopogon citratus (DC.) Stapf Lemongrass | SCL-124              | H | Leaves | L | 2.0 | 1.9 | 2.1 | 0.7 | 1.2 | 1.3 | 2.3 | Indigestion, loss weight\textsuperscript{a}, low back pain | 0.63  | 125     | 0.942   | 0.594 |
|                 |                                  |                      | H | Seeds | L | 2.4 | 2.4 | 1.8 | 2.4 | 2.4 | 2.4 | 2.4 | Sore throat, skin diseases\textsuperscript{a}          | 0.61  | 103     | 0.8     | 0.490 |
| Family          | Genus/Species                        | Part       | SCF  | Khushk lemon | SAF  | Belgiri | SRR  | SPF  | Bera | Ziziphus nummularia | Ziziphus jujuba | Mamana | SNS  | SAR  | SPF  | Anjabar | SRL  | Shalkhy | SRR  | 11  | 0.109 | 0.199 |
|-----------------|--------------------------------------|------------|------|--------------|------|---------|------|------|------|---------------------|-----------------|--------|------|------|------|------|---------|------|---------|------|-----|-------|-------|
| Rutaceae        | *Rumex dentatus* L. Shalikhy SRL-127 | Leaves     | 0.5  | 0.5          | -    | 0.3     | 0.5  | 0.3  | 0.2  | Dermatitis          |                 |         |      |      |      |      |         |      |         |      |     | 0.280 | 0.179 |
| Rutaceae        | *Polygonum aviculare* L. Anarsawey SPF-129 | Leaves     | -    | 2.7          | 3.0  | 2.3     | 2.1  | 2.1  | 2.5  | Colic*, diarrhea, * |                 |         |      |      |      |      |         |      |         |      |     | 0.304 | 0.147 |
| Punicaceae      | *Punica granatum* L. Anarsawey SPP-129 | Pericarp   | 0.8  | 1.2          | 0.7  | 0.5     | 0.4  | 0.5  | 0.7  | Coughing, Heart disease* |                 |         |      |      |      |      |         |      |         |      |     | 0.976 | 0.628 |
| Ranunculaceae   | *Aconitum heterophyllum* Wall. ex Royle Zaharmora SAR-130 | Rhizome    | -    | -            | -    | -       | -    | 4.3  | 4.3  | Headache, skin diseases, joint pain |                 |         |      |      |      |      |         |      |         |      |     | 0.95  | 0.628 |
| Ranunculaceae   | *Aconitum violaceum* Jacqem. ex Stapf Zaharboty SAR-131 | Root       | -    | -            | -    | -       | -    | -    | 5.7  | Snake bite, arthritis*, inflammation |                 |         |      |      |      |      |         |      |         |      |     | 0.080 | 0.166 |
| Rhamnaceae      | *Nigella sativa* L. Kalvangi SNS-132 | Seeds      | 3.0  | 3.1          | 4.0  | 3.8     | 2.0  | 2.0  | 3.2  | Cardiovascular disease, chest pain* |                 |         |      |      |      |      |         |      |         |      |     | 0.72  | 0.523 |
| Rhamnaceae      | *Sageretia theezans* Brongn. Mamana SSL-133 | Leaves     | -    | -            | -    | -       | -    | 3.9  | 3.9  | Fever, joint pain* |                 |         |      |      |      |      |         |      |         |      |     | 0.171 | 0.199 |
| Rosaceae        | *Ziziphus jujuba* Mill., Beera SZF-134 | Fruit      | 1.4  | 2.0          | 0.8  | 1.8     | 4.0  | 1.0  | 1.0  | Insomnia, tonic*, sex tonic* |                 |         |      |      |      |      |         |      |         |      |     | 0.904 | 0.580 |
| Rosaceae        | *Ziziphus nummularia* (Burm. f.) Wight & Arn. Bera SZF-135 | Fruit      | 1.1  | 1.2          | 0.5  | 0.7     | 0.9  | 1.2  | 0.5  | Cold, diarrhea, inflammation of gums, sex tonic* |                 |         |      |      |      |      |         |      |         |      |     | 0.871 | 0.628 |
| Rosaceae        | *Phinus bokhariensis* Royle ex C.K. Schneid. Aalo Bukhara SPF-136 | Fruit      | 2.6  | 2.9          | -    | 2.4     | 2.4  | 2.7  | 3.2  | Digestive disorders, cooling effect, eye vision*,*SAR, cooling agent* |                 |         |      |      |      |      |         |      |         |      |     | 0.847 | 0.705 |
| Rosaceae        | *Rosa indica* L. Khushik gulab SRR-137 | Petals     | 0.3  | 0.6          | 0.3  | 0.7     | 1.0  | 0.3  | 0.3  | Dry lips, age spots, anti-constipation* |                 |         |      |      |      |      |         |      |         |      |     | 0.842 | 0.594 |
| Rutaceae        | *Aegle marmelos* L. Correa Belgiri SAF-138 | Fruit      | 7.9  | 8.1          | -    | 7.8     | 7.8  | 8.0  | -    | Constipation, Scurvy, peptic ulcer |                 |         |      |      |      |      |         |      |         |      |     | 0.580 | 0.366 |
| Rutaceae        | *Citrus limon* (L.) Osbeck SCF-139 | Fruit      | 1.0  | 1.2          | 1.1  | 1.0     | 1.0  | 1.0  | 1.0  | Smooth digestion, Kidney stones, skin care |                 |         |      |      |      |      |         |      |         |      |     | 0.890 | 0.656 |
| Family         | Genus                  | Part    | Species | Country or Code | Content Code | Voucher Code | C | H | S | T | F | R | L | I | D | Purpose                                                                 |
|---------------|------------------------|---------|---------|----------------|--------------|--------------|--------|---|---|---|---|---|---|---|---|---|-------------------------------------------------------------------------|
| Zingiberaceae | Zingiber                           | Leaves | L       | -              | -            | -            | 8.4    | - | - | - | - | - | - | - | - | Digestive disorders, bruises                                         |
| Vitaceae      | Vitis                  | Leaves | L       | 3.0            | 3.0          | -            | 4.8    | 4.2| - | 3.4| 2.3| - | - | - | - | Irregular menstrual bleeding⁵, leucorrhoea                             |
| Vitaceae      | Vitis                  | Seeds   | L       | 48.0           | 48.0         | 48.0         | -      | - | - | 48.0| - | - | - | - | Indigestion⁶, peeling skin, melisma                                    |
| Tamaricaceae  | Tamarix                | Bark    | L       | -              | -            | 4.0          | 4.7    | 4.7| - | 4.2| 4.2| - | - | - | - | Bladder stones, conjunctivitis, dysentery⁷                              |
| Schisandraceae| Schisandra             | Fruit   | L       | 11.8           | 12.8         | 10.0         | 13.1   | 12.0| 12.0| 13.0| 5 | - | - | - | - | Bloating, colic, stomachache, intestinal gases⁸                         |
| Solanaceae    | Capsicum               | Fruit   | L       | 0.3            | 0.4          | 0.3          | 0.3    | 0.3| - | 0.4| 0.4| - | - | - | - | Increase immunity, pain reliever, taste purpose                       |
| Solanaceae    | Solanum nigrum        | Fruit   | L       | 4.2            | -            | -            | 4.2    | - | - | 4.2| - | - | - | - | Acne, abdominal diseases                                              |
| Solanaceae    | Solanum surnattense   | Fruit   | L       | 5.0            | -            | -            | -      | - | - | - | 5.2| - | - | - | - | Alternative, Asthma                                                    |
| Solanaceae    | Wilfania              | Seeds   | L       | 11.7           | 13.7         | 9.0          | 13.2   | 12.5| 12.0| 12.0| 0 | - | - | - | - | Antidiabetic, liver diseases, indigestion⁹                             |
| Tamaricaceae  | Tamarix aphylla       | Bark    | L       | 2.1            | 2.0          | 0.4          | 1.4    | - | - | 0.9| - | - | - | - | Astringent                                                              |
| Theaceae      | Camellia              | Leaves  | i       | 6.0            | 6.0          | 6.4          | 6.0    | 4.3| - | 6.0| 5.7| - | - | - | - | High blood pressure, obesity⁷, thermo genic⁸                           |
| Violaceae     | Viola serpens         | Fruit   | L       | 7.2            | 8.3          | 11.0         | 7.2    | 7.8| - | 7.2| 6.4| - | - | - | - | Cough, chest problems⁹                                                |
| Vitaceae      | Vitissinavia          | Fruit   | i       | 0.8            | 0.8          | 0.4          | 0.8    | 0.8| - | 1.0| 1.5| - | - | - | - | Testosterone booster⁸, acidosis, carminative⁹                          |
| Zingiberaceae | Alpinia galanga       | Rhizome | L       | -              | -            | -            | 2.4    | 2.0| - | 2.0| - | - | - | - | Impotence⁹, Menstrual cycle disorders                                  |
| Amomum        | Amomum subulatum      | Seeds   | i       | 10.0           | 10.7         | 8.0          | 10.8   | 12.0| 12.0| 11.3| 3 | - | - | - | Nervine, Anti-malarial, brain enhancer                                 |

⁵ Irregular menstrual bleeding, leucorrhoea ⁶ Indigestion, peeling skin, melisma ⁷ Bladder stones, conjunctivitis, dysentery ⁸ Antidiabetic, liver diseases, indigestion ⁹ High blood pressure, obesity, thermo genic ¹⁰ Cough, chest problems ¹¹ Testosterone booster, acidosis, carminative ¹² Impotence, Menstrual cycle disorders ¹³ Nervine, Anti-malarial, brain enhancer
| Species                        | Part          | H | Rhizome | L | 1.5 | 1.4 | 1.3 | 1.4 | 1.2 | 1.4 | 2.1 | 2.3 |
|-------------------------------|---------------|---|---------|---|-----|-----|-----|-----|-----|-----|-----|-----|
| *Curcuma longa* L. Korkaman   | SCR-156       | H | Seeds   | i | 50.0| 50.0| 51.0| 50.0| 50.0| 50.0| 51.0| 1.5 |
| *Elettaria cardamomum* (L.) Maton, Sheen Aaiachi | SEB-157       | H | Seeds   | i | 50.0| 50.0| 51.0| 50.0| 50.0| 50.0| 51.0| 1.4 |
| *Zingiber officinale* Roscoe Sonth | SZR-153       | H | Rhizome | L | 3.5 | 4.3 | 3.5 | 3.8 | 4.2 | 4.0 | 2.8 | 1.3 |
| *Fagonia cretica* L. Dhamasa | SFL-158       | S | Leaves  | L | 35.0| 39.1| 38.0| 36.0| 0.60| 0.338| 0.358|
| *Peganum harmala* L. Spelany SPS-159 | H | Seeds   | L | 1.3 | 1.0 | 1.3 | 1.2 | 1.2 | 1.0 | 2.4 | 1.0 |
| *Cycas revoluta* Thunb. Sago dana | SCB-160       | T | Seeds   | L | 3.0 | 1.2 | 1.1 | 1.0 | 1.0 | 1.0 | 1.0 |
| *Pinus roxburghii* Sarg. Ganda beroza | SPR-161       | T | Resin   | L | 4.7 | 2.9 | -   | -   | 4.0 | 4.2 | 1.0 |
| *Calvatia gigantea* (Batsch ex pers) Lloyd Khareng SCW-182 | H | Whole plant | L | 1.0 | -   | -   | -   | -   | -   | -   | 1.0 |
| *Morchella deliciosa* Fr. Husay/Ghusay SMW-163 | H | Whole Plant | L | 11  | 119.0| 119.0| 119.0| 119.0| 119.0| 119.0| 1.0 |
| *Morchella esculenta* Fr. Husay/ Ghusay SMW-164 | H | Whole Plant | L | 100.0| 119.0| 119.0| 119.0| 119.0| 119.0| 119.0| 1.0 |

| Diseases/Effects             | K            |
|-------------------------------|--------------|
| High cholesterol              | 0.63         |
| Alzheimer's                   | 0.819        |
| Analgesic                     | 0.523        |
| Bad breath                    | 0.66         |
| Indigestion                   | 0.73         |
| Heart burn                    | 1.46         |
| Cooling effect                | 0.60         |
| Diabetes                      | 0.60         |
| Allergy                       | 0.60         |
| Tendinitis                    | 0.60         |
| Nausea                        | 0.60         |
| Fever                         | 0.60         |
| Vomiting                      | 0.60         |
| Diabetes                      | 0.60         |
| Liver tonic                   | 0.60         |
| Analgesic, Stimulate          | 0.60         |
| Burn, bone regeneration       | 0.36         |
| Anticonstipation              | 0.18         |
| Urinary diseases              | 0.43         |
| Antiseptic                    | 0.20         |
| Antiseptic, anthelmintic      | 0.166        |
| Blood clotting                | 0.31         |
| Infertility                   | 0.73         |
| Infertility, purgative        | 0.78         |
| Infertility, tonic, carminative | 0.78     |

*Note: H = Hairy, P = Perennial, M = Monocot, B = Broadleaf, L = Leaf, L = Leaf, T = Tree, S = Seed, R = Resin*
The marketing routes for trade and commercialization of medicinal plants were derived from the interviews with the informants. Figure 4 shows that the majority of the plant’s parts traded in markets of selected districts of Khyber Pakhtunkhwa were collected locally (138 species) while the rest (26 species) were imported from the neighboring countries like China, Nepal, India.

Peshawar (Qissa Khawni bazar) is the central business hub regarding the import and export of medicinal in the Province and all over the country (Figure 5). Mingora (Swat) is the main collection hub for medicinal plants. All the plants collected from Northern areas were brought to Mingora from where they were exported to rest of the Province and all over the country. The herbal markets of Lahore turned out to be the primary trade center getting herbal Figure 5. Routes identified for medicinal plants Trade and Commercialization products and plants from India, China and Karachi. Karachi was the main hub for exporting natural products and plants to abroad.
Figure 4. Status of plants traded in herbal markets

Figure 5. Routes identified for medicinal plants trade and commercialization
Quantitative appraisal of medicinal plants

The current study was the first to document medicinal taxa traded in herbal markets of the seven selected districts of Khyber Pakhtunkhwa. In order to quantify and cross check the importance and local uses of plants various analytical techniques were used, such as Use Value, Use Report, Relative Frequency of Citation and Cultural Importance Index.

Use Value

UV is used to highlight protuberant species in an area and to enumerate relative importance of medicinal plants (Zenderland et al. 2019). In the current study UV ranges from 0.18-0.86. The species with maximum UV were *Allium cepa*, *Bergenia ciliata*, *Brassica campestris*, *Carum carvi*, *Coriandrum sativum* and *Plantago major* each having (0.86) while minimum UV was recorded for *Seriphidium kurramense* (0.18). Other species having high UV included *Lawsonia inermis* (0.80), *Camellia sinensis* (0.79), *Morchella esculenta*, *Piper nigrum*, *Astragalus tribulifolius*, *Trachyspermum ammi* each having (0.78), *Ficus carica* (0.77) and *Aloe vera* (0.76). The high UV values of the plants resulted from their high number of use reports, local collection, easy availability, ethnopharmacological knowledge and average price.

Relative Frequency of Citation and Use Report

RFC ranged from 0.08 to 0.98. The highest RFC value were recorded for *Allium cepa*, *Piper nigrum* and *Punica granatum* (0.976), followed by *Camellia sinensis* and *Ficus carica* (0.971), *Lawsonia inermis*, *Mentha arvensis*, *Plantago ovata* and *Senna alexandrina* (0.966) and *Brassica campestris* (0.961). The lowest RFC values were recorded for *Nymphaea alba* and *Seriphidium kurramense*. The highest RFC value means the plants and their uses are common among the local healers in the study area. The highest number of use reports were found for *Allium cepa* (177), followed by *Coriandrum sativum* (175), *Brassica campestris* and *Trigonella foenum-graecum* (174) each, *Astragalus tribulifolius* (173), and *Curcuma longa* (172). The species having least use report was *Seriphidium kurramense* (3).

Cultural Importance Index

Cultural Importance index and mean CI index were calculated to quantify the importance values of traded plants. The CI value depends on the intensity of use and quality of use of a species for a disease. The Cultural Importance index highlights the range, worth and uses of a species in each locality (Kamalebo et al. 2018). In the current study Cultural importance (CI) and mean cultural importance (mCI) of medicinal plants traded in markets of Khyber Pakhtunkhwa were calculated. The highest mCI value was recorded for *Allium cepa* (0.842), followed by *Coriandrum sativum* (0.833), *Brassica campestris* (0.828) *Morchella deliciosa* (0.816), *Plantago major* (0.813), *Morchella esculenta* (0.799) and *Carum carvi* (0.794). Plants having lowest mCI values were *Ferula assa-foetida*, *Terminalia chebula* and *Croton tiglium* having each (0.83). Various plants are considered sacred because they are cited in holy books (*Allium cepa*, *Brassica campestris*, *Lawsonia inermis*, *Punica granatum* in the Quran), (*Coriandrum sativum* in the Bible). All plants having high cultural importance values were harvest and consumed locally. The highest Cultural values recorded for a single species in a single District was 1 for *Lawsonia inermis* (Mardan), *Piper nigrum* (Swabi), *Plantago major* (Peshawar) and *Senna alexandrina* (Peshawar).

Cross districts assessment

The similarity among the seven Districts was calculated using the Jaccard index (JI). Table 4 shows the similarity among the species present in seven districts. The highest similarity value recorded was 78.26 between Mardan and Dir, followed by Peshawar and Mardan (76.35), Peshawar and Dir (76.05), Swat and Swabi (74.64). The least Jaccard similarity value was between Peshawar and Kurram (50.30).

Table 4. Jaccard Index of similarity among the selected markets

|       | Bannu | Dir   | Kurram | Mardan | Peshawar | Swabi | Swat  |
|-------|-------|-------|--------|--------|----------|-------|-------|
| Bannu | x     |       |        |        |          |       |       |
| Dir   | 66.176| x     | 53.658 | 69.784 | 70.714   | 66.911| 69.064|
| Kurram| 53.658| 52.30 | x      | 45.833 | 50.704   | 53.03 | 48.591|
| Mardan| 69.784| 78.26 | 45.833 | x      | x        | 68.666| 74.64 |
| Peshawar| 70.714| 76.05 | 50.704 | 76.35  | x        |       |       |
| Swabi | 66.911| 66.206| 53.03  | 68.666 | x        |       |       |
| Swat  | 69.064| 67.808| 48.591 | 67.32  | 67.741   | 74.64 |       |
The transfer of medicinal knowledge from one generation to the next is a time dependent process (Hussain et al. 2012; Kanwal and Sherazi 2017, Larsen and Smith 2004). Over harvesting is a major problem in the context of medicinal plant use and trade (Hamayun et al. 2003).

The number of medicinal plants traded and utilized in the herbal markets of Khyber Pakhtunkhwa was higher than comparative results in previous studies. A total of 133 species were traded in markets of Peshawar, followed by 128 species in Mardan and Swat, 123 species in Swabi, 118 species in Dir, 109 species in Bannu and 85 species in Kurram compared to the 92 plants reported from herbal markets of District Rawalpindi (Punjab Province) (Ahmad et al. 2016). Only 44 medicinal plants were traded in herbal markets of Makerwal and Gulla Khel (Zougagh et al. 2019), and 103 species were traded in herbal markets of Gilgit-Baltistan (Yebouk et al. 2020). Peshawar was however the central hub for medicinal plants trade. Majority of the revenue of herbal dealers were generated from the plants that have average price, easy and local availability, common uses, and traded in each District. Men were generally more knowledgeable and active in medicinal plants trade and utilization than women, as also found in other studies (Malik et al. 2019, Zougagh et al. 2019). In our study seeds were the most traded plant part, in contrast to other studies (e.g. Panmei et al. 2019) who found leaves as more commonly traded.

**Novelty Profile and Future Research**

The current study is the first cross district study on plant resource utilization and trade in the herbal markets of Khyber Pakhtunkhwa. Plants and their uses such as *Acorus calamus* for flatulence from Mardan, Peshawar and Swabi, *Artemisia absinthium, Senna alexandrina* and *Seriphidium kurramese* (Kurram) for COVID-19, *Berberis lyceum* and *Butea monosperma* for back pain were reported for the first time from the selected districts. It was also observed and documented that the price and medicinal uses of a plant may be varying from one district to another. Three species *Artemisia absinthium, Senna alexandrina* and *Seriphidium kurramese* (Kurram) was documented for the first time from Pakistan as anti-COVID-19. Of course the use of plants against COVID-19 has to be seen with a caveat, because the majority of the study occurred before the pandemic.

**Conclusions**

The present investigation of traded therapeutic taxa uncovers a rich assorted variety of herbal culture and socio-financial assets of collectors, herbalists, healers, traders and local people inhabited in the herbal markets of Khyber Pakhtunkhwa. During data collection it was also found that due to lack of proper attention and identification various herbal products and plants were unauthenticated, misidentified and not stored in suitable environment (temperature, light, humidity) due to which it may produce huge misunderstanding and hurdles in primary health care. The plants having high importance should be further investigated for their secondary metabolites in clinical scientific laboratories to regulate their potential in treatment of various human ailments in primary health care medical services. A balance is required between the value of plant trade and the environmental services provided by the local vegetation. The increasing supply needed in local markets is a problem mainly because most of the plants are harvested from the wild. As the trade has become international and market-oriented, the activities of a growing number of gatherers are outstripping natural plant populations. Conservation and better management of medicinal plant resources are urgently needed.

**Declarations**

**List of abbreviation:** H: Herb; S, Shrub; T: Tree; C, Climber; L: Local; I: Imported; B: Use only in Banu; D: Use only in Dir; K: Use only in Kurram; M: Use only in Mardan; P: Use only in Peshawar; SW: Use only in Swabi; S: Use only in Swat; UR: Use Report; UV: Use Value; RFC: Relative Frequency of Citation; mCI: Mean Cultural Importance value; Kg: Kilogram (Mass unit); $: US dollar

**Ethics approval and consent to participate:** All participants were informed about the aim and objectives of the study and provided their prior informed consent.

**Consent for publication:** Not applicable

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**Author contribution:** W. Hussain: Study design and monitor the whole project. Sulaiman and Murad: Conduct surveys and structure the methodology. Sikandar and Sheharyar: Analyze, interpret and write the manuscript. Lal Badshah: Review and proofread the manuscript. R.W. Bussmann: Critical revision of the manuscript. All authors read, reviewed and approved the manuscript.

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### Supplementary Table 1. Socio-demographics of the respondents

| Parameter            | Classes          | Banu | Dir | Kurrum | Mardan | Peshawar | Swabi | Swat | Frequency of respondents in each class | Percentage of respondents |
|----------------------|------------------|------|-----|--------|--------|----------|-------|------|----------------------------------------|--------------------------|
| Gender               | Male             | 29   | 27  | 28     | 28     | 30       | 26    | 27   | 195                                    | 92.86                    |
|                      | Female           | 1    | 3   | 2      | 2      | 0        | 4     | 3    | 15                                     | 7.14                     |
| Age classes          | 20-40 years      | 5    | 7   | 10     | 6      | 8        | 11    | 10   | 57                                     | 27.14                    |
|                      | 40-60 years      | 18   | 14  | 17     | 16     | 22       | 11    | 20   | 118                                    | 56.20                    |
|                      | Above 60 years   | 7    | 9   | 3      | 8      | 0        | 8     | 0    | 35                                     | 16.66                    |
| Educational background | Illiterate       | 4    | 7   | 10     | 0      | 3        | 3     | 2    | 27                                     | 12.86                    |
|                      | Matriculate      | 2    | 4   | 4      | 2      | 1        | 0     | 2    | 15                                     | 7.14                     |
|                      | Intermediate     | 7    | 5   | 5      | 6      | 5        | 8     | 6    | 42                                     | 20                       |
|                      | Diploma holder   | 11   | 9   | 9      | 10     | 9        | 10    | 8    | 66                                     | 31.42                    |
|                      | Graduate         | 6    | 4   | 2      | 9      | 12       | 9     | 11   | 53                                     | 25.23                    |
|                      | Postgraduate     | 0    | 1   | 0      | 3      | 3        | 0     | 0    | 7                                      | 3.34                     |
| Respondents professions | Collectors      | 1    | 4   | 6      | 1      | 0        | 2     | 7    | 21                                     | 10                       |
|                      | Healers          | 4    | 6   | 1      | 4      | 5        | 6     | 7    | 33                                     | 15.72                    |
|                      | Herbalists       | 9    | 8   | 7      | 10     | 15       | 14    | 9    | 72                                     | 34.29                    |
|                      | Local dealers    | 8    | 4   | 9      | 6      | 4        | 1     | 3    | 35                                     | 16.67                    |
|                      | Local people (Nonprofessional) | 7    | 6   | 4      | 9      | 5        | 4     | 3    | 38                                     | 18.09                    |
|                      | Traders (Wholesale) | 1    | 2   | 3      | 0      | 1        | 3     | 1    | 11                                     | 5.23                     |
| Experience in relevant professions | 5-10 years | 4    | 5   | 7      | 6      | 6        | 4     | 3    | 35                                     | 16.67                    |
|                      | 11-15 years      | 10   | 8   | 9      | 7      | 11       | 7     | 10   | 62                                     | 29.53                    |
|                      | More than 15 years | 16   | 17  | 14     | 17     | 13       | 19    | 17   | 113                                    | 53.80                    |
**Supplementary Table 2. Use reports of each medicinal plant traded in selected districts of Khyber Pakhtunkhwa**

| Scientific name                                | UR  | Banu | Dir  | Kurrum | Mardan | Peshawar | Swabi | Swat |
|------------------------------------------------|-----|------|------|--------|--------|----------|-------|------|
| **Angiosperms**                                |     |      |      |        |        |          |       |      |
| Acacia modesta Wall.                           | 107 | 15   | 18   | -      | 21     | 13       | 17    | 23   |
| Acanthus mollis L.                             | 30  | 9    | -    | 8      | 4      | 8        | 5     | -    |
| Aconitum heterophyllum Wall. ex Royle          | 10  | -    | -    | -      | -      | -        | 3     | 7    |
| Aconitum violaceum Jacquem. ex Stapf           | 7   | -    | -    | -      | -      | -        | -     | 7    |
| Acorus calamus L.                              | 51  | -    | 9    | -      | 7      | 10       | 14    | 11   |
| Aegle marmelos (L.) Correa                     | 55  | 12   | 9    | -      | 16     | 10       | 8     | -    |
| Albizia lebbeck (L.) Benth.                    | 49  | 5    | -    | 18     | 9      | 11       | 6     |      |
| Allium cepa L.                                 | 177 | 27   | 26   | 27     | 22     | 27       | 22    | 26   |
| Allium sativum L.                              | 146 | 20   | 24   | 21     | 11     | 25       | 20    | 25   |
| Aloe vera (L.) Burm. f.                        | 119 | 18   | 18   | 15     | 14     | 16       | 17    | 21   |
| Alpinia galanga (L.) Willd.                    | 12  | -    | -    | -      | 4      | 3        | 5     | -    |
| Amomum subulatum Roxb.                         | 130 | 21   | 19   | 22     | 14     | 16       | 18    | 20   |
| Anacyclus pyrethrum (L.) Lag.                  | 16  | -    | 4    | -      | 5      | 7        | -     | -    |
| Anethum graveolens L.                          | 27  | -    | -    | 7      | -      | 11       | 9     | -    |
| Anogeissus latifolia (Roxb. ex DC.) Wall.      | 24  | -    | 8    | -      | 7      | -        | 9     | -    |
| Areca catechu L.                               | 56  | 8    | 7    | 10     | -      | 11       | 11    | 9    |
| Artemisia absinthium L.                        | 21  | -    | 5    | 7      | -      | 4        | -     | 5    |
| Asparagus racemosus Willd.                     | 35  | 7    | 5    | -      | 5      | 6        | 7     | 5    |
| Astragalus tribulifolius Benth. ex Bunge        | 136 | 19   | 28   | -      | 23     | 19       | 20    | 27   |
| Azadirachta indica A.Juss.                     | 61  | 14   | 11   | -      | 9      | 10       | 13    | 4    |
| Berberis lycium L.                             | 128 | 16   | 14   | 17     | 21     | 17       | 20    | 23   |
| Berberis vulgaris L.                           | 67  | 11   | 8    | 9      | 12     | 14       | 13    |      |
| Bergenia ciliata (Haw.) Sternb                 | 50  | -    | 6    | -      | 4      | 12       | 16    | 12   |
| Bombax ceiba L.                                | 69  | 13   | 12   | 9      | 13     | 12       | 12    | 10   |
| Borago officinalis L.                          | 6   | -    | -    | 2      | 4      | -        | -     | -    |
| Brassica campestris L.                         | 174 | 26   | 24   | 23     | 27     | 25       | 24    | 25   |
| Brassica juncea (L.)                           | 148 | 23   | 19   | 23     | 18     | 20       | 21    | 24   |
| Butea monosperma (Lam.) Taub.                  | 80  | 10   | 6    | 9      | 11     | 13       | 19    | 12   |
| Calotropis gigantea (L.) Dryand.               | 30  | 6    | 5    | -      | 6      | 7        | -     | 5    |
| Camellia sinensis (L.) Kuntze.                 | 162 | 29   | 23   | 27     | 19     | 18       | 22    | 24   |
| Canarium strictum Roxb.                        | 8   | -    | -    | 3      | -      | -        | -     | 5    |
| Capsicum annuum L.                             | 87  | 13   | 10   | 14     | 18     | 6        | 14    | 12   |
| Species                                      | Column 1 | Column 2 | Column 3 | Column 4 | Column 5 | Column 6 | Column 7 | Column 8 |
|------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|
| Carica papaya L.                              | 76       | 14       | -        | 13       | -        | 15       | 16       | 18       |
| Carthamus tinctorius L.                        | 12       | -        | -        | -        | 4        | 8        | -        | -        |
| Carthamus oxyacantha M. Bieb.                 | 8        | 3        | -        | -        | 3        | -        | -        | 2        |
| Carum carvi L.                                | 167      | 24       | 28       | 22       | 25       | 20       | 22       | 26       |
| Cascatula reflexa Roxb.                       | 41       | 9        | -        | -        | 11       | -        | 12       | 9        |
| Cassia fistula L.                             | 131      | 13       | 16       | 20       | 22       | 19       | 20       | 21       |
| Casuarina equisetifolia L.                    | 30       | 6        | -        | -        | 7        | 4        | 6        | 7        |
| Centella asiatica (L.) Urb.                   | 20       | -        | 8        | -        | -        | -        | -        | 12       |
| Centratherum anthemanticum (L.) Gamble        | 136      | 17       | 16       | 19       | 18       | 24       | 23       | 19       |
| Cichorium intybus L.                          | 84       | 13       | 10       | 12       | 14       | 11       | 13       | 11       |
| Cinnamomum camphora (L.) J. Presl             | 30       | 5        | 6        | -        | 3        | 7        | 4        | 5        |
| Cinnamomum verum J. Presl                    | 138      | 23       | 14       | 19       | 21       | 14       | 19       | 28       |
| Citrus limon (L.) Osbeck                      | 138      | 17       | 19       | 23       | 28       | 26       | 15       | 10       |
| Colchicum futeum Baker                        | 62       | 9        | 8        | 6        | 10       | 10       | 7        | 12       |
| Cordia myxa L.                                | 18       | -        | -        | -        | 7        | -        | 4        | 7        |
| Coriandrum sativum L.                         | 175      | 24       | 22       | 25       | 27       | 26       | 27       | 24       |
| Crocus sativus L.                             | 84       | 12       | 16       | 13       | 19       | 10       | 9        | 5        |
| Croton tiglium L.                             | 10       | 2        | -        | -        | 3        | -        | 3        | 2        |
| Cucumeropsis mannii Naudin                   | 27       | 6        | 3        | -        | 5        | 7        | 2        | 4        |
| Cullen corylifolium (L.) Medik.               | 13       | -        | 5        | -        | 6        | 2        | -        | -        |
| Cuminum cyminum L.                            | 135      | 24       | 13       | 21       | 20       | 22       | 16       | 19       |
| Curculigo orchioidea Gaertn.                  | 8        | -        | 3        | -        | 3        | 2        | -        | -        |
| Curcuma longa L.                              | 110      | 17       | 16       | 19       | 17       | 15       | 13       | 13       |
| Cymbopogon citratus (DC.) Stapf               | 125      | 23       | 19       | 12       | 11       | 17       | 25       | 18       |
| Daucus carota L.                              | 38       | 6        | 7        | -        | 8        | -        | 7        | 10       |
| Diospyros lotus L.                            | 138      | 23       | 19       | 24       | 18       | 11       | 22       | 21       |
| Dysphania botryis (L.) Mosykin & Clemants     | 69       | 11       | 10       | -        | 8        | 17       | 12       | 11       |
| Elettaria cardamomum (L.) Maton,-             | 95       | 15       | 10       | 14       | 11       | 17       | 15       | 13       |
| Fagonia cretica L.                            | 43       | -        | 13       | -        | 15       | 9        | -        | 6        |
| Ferula assa-foetida L.                        | 5        | -        | -        | -        | -        | 2        | -        | 3        |
| Ficus carica L.                               | 158      | 23       | 19       | 28       | 23       | 27       | 20       | 18       |
| Ficus palmata Forsk.                          | 74       | 23       | -        | -        | 14       | 18       | 13       | 6        |
| Foeniculum vulgare Mill.                     | 136      | 24       | 20       | 19       | 20       | 18       | 16       | 19       |
| Fumaria officinalis L.                        | 28       | 5        | 3        | 7        | 4        | 3        | -        | 6        |
| Garcinia indica (Thouras) Choisy              | 9        | -        | -        | -        | 9        | -        | -        | -        |
| Geranium wallichianum D.Don ex Sweet          | 8        |          |          |          |          |          |          |          |
| Common Name | Scientific Name | Acidity | Bitterness | Sweetness | Astringency | Spiciness | Total Score |
|-------------|-----------------|---------|------------|-----------|-------------|-----------|-------------|
| Glycyrrhiza glabra L. | *Glycyrrhiza glabra* L. | 23 | 5 | 3 | 4 | 2 | 3 | 2 | 4 |
| Gymnema sylvestre (Retz.) R.Br. ex. Sm. | *Gymnema sylvestre* (Retz.) R.Br. ex. Sm. | 19 | - | 6 | - | 4 | 5 | - | 4 |
| Helianthus annuus L. | *Helianthus annuus* L. | 150 | 18 | 22 | 21 | 22 | 24 | 19 | 24 |
| Helicteres isora L. | *Helicteres isora* L. | 8 | - | - | - | 3 | 5 | - | 4 |
| Hordeum vulgare L. | *Hordeum vulgare* L. | 103 | 12 | 19 | 17 | 20 | 12 | 13 | 10 |
| Ipomoea nil (L.) Roth. | *Ipomoea nil* (L.) Roth. | 44 | 9 | - | - | 11 | 8 | 7 | 6 |
| Juglans regia L. | *Juglans regia* L. | 115 | 23 | 25 | 29 | 13 | 12 | 6 | 7 |
| Lallemantia royleana (Benth.) Benth. | *Lallemantia royleana* (Benth.) Benth. | 144 | 16 | 13 | 25 | 20 | 14 | 27 | 29 |
| Lawsonia inermis L. | *Lawsonia inermis* L. | 163 | 23 | 15 | 22 | 29 | 30 | 19 | 25 |
| Lepidium sativum L. | *Lepidium sativum* L. | 89 | 17 | 17 | 15 | - | 19 | - | 21 |
| Linum usitatissimum L. | *Linum usitatissimum* L. | 91 | 13 | 19 | - | 15 | 11 | 15 | 18 |
| Litsea glutinosa (Lour.) C.B. Rob. | *Litsea glutinosa* (Lour.) C.B. Rob. | 20 | - | - | - | 11 | - | 5 | 4 |
| Mallotus philippensis (Lam.) Müll.-Arg. | *Mallotus philippensis* (Lam.) Müll.-Arg. | 13 | - | - | - | - | - | 7 | 6 |
| Mangifera indica L. | *Mangifera indica* L. | 126 | 24 | - | 18 | 22 | 17 | 20 | 25 |
| Matricaria chamomilla L. | *Matricaria chamomilla* L. | 32 | 7 | - | 8 | - | 9 | 8 | - |
| Medicago sativa L. | *Medicago sativa* L. | 16 | - | - | 4 | 5 | - | 7 | - |
| Mentha arvensis L. | *Mentha arvensis* L. | 138 | 13 | 22 | 20 | 14 | 29 | 12 | 28 |
| Mentha longifolia L. | *Mentha longifolia* L. | 133 | 23 | 15 | 18 | 25 | 29 | 13 | 10 |
| Mimosa pudica L. | *Mimosa pudica* L. | 27 | - | 9 | 12 | 6 | - | - | - |
| Momordica charantia L. | *Momordica charantia* L. | 63 | 10 | 13 | - | 17 | 9 | 7 | 7 |
| Moringa oleifera Lam. | *Moringa oleifera* Lam. | 102 | 16 | 25 | - | 19 | 14 | 15 | 13 |
| Mucuna pruriens (L.) DC. | *Mucuna pruriens* (L.) DC. | 25 | - | - | - | 8 | 10 | 7 |
| Munaya koenigii (L.) Spreng. | *Munaya koenigii* (L.) Spreng. | 7 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Myristica fragrans Houtt. | *Myristica fragrans* Houtt. | 35 | 6 | 2 | 7 | 8 | 4 | 2 | 6 |
| Nardostachys jatamansi (D. Don) DC | *Nardostachys jatamansi* (D. Don) DC | 17 | - | 6 | - | 5 | 6 | - | - |
| Nigella sativa L. | *Nigella sativa* L. | 110 | 17 | 12 | 15 | 16 | 14 | 18 | 18 |
| Nymphaea alba L. | *Nymphaea alba* L. | 8 | - | - | 8 | - | - | - | - |
| Ocimum basilicum L. | *Ocimum basilicum* L. | 110 | 20 | 16 | 12 | 20 | 17 | 15 | 10 |
| Olea ferruginea Wall. ex Aitch | *Olea ferruginea* Wall. ex Aitch | 68 | 12 | 9 | 10 | 7 | 8 | 9 | 13 |
| Onosma echiosioides L. | *Onosma echiosioides* L. | 13 | - | 4 | - | 3 | 3 | - | 3 |
| Opuntia dillenii (Ker Gawl.) Haw. | *Opuntia dillenii* (Ker Gawl.) Haw. | 7 | - | - | - | 5 | - | 2 | - |
| Orchis mascula (L.) L. | *Orchis mascula* (L.) L. | 19 | 3 | 5 | - | 6 | 5 | - | - |
| Paeonia emodi Royle. | *Paeonia emodi* Royle. | 25 | - | 5 | - | 4 | 6 | 3 | 7 |
| Species Name                                      | Code 1 | Code 2 | Code 3 | Code 4 | Code 5 | Code 6 | Code 7 | Code 8 | Code 9 |
|--------------------------------------------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| Papaver somniferum L.                            | 145    | 23     | 19     | 18     | 20     | 18     | 19     | 28     |
| Pastinaca sativa L.                               | 31     | 9      | 7      | -      | 6      | 8      | -      | -      |
| Peganum harmala L.                                | 42     | 4      | 8      | 6      | 4      | 9      | 5      | 6      |
| Petroselinum crispum (Mill.) Fuss               | 42     | 15     | -      | 11     | -      | -      | -      | 16     |
| Phyllanthus emblica L.                            | 47     | 5      | 12     | -      | 8      | 7      | 9      | 6      |
| Plantago major L.                                 | 31     | 3      | 8      | 5      | 2      | 5      | 4      | 4      |
| Plantago ovata Forssk.                           | 135    | 18     | 21     | 24     | 20     | 15     | 22     | 15     |
| Polygonum aviculare L.                           | 31     | 3      | 8      | 5      | 2      | 5      | 4      | 4      |
| Prunus bokhariensis Royle ex C.K. Schneid.        | 127    | 16     | 13     | -      | 23     | 24     | 26     | 25     |
| Punica granatum L.                                | 132    | 19     | 17     | 21     | 20     | 13     | 20     | 22     |
| Quercus infectoria G. Olivier                     | 18     | -      | -      | -      | -      | 6      | 8      | 4      |
| Rauvolfia serpentina (L.) Benth. ex Kurz          | 61     | -      | 15     | 14     | 12     | 11     | -      | 9      |
| Rheum australe D. Don                             | 11     | -      | 5      | -      | -      | 7      | -      | -      |
| Ribes uva-crispa L.                               | 29     | -      | 6      | 4      | 5      | 9      | 5      | -      |
| Ricinus communis L.                               | 29     | -      | 7      | -      | 8      | 10     | -      | 4      |
| Rosa indica L.                                    | 125    | 23     | 22     | 16     | 25     | 17     | 10     | 12     |
| Rudbeckia hirta L.                                | 32     | 6      | 4      | 5      | 6      | 4      | 4      | 3      |
| Rumex dentatus L.                                 | 27     | 5      | -      | 4      | 6      | 7      | 5      |        |
| Sageretia theezans Brongn.                        | 12     | -      | -      | -      | -      | -      | 7      | 5      |
| Salvia hispanica L.                               | 15     | -      | 4      | 7      | -      | 4      | -      | -      |
| Salvia officinalis L.                             | 12     | -      | -      | -      | -      | -      | 5      | 7      |
| Salvia pratensis L.                               | 17     | -      | 4      | -      | 3      | 2      | 6      | 2      |
| Santalum album L.                                 | 22     | -      | 5      | -      | 7      | 4      | 6      | -      |
| Senna alexandrina Mill.                          | 159    | 23     | 28     | 27     | 25     | 30     | 26     |        |
| Senna tora (L.) Roxb.                             | 14     | 5      | -      | 4      | -      | 5      | -      | -      |
| Seriphidium kurzmannse (Qazilb.) Y.R. Ling        | 3      | -      | -      | 3      | -      | -      | -      | -      |
| Sesamum indicum L.                                | 86     | 21     | 16     | -      | 18     | 19     | 7      | 5      |
| Sibirium ino L.                                   | 29     | -      | 6      | 8      | -      | -      | 9      | 6      |
| Solanum nigrum L.                                 | 13     | -      | -      | -      | 6      | -      | 4      | 3      |
| Solanum surattense Burn. f.                       | 9      | -      | 1      | 2      | 1      | 2      | -      | 3      |
| Syzygium aromaticum (L.) Merr. & L.M.Perry.       | 130    | 19     | 13     | 16     | 14     | 20     | 23     | 25     |
| Tamarindus indica L.                              | 150    | 23     | 26     | 19     | 25     | 20     | 19     | 18     |
| Species                                      | Code1 | Code2 | Code3 | Code4 | Code5 | Code6 | Code7 | Code8 |
|----------------------------------------------|-------|-------|-------|-------|-------|-------|-------|-------|
| Tamarix aphylla (L.) H. Karst.               | 40    | 5     | 6     | -     | 13    | 12    | -     | 4     |
| Terminalia arjuna (Roxb. DC.) Wight & Arn.  | 16    | 5     | -     | -     | -     | 7     | 4     | -     |
| Terminalia bellirica (Gaertn.) Roxb.         | 7     | -     | -     | -     | -     | -     | -     | 7     |
| Terminalia chebula Retz.                     | 15    | 3     | 2     | -     | 4     | 3     | 1     | 2     |
| Teucrium stocksianum Boiss.                  | 10    | -     | -     | 10    | -     | -     | -     | -     |
| Thymus serphyllum L.                         | 22    | -     | -     | -     | 11    | 5     | 6     | -     |
| Tinospora cordifolia (Willd.) Meirs          | 50    | 10    | 7     | -     | 6     | 4     | 11    | 12    |
| Trachyspermum ammi (L.) Sprague              | 117   | 18    | 17    | 15    | 20    | 15    | 18    | 14    |
| Trigonella foenum-graecum L.                 | 64    | 14    | 9     | 12    | 5     | 8     | 6     | 10    |
| Vachellia nilotica (L.) P.J.H. Hurter & Mabb.| 50    | 3     | 6     | 5     | 12    | 7     | 9     | 8     |
| Vanilla planifolia Jacks.ex Andrews         | 14    | 6     | -     | -     | 5     | -     | -     | 3     |
| Viola serpens Wall. ex Ging.                 | 85    | 9     | 11    | 6     | 10    | 7     | 18    | 24    |
| Vitis vinifera L.                            | 145   | 19    | 18    | 15    | 23    | 21    | 27    | 22    |
| Withania coagulans (Stocks) Dunal            | 53    | 7     | 9     | 12    | 6     | 3     | 10    | 6     |
| Wrightia antidysenterica (L.) R.Br.          | 32    | 6     | 4     | -     | 4     | 5     | 6     | 7     |
| Zanthoxylum armatum DC.                      | 98    | 19    | 15    | -     | 20    | 12    | 13    | 19    |
| Zingiber officinale Roscoe                   | 146   | 15    | 23    | 24    | 22    | 18    | 23    | 19    |
| Ziziphus jujuba Mill.                        | 122   | 23    | 19    | 16    | 13    | 10    | 22    | 19    |
| Ziziphus nummularia (Burm.f.) Wight & Arn.   | 132   | 15    | 16    | 20    | 23    | 17    | 22    | 19    |
| Gymnosperms                                  |       |       |       |       |       |       |       |       |
| Cyclic Revoluta Thunb.                       | 14    | -     | -     | 3     | 4     | 2     | 4     | 1     |
| Pinus roxburghii Sarg.                       | 20    | -     | 6     | 4     | -     | 7     | 3     |       |
| Fungi                                        |       |       |       |       |       |       |       |       |
| Calvatia gigantea (Batsch ex Pers.) Lloyd    | 5     | -     | 5     | -     | -     | -     | -     | -     |
| Morchella deliciosa Fr.                      | 98    | -     | 23    | -     | 25    | -     | 29    | 21    |
| Morchella esculenta Fr.                      | 144   | 23    | 28    | 25    | 19    | -     | 21    | 28    |
### Supplementary Table 3. RFC, CI and mCI of each medicinal plant traded in selected districts of Khyber Pakhtunkhwa

| Scientific name | RFC Banu | RFC Dir | RFC Kurram | RFC Mardan | RFC Peshawar | RFC Swat | RFC Swat | Σ of all CI | Plant present in districts | mCI   |
|-----------------|----------|---------|-----------|-----------|-------------|---------|---------|-----------|--------------------------|-------|
| **Angiosperms** |          |         |           |           |             |         |         |           |                          |       |
| Acacia modesta Wall. | 0.5 | 0.6 | - | 0.7 | 0.433 | 0.566 | 0.766 | 3.565 | 6 | 0.594 |
| Acanthus mollis L. | 0.3 | - | 0.266 | 0.133 | 0.133 | 0.166 | - | 0.998 | 4 | 0.249 |
| Aconitum heterophyllum Wall. ex Royle | 0.633 | 0.566 | 0.7 | 0.666 | 0.433 | 0.666 | 0.733 | 4.397 | 7 | 0.628 |
| Aconitum violaceum Jacqem. ex Stapf | - | - | - | 0.1 | 0.233 | 0.333 | 2 | 0.166 |
| Acorus calamus L. | - | 0.3 | - | 0.233 | 0.333 | 0.466 | 0.366 | 1.698 | 4 | 0.424 |
| Aegle marmelos (L.) Correa | 0.4 | 0.3 | - | 0.533 | 0.333 | 0.266 | - | 1.832 | 5 | 0.3664 |
| Albizia lebbeck (L.) Benth. | 0.166 | - | - | 0.6 | 0.3 | 0.366 | 0.2 | 1.632 | 5 | 0.326 |
| Allium cepa L. | 0.9 | 0.866 | 0.9 | 0.733 | 0.9 | 0.733 | 0.866 | 5.896 | 7 | 0.842 |
| Allium sativum L. | 0.666 | 0.8 | 0.7 | 0.366 | 0.833 | 0.666 | 0.833 | 4.864 | 7 | 0.694 |
| Aloe vera (L.) Burm. f. | 0.6 | 0.6 | 0.5 | 0.466 | 0.533 | 0.566 | 0.7 | 3.965 | 7 | 0.566 |
| Alpinia galanga (L.) Wild. | - | - | - | 0.133 | 0.1 | 0.166 | - | 0.399 | 3 | 0.133 |
| Amomum subulatum Roxb | 0.7 | 0.633 | 0.733 | 0.466 | 0.533 | 0.8 | 0.666 | 4.331 | 7 | 0.618 |
| Anacyclus pyrethrum (L.) Lag. | - | 0.133 | - | 0.166 | 0.233 | - | - | 0.532 | 3 | 0.177 |
| Anethum graveolens L. | - | - | 0.233 | - | 0.366 | 0.3 | - | 0.899 | 3 | 0.299 |
| Anogeissus latifolia (Roxb. ex DC.) Wall. | 0.8 | - | 0.233 | - | 0.3 | - | 1.333 | 3 | 0.444 |
| Areca catechu L. | 0.266 | 0.233 | 0.333 | - | 0.366 | 0.366 | 0.3 | 1.864 | 6 | 0.310 |
| Artemisia absinthium L. | - | 0.166 | 0.233 | - | 0.133 | - | 0.166 | 0.698 | 4 | 0.174 |
| Asparagus racemosus Wild. | 0.233 | 0.166 | - | 0.166 | 0.2 | 0.233 | 0.166 | 1.164 | 6 | 0.194 |
| Astragalus tribulifolius Benth. ex Bunge | 0.633 | 0.933 | - | 0.766 | 0.633 | 0.666 | 0.9 | 4.531 | 6 | 0.755 |
| Azadirachta indica A.Juss. | 0.466 | 0.366 | - | 0.3 | 0.333 | 0.433 | 0.133 | 2.031 | 6 | 0.338 |
| Berberis lyceum L. | 0.533 | 0.466 | 0.566 | 0.7 | 0.566 | 0.666 | 0.766 | 4.263 | 7 | 0.609 |
| Berberis vulgaris L. | 0.366 | 0.266 | 0.566 | 0.7 | 0.566 | 0.466 | 0.433 | 2.231 | 6 | 0.371 |
| Bergenia ciliata (Haw.) Sternb | - | 0.2 | - | 0.133 | 0.4 | 0.533 | 0.4 | 1.666 | 5 | 0.333 |
| Bombax ceiba L. | 0.433 | 0.4 | - | 0.3 | 0.433 | 0.4 | 0.333 | 2.299 | 6 | 0.383 |
| Borage officinalis L. | - | - | - | 0.066 | 0.133 | - | - | 0.199 | 2 | 0.099 |
| Brassica campestris L. | 0.866 | 0.8 | 0.766 | 0.9 | 0.833 | 0.8 | 0.833 | 5.798 | 7 | 0.828 |
| Brassica juncea (L.) | 0.766 | 0.633 | 0.766 | 0.6 | 0.666 | 0.7 | 0.8 | 4.931 | 7 | 0.704 |
| Butea monosperma (Lam.) Taub. | 0.333 | 0.2 | 0.3 | 0.366 | 0.433 | 0.633 | 0.4 | 2.665 | 7 | 0.380 |
| Calotropis gigantea (L.) Dryand. | 0.233 | 0.166 | - | 0.2 | 0.233 | - | 0.166 | 0.998 | 5 | 0.199 |
| Camellia sinensis (L.) Kuntze. | 0.966 | 0.766 | 0.9 | 0.833 | 0.8 | 0.733 | 0.8 | 5.398 | 7 | 0.771 |
| Canarium strictum Roxb. | - | - | - | 0.1 | - | - | 0.166 | 0.266 | 2 | 0.133 |
| Capsicum annuum L. | 0.433 | 0.333 | 0.466 | 0.6 | 0.2 | 0.466 | 0.4 | 2.898 | 7 | 0.414 |
| Carica papaya L. | 0.466 | - | 0.433 | - | 0.5 | 0.533 | 0.6 | 2.532 | 5 | 0.506 |
| Carthamus oxyacantha M. Bieb. | 0.1 | - | - | 0.1 | - | - | 0.066 | 0.266 | 3 | 0.088 |
| Plant Name                                      | 0.166 | 0.2 | 0.3 | 0.4 | 0.5 | 0.6 | 0.7 | 0.8 | 0.9 |
|------------------------------------------------|------|-----|-----|-----|-----|-----|-----|-----|-----|
| Carthamus tinctorius L.                        | -    | -   | -   | 0.133| 0.266| -   | -   | 0.399| 2   |
| Carum carvi L.                                 | 0.8  | 0.933| 0.733| 0.833| 0.666| 0.733| 0.866| 5.564| 7   |
| Cascuta reflexa Roxb.                          | 0.3  | -   | -   | 0.366| -   | 0.4 | 0.3 | 1.366| 4   |
| Cassia fistula L.                              | 0.433| 0.533| 0.666| 0.733| 0.633| 0.666| 0.7  | 4.364| 7   |
| Casuarina equisetifolia L.                     | 0.2  | -   | -   | 0.233| 0.133| 0.2  | 0.233| 0.999| 5   |
| Centella asiatica (L.) Urb.                    | -    | 0.266| -   | -   | -   | -   | 0.4 | 0.666| 2   |
| Centratherum anthemninctum (L.) Gamble          | 0.566| 0.533| 0.633| 0.6  | 0.8  | 0.766| 0.633| 4.531| 7   |
| Cichorium intybus L.                           | 0.433| 0.333| 0.4  | 0.466| 0.366| 0.433| 0.366| 2.797| 7   |
| Cinnamonum camphora (L.) J.Presl               | 0.166| 0.2  | -   | 0.1  | 0.233| 0.133| 0.166| 0.998| 6   |
| Cinnamonum verum J. Presl                      | 0.766| 0.466| 0.633| 0.7  | 0.466| 0.633| 0.933| 4.597| 7   |
| Citrus limon (L.) Osbeck                       | 0.566| 0.633| 0.766| 0.933| 0.866| 0.5  | 0.333| 4.597| 7   |
| Colchicum luteum Baker                         | 0.3  | 0.266| 0.2  | 0.333| 0.333| 0.233| 0.4  | 2.065| 7   |
| Cordia myxa L.                                 | -    | -   | -   | 0.233| -   | 0.133| 0.233| 0.599| 3   |
| Coriandrum sativum L.                          | 0.8  | 0.733| 0.833| 0.9  | 0.866| 0.9  | 0.8  | 5.832| 7   |
| Crocus sativus L.                              | 0.4  | 0.533| 0.433| 0.633| 0.333| 0.3  | 0.166| 2.798| 7   |
| Crotalaria ligustrina L.                       | 0.066| -    | -   | 0.1  | -   | 0.1  | 0.066| 0.332| 4   |
| Cucumeropas mannii Naudin                      | 0.2  | 0.1  | -   | 0.166| 0.233| 0.066| 0.133| 0.898| 6   |
| Cullen coryloifolium (L.) Medik.               | -    | 0.166| -   | 0.1  | 0.366| -   | -   | 0.432| 3   |
| Curcuma zyganthum L.                           | 0.8  | 0.433| 0.1  | 0.7  | 0.666| 0.733| 0.533| 4.498| 7   |
| Curculiof orchideoides Gaertn.                  | -    | -   | -   | 0.1  | 0.1  | 0.1  | 0.666| -    | 3   |
| Curcuma longa L.                               | 0.566| 0.533| 0.633| 0.566| 0.5  | 0.433| 0.433| 3.664| 7   |
| Cymbopogon citratus (DC.) Stapf                | 0.766| 0.633| 0.4  | 0.366| 0.566| 0.833| 0.6  | 4.164| 7   |
| Daucus carota L.                               | 0.2  | 0.233| -   | 0.266| -  | 0.233| 0.333| 1.265| 5   |
| Diospyros lotus L.                             | 0.766| 0.633| 0.8  | 0.6  | 0.366| 0.733| 0.7  | 4.598| 7   |
| Dysphania botrys (L.) Mosykin & Clements        | 0.366| 0.333| -   | 0.266| 0.566| 0.4  | 0.366| 2.297| 6   |
| Elettaria cardamomum (L.) Maton                | 0.5  | 0.333| 0.466| 0.366| 0.566| 0.5  | 0.433| 3.164| 7   |
| Fagonia cretica L.                             | -    | 0.433| -   | 0.5  | 0.3  | -   | 0.2  | 1.433| 4   |
| Ferula assa-foetida L.                         | -    | -   | -   | -    | 0.066| -   | 0.1  | 0.166| 2   |
| Ficus carica L.                                | 0.766| 0.633| 0.933| 0.766| 0.9  | 0.666| 0.6  | 5.264| 7   |
| Ficus palmata Forsk.                           | 0.766| -    | 0.466| -    | 0.6  | 0.433| 0.2  | 2.465| 5   |
| Foeniculum vulgare Mill.                      | 0.8  | 0.66 | 0.633| 0.666| 0.8  | 0.533| 0.633| 4.525| 7   |
| Fumaria officinalis L.                         | 0.166| 0.1  | 0.233| 0.133| 0.1  | -   | 0.2  | 0.932| 6   |
| Garcinia indica (Thouras) Choisy               | -    | -   | -   | -    | 0.3  | -   | -    | 0.3  | 1   |
| Geranium wallachianum D. Don ex Sweet          | -    | -   | -   | 0.1  | 0.166| 0.266| -    | 0.133| 2   |
| Glycyrrhiza glabra L.                          | 0.166| 0.1  | 0.133| 0.066| 0.1  | 0.066| 0.133| 0.764| 7   |
| Gmelina philippensis Cham.                     | -    | -   | -   | 0.266| 0.2  | 0.466| 0.2  | 0.233| 2   |
| Species                                           | Column 1 | Column 2 | Column 3 | Column 4 | Column 5 | Column 6 | Column 7 |
|---------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|
| Gymnema sylvestre (Retz.) R.Br. ex. Sm.           |          |          |          |          |          |          |          |
| Helianthus annuus L.                              | 0.6      | 0.066    | 0.7      | 0.733    | 0.8      | 0.633    | 0.8      | 4.332    | 7       | 0.618 |
| Helicteres isora L.                               | -        | -        | -        | -        | 0.1      | 0.166    | -        | 0.266    | 2       | 0.133 |
| Hordeum vulgare L.                                | 0.4      | 0.633    | 0.566    | 0.666    | 0.4      | 0.433    | 0.333    | 3.431    | 7       | 0.490 |
| Ilicium verum Hook. f.                            | 0.1      | 0.133    | 0.166    | 0.066    | 0.233    | 0.166    | 0.266    | 1.13     | 7       | 0.161 |
| Ipomoea nil (L.) Roth.                            | 0.4      | -        | -        | 0.366    | 0.266    | 0.233    | 0.2      | 1.465    | 5       | 0.293 |
| Juglans regia L.                                  | 0.766    | 0.833    | 0.966    | 0.433    | 0.4      | 0.2      | 0.233    | 3.831    | 7       | 0.547 |
| Lactuca usitatissimum L.                          | 0.433    | 0.633    | -        | 0.5      | 0.366    | 0.5      | 0.6      | 3.032    | 6       | 0.505 |
| Lithospermum officinale L.                        | -        | -        | 0.366    | -        | 0.166    | 0.133    | 0.665    | 3        | 0.221 |
| Mallotus philippensis (Lam.) Mull. Arg.           | -        | -        | -        | -        | 0.233    | 0.2      | 0.433    | 1        | 0.433 |
| Mangifera indica L.                               | 0.8      | -        | 0.6      | 0.733    | 0.566    | 0.666    | 0.833    | 4.198    | 6       | 0.699 |
| Matricaria chamomilla L.                          | 0.233    | 0.266    | -        | 0.3      | 0.266    | -        | 1.065    | 4        | 0.266 |
| Medicago sativa L.                                |          |          |          |          |          |          |          |          |        |
| Mentha arvensis L.                                | 0.433    | 0.733    | 0.666    | 0.466    | 0.966    | 0.4      | 0.933    | 4.597    | 7       | 0.656 |
| Menthona longifolia L.                            | 0.766    | 0.5      | 0.6      | 0.833    | 0.966    | 0.433    | 0.333    | 4.431    | 7       | 0.633 |
| Mimosa pudica L.                                  | -        | 0.3      | 0.4      | 0.2      | -        | 0.9      | -        | 0.3      |        |
| Momordica charantia L.                            | 0.333    | 0.433    | -        | 0.566    | 0.3      | 0.233    | 0.233    | 2.988    | 6       | 0.349 |
| Morinda oleifera Lam.                             | 0.533    | 0.833    | -        | 0.833    | 0.466    | 0.5      | 0.433    | 3.398    | 6       | 0.566 |
| Mucuna pruriens (L.) DC.                          | -        | -        | -        | 0.266    | 0.333    | 0.233    | 0.832    | -        | 3       | 0.277 |
| Muraya koenigii (L.) Spreng.                      | 0.566    | 0.633    | 0.768    | 0.933    | 0.866    | 0.5      | 0.333    | 4.597    | 7       | 0.656 |
| Myristica fragrans Houtt.                          | 0.2      | 0.066    | 0.233    | 0.266    | 0.133    | 0.066    | 0.2      | 1.164    | 7       | 0.166 |
| Nardostachys jatamansi (D. Don) DC                | -        | 0.2      | -        | 0.166    | 0.2      | -        | -        | 0.566    | 3       | 0.188 |
| Nigella sativa L.                                 | 0.566    | 0.4      | 0.5      | 0.533    | 0.466    | 0.8      | 0.6      | 3.665    | 7       | 0.523 |
| Nymphaea alba L.                                  | -        | -        | 0.266    | -        | -        | -        | 0.266    | 1        | 0.266 |
| Ocimum basilicum L.                                | 0.666    | 0.53     | 0.4      | 0.666    | 0.566    | 0.5      | 0.333    | 3.661    | 7       | 0.523 |
| Olea europaea L.                                  | 0.4      | 0.3      | 0.333    | 0.233    | 0.266    | 0.3      | 0.433    | 2.265    | 7       | 0.323 |
| Onosma echoides L.                                | -        | 0.133    | -        | 0.1      | 0.1      | -        | 0.1      | 0.433    | 4       | 0.108 |
| Opuntia dilleni (Ker-Gawl.) Haw.                  | -        | -        | -        | -        | 0.166    | -        | 0.066    | 0.232    | 2       | 0.116 |
| Orchis mascula (L.)                               | 0.1      | 0.166    | -        | 0.2      | 0.166    | -        | 0.632    | 4        | 0.158 |
| Paeonia emodi Royle.                              | -        | 0.166    | -        | 0.133    | 0.2      | 0.1      | 0.233    | 0.832    | 5       | 0.166 |
| Papaer somniferum L.                              | 0.766    | 0.633    | 0.6      | 0.666    | 0.8      | 0.633    | 0.933    | 4.831    | 7       | 0.690 |
| Pastinaca sativa L.                               | 0.333    | 0.233    | -        | 0.2      | 0.266    | -        | 1.032    | 4        | 0.258 |
| Peganum harmala L.                                | 0.133    | 0.266    | 0.2      | 0.133    | 0.3      | 0.166    | 0.2      | 1.398    | 7       | 0.199 |
| Petroelium crispum (Mill.) Fuss                   | 0.5      | -        | 0.366    | -        | -        | 0.533    | 1.399    | 3        | 0.466 |
| Phyllanthus emblica L.                            | 0.166    | 0.4      | -        | 0.2666   | 0.233    | 0.3      | 0.2      | 1.5656   | 6       | 0.260 |
| Plant Name                        | P.  | V.  | F.  | P.  | V.  | F.  | P.  | V.  | F.  |
|----------------------------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| Teucrium                        | 0.3 | 0.266 | 0.266 | - | - | - | 0.832 | 3 | 0.277 |
| Piper cubeba L.f.                | 0.233 | - | - | 0.266 | 0.3 | 0.266 | - | 1.065 | 4 | 0.266 |
| Piper longum L.                  | 0.266 | 0.266 | - | 0.233 | 0.3 | - | - | 1.065 | 4 | 0.266 |
| Piper nigrum L.                  | 0.8 | 0.066 | 0.966 | 1.066 | 0.533 | 1 | 0.966 | 5.397 | 7 | 0.771 |
| Plantago major L.                | 0.733 | 0.666 | 0.8 | 0.966 | 1 | 0.766 | 0.766 | 5.697 | 7 | 0.813 |
| Plantago ovata Forssk.           | 0.6 | 0.7 | 0.8 | 0.966 | 0.5 | 0.733 | 0.5 | 4.499 | 7 | 0.642 |
| Polygonum aviculare L.           | 0.1 | 0.266 | 0.966 | 0.066 | 0.1666 | 0.133 | 0.133 | 1.0306 | 7 | 0.147 |
| Prunus bokhariensis Royle ex C.K. Schned. | 0.533 | 0.433 | - | 0.766 | 0.8 | 0.866 | 0.833 | 4.231 | 6 | 0.705 |
| Punica granatum L.               | 0.633 | 0.566 | 0.7 | 0.966 | 0.433 | 0.666 | 0.733 | 4.397 | 7 | 0.628 |
| Quercus infectoria G. Olivier    | - | - | - | 0.2 | 0.666 | 0.133 | 0.599 | 3 | 0.199 |
| Rauwolfia serpentina (L.) Benth. ex Kurz | - | 0.5 | 0.466 | 0.4 | 0.366 | - | 0.3 | 2.032 | 5 | 0.406 |
| Rheum australe D. Don.           | 0.166 | - | - | 0.233 | - | - | 0.399 | 2 | 0.199 |
| Ribes uva-crispa L.              | - | 0.2 | 0.133 | 0.166 | 0.3 | 0.166 | - | 0.965 | 5 | 0.193 |
| Ricinus communis L.              | - | 0.233 | - | 0.266 | 0.333 | - | 0.133 | 0.965 | 4 | 0.241 |
| Rosa indica L.                   | 0.766 | 0.733 | 0.533 | 0.833 | 0.566 | 0.333 | 0.4 | 4.164 | 7 | 0.594 |
| Rudbeckia hirta L.               | 0.2 | 0.133 | 0.166 | 0.2 | 0.133 | 0.133 | 0.1 | 1.065 | 7 | 0.152 |
| Rumex dentatus L.                | 0.166 | - | - | 0.133 | 0.2 | 0.233 | 0.166 | 0.898 | 5 | 0.179 |
| Sageretia theezans Brongn.       | - | - | - | - | - | - | 0.233 | 0.166 | 0.399 | 2 | 0.199 |
| Salvia hispanica L.              | - | 0.133 | 0.233 | - | 0.133 | - | - | 0.233 | 0.166 | 0.399 | 2 | 0.199 |
| Salvia officinalis L.            | - | - | - | - | - | - | - | 0.166 | 0.233 | 0.399 | - | 2 | 0.199 |
| Salvia pratensis L.              | - | 0.133 | - | 0.1 | 0.066 | 0.2 | 0.666 | 0.566 | 4 | 0.113 |
| Santalum album L.                | - | 0.166 | - | 0.033 | 0.133 | 0.2 | - | 0.732 | 4 | 0.183 |
| Senna alexandrina-Mill.          | 0.766 | 0.933 | 0.9 | 0.833 | - | 0.866 | 0.5298 | 6 | 0.883 |
| Senna tora (L.) Roxb.            | 0.166 | - | 0.133 | 0.166 | - | - | 0.465 | 3 | 0.155 |
| Seriphidium kurrmannse (Qazib.) Y.R. Ling | - | - | 0.1 | - | - | - | 0.1 | 1 | 0.1 |
| Sesamum indicum L.               | 0.7 | 0.533 | - | 0.6 | 0.633 | 0.233 | 0.166 | 2.865 | 6 | 0.477 |
| Sisymbrium intro L.              | - | 0.2 | 0.266 | - | - | 0.2 | 0.2 | 0.966 | 4 | 0.241 |
| Solarium nigrum L.               | 0.433 | 0.333 | 0.466 | 0.6 | 0.2 | 0.466 | 0.4 | 2.898 | 7 | 0.414 |
| Solarium surrattense Burm. f.    | 0.2 | - | 0.133 | - | 0.1 | - | 0.433 | 3 | 0.144 |
| Syzygium aromaticum (L.) Merr. & L.M.P erry. | 0.633 | 0.433 | 0.533 | 0.466 | 0.666 | 0.766 | 0.833 | 4.33 | 7 | 0.618 |
| Tamarindus indica L.              | 0.766 | 0.866 | 0.633 | 0.833 | 0.666 | 0.633 | 0.6 | 4.997 | 7 | 0.713 |
| Tamarix aphylla -(L.) H.Karst.    | 0.166 | 0.3 | - | 0.433 | 0.4 | - | 0.133 | 1.432 | 5 | 0.286 |
| Terminalia arjuna (Roxb. DC.) Wight &Am. | 0.166 | - | - | - | 0.233 | 0.133 | - | 0.532 | 3 | 0.177 |
| Terminalia bellirica (Gaertn ) Roxb. | - | - | - | - | - | 0.233 | 0.233 | - | 1 | 0.233 |
| Terminalia chebula Retz.          | 0.1 | 0.066 | - | 0.133 | 0.1 | 0.033 | 0.066 | 0.498 | 6 | 0.083 |
| Teucrium stocksianum Boiss.       | - | 0.333 | - | - | - | 0.333 | 1 | 0.333 |
| Species                                                                 | Dimensions | V1 | V2 | V3 | V4 | V5 | V6 | V7 | V8 |
|------------------------------------------------------------------------|------------|----|----|----|----|----|----|----|----|
| *Thymus serphyllum* L.                                                  | -          | -  | -  | 0.366 | 0.166 | 0.2 | -  | 0.732 | 3 | 0.244 |
| *Tinospora cordifolia* (Willd.) Meirs                                 | 0.333      | 0.233 | -  | 0.2  | 0.133 | 0.366 | 0.4 | 1.665 | 6 | 0.277 |
| *Trachyspermum ammi* (L.) Sprague                                    | 0.6        | 0.566 | 0.5 | 0.666 | 0.5  | 0.6  | 0.466 | 3.898 | 7 | 0.556 |
| *Trigonella foenum-graecum* L.                                        | 0.466      | 0.3  | 0.4 | 0.166 | 0.266 | 0.2  | 0.333 | 2.131 | 7 | 0.304 |
| *Vachellia nilotica* (L.) P.J.H. Hurter & Mabb.                       | 0.1        | 0.2  | 0.166 | 0.4  | 0.233 | 0.3  | 0.266 | 1.665 | 7 | 0.237 |
| *Vanilla planifolia* Jacks.ex Andrews                                 | 0.2        | -    | -  | 0.166 | -    | 0.1  | -  | 0.466 | 3 | 0.155 |
| *Viola serpens* Wall. ex Ging.                                        | 0.3        | 0.366 | 0.2 | 0.333 | 0.233 | 0.6  | 0.8  | 2.832 | 7 | 0.404 |
| *Vitis vinifera* L.-                                                  | 0.633      | 0.6  | 0.5 | 0.766 | 0.7  | 0.9  | 0.733 | 4.832 | 7 | 0.690 |
| *Withania coagulans* (Stocks) Dunal                                   | 0.233      | 0.3  | 0.4 | 0.2  | 0.133 | 0.333 | 0.2  | 1.766 | 7 | 0.252 |
| *Wrightia anidiysenterica* (L.) R. Br.                                | 0.2        | 0.133 | -  | 0.133 | 0.166 | 0.2  | 0.233 | 1.065 | 6 | 0.177 |
| *Zanthoxylum armatum* DC.                                             | 0.633      | 0.5  | -  | 0.666 | 0.4  | 0.433 | 0.633 | 3.265 | 6 | 0.544 |
| *Zingiber officinale* Roscoe                                          | 0.566      | 0.766 | 0.8 | 0.733 | 0.6  | 0.766 | 0.633 | 4.864 | 7 | 0.694 |
| *Ziziphus jujuba* Mill.                                               | 0.766      | 0.633 | 0.533 | 0.433 | 0.333 | 0.733 | 0.633 | 4.064 | 7 | 0.580 |
| *Ziziphus nummularia* (Burm. f.) Wight & Arn.                         | 0.5        | 0.533 | 0.666 | 0.766 | 0.566 | 0.733 | 0.6333 | 4.3973 | 7 | 0.628 |

**Gymnosperms**

| Species                        | Dimensions | V1 | V2 | V3 | V4 | V5 | V6 | V7 | V8 |
|--------------------------------|------------|----|----|----|----|----|----|----|----|
| *Cycas revoluta* Thunb.        | -          | -  | 0.1 | 0.133 | 0.066 | 0.133 | 0.033 | 0.465 | 5 | 0.093 |
| *Pinus roxburghii* Sarg.       | -          | 0.2 | 0.133 | -  | -  | 0.233 | 0.1  | 0.666 | 4 | 0.166 |

**Fungi**

| Species                | Dimensions | V1 | V2 | V3 | V4 | V5 | V6 | V7 | V8 |
|------------------------|------------|----|----|----|----|----|----|----|----|
| *Calvatia gigantea* (Batsch ex Pers.) Lloyd   | -          | 0.166 | -  | -  | -  | -  | 0.166 | 1 | 0.166 |
| *Morchella delicosa* Fr.       | -          | 0.766 | 0.833 | -  | 0.966 | 0.7  | 3.265 | 4 | 0.816 |
| *Morchella esculenta* Fr.     | 0.766      | 0.933 | 0.833 | 0.833 | -  | 0.7  | 0.933 | 4.798 | 6 | 0.799 |
“Questionnaire for Collecting Data from Herbal Markets of Khyber Pakhtunkhwa”

1. Market name ....................
2. Respondent Name ......................
3. Age ................
4. Gender ................
5. Respondents Profession ..................
6. Experience ......................
7. Education
   a) Illiterate
   b) Matriculate
   c) Intermediate
   d) Diplomats
   e) Graduate
   f) Post Graduate
8. Income per month of the respondent....................

9. List of Plants sold/ used in the specific market
   a) ......................
   b) ......................
   c) ......................
   d) ......................
   e) ......................

10) Part of the specific plant used

| Plant Name | Parts used |
|------------|------------|
|            | Leaves | Stems | Roots | Flowers | Rhizome | Bark | Bulb | Seed | Whole plant |
|            |        |       |       |         |         |      |      |      |             |
|            |        |       |       |         |         |      |      |      |             |
|            |        |       |       |         |         |      |      |      |             |
|            |        |       |       |         |         |      |      |      |             |
|            |        |       |       |         |         |      |      |      |             |

11) Price of each plant in local unit
   a) ......................
   b) ......................
   c) ......................
   d) ......................
   e) ......................

12) Plant Availability
   a) Local
   b) Imported

13) If Imported then from which city .................

14) Medicinal use of the plant
   a) ......................
   b) ......................
c) ................................

d) ................................

e) ..............................

15) Nature of each Plant (Habit)

a) ..........................

b) ..........................

c) ..........................

d) ..........................

e) ..........................