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Ethnobotanical documentation of traditional knowledge about medicinal plants used by indigenous people in the Talash Valley of Dir Lower, northern Pakistan

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ABSTRACT

Aim/Background: The indigenous communities of the Talash Valley district Dir Lower, in Northwest Khyber Pakhtunkhwa, Pakistan, depend on ethnomedicine for their basic health care. The aim of this survey was to identify, collect, and document significantly distinguishable ethnomedicinal plants and their ethnopharmacological application among the indigenous communities of the Talash Valley, Dir Lower, Pakistan.

Materials and Methods: Open-ended and semi-structured interviews, questionnaires, inquiries, and group discussion were conducted from March 2014 to September 2015 to obtain ethnobotanical data from the local herbalist and elder villagers. Quantitatively, the ethnobotanical data were analyzed by using indices, Use Value, Relative frequency of citation, and Informant Agreement Ratio.

Results: The study identified a total of 50 medicinal plant species belonging to 33 botanical families and 46 genera in the 17 villages. Lamiaceae with 6 species is the dominant family, and herbs (68%) the main sources of herbal formulations. Leaves (41%) are the main parts for ethnomedicine, and 32% of drug orally administrated in the form of decoction.

Conclusion: The Talash Valley is rich in its medicinal plant's flora and the associated traditional knowledge. Ethnomedicine plays an important role in the local healthcare system. The finding of new medicinal uses, recipes; vernacular plant names, using new morphological parts, and harvesting methods in the current study show the importance of the documentation of plant resources and ethnobotanical knowledge. We suggest and recommend that documented plants to be screened for further ethnopharmacological studies.

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Introduction

Despite the increasing development and growth of the pharmaceutical industry, still the world uses much ethnomedicine to treat basic ailments [1]. Nowadays, ethnomedicines have gained popularity in many countries and indigenous people living in different parts of the world use medicinal plants as sources of medicine for the treatment of various human ailments [2,3]. Ethnomedicine plays a very important role in health issues of indigenous communities, and they also address healing practices as well as the healthcare seeking process [4]. From early on, mankind used natural materials and thereby gained a considerable indigenous knowledge base for using ethnomedicinal plants that was built up over time. This knowledge was passed through generations by generations and initially by oral communication while later in a written form by using baked clay tablets, papyri, parchments, scientific literature like manuscripts, and herbals [5,6]. This knowledge was used for treatment in successive civilizations as a fundamental means for health maintenance, disease prevention, and also curing extensive ranges of ailments from the previous time [7].

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The use and reputation of ethnomedicine are very important and are increasing day by day around most parts of the world [8]. Especially in rural areas, and also in many tropical countries, the health facilities are less developed and sometimes not even provided [9]. The estimated 50,000–60,000 *tabbies* (practitioners) and also a huge number of unregistered medicine practitioners are scattered in the rural and mostly remote hilly areas of Pakistan. There is an estimate that about 60% of the human population uses ethnomedicine of the traditional practitioners. Approximately, 80% of the population in Pakistan lives in rural households where medicinal plants are available easily. While a lower income situation and unavailability of the modern health facilities in the remote rural areas limits the access of local inhabitants to modern medicines [10]. In Pakistan, the available modern and synthetic healthcare services are sometimes insufficient, inaccessible and at times unaffordable to the majority of people. Moreover, due to poverty and illiteracy, most of the poor people are dependent on herbal products for curing various diseases [11].

Although the estimated 422,000 angiosperms are found worldwide [12], only 50,000 plants species are used for medicinal purposes [13]. In addition, only about 5,000 plants have been investigated for their phytochemicals. However, the ethnobotany is playing a very crucial role in conserving the natural sources and also medicinal plant diversity [14]. According to one report in Pakistan, a total of 1,572 plant genera and about 5,521 species of angiosperms are identified. Among these, only 400–600 plants are known to be important medicinally. Of these plant species, about 400 species of plants are believed to be endemic to Pakistan [15].

The worldwide market of traditional and ethnomedicine in the last three decades has seen a considerable increase in herbs and their relevant products. People are interested in ethnomedicine for basic traditional systems of health care and so trade and demand of herbal products are rapidly increasing around the globe [7]. The estimated global trade from sales of herbs and herbal products was summed to an amount worth US Dollar 60,000 million by the year 2002 [16]. A survey conducted by Pakistan Forest Institute determines that 75 of crude ethnomedicines are widely exported while more than 200 are traded locally in Pakistan [17]. According to a study by Chaudhary et al. [18], approximately 500 families are linked with a collection of medicinal plants only in the District of Swat (Pakistan) and they are estimated to collect approximated 5,000 tons of medicinal plants in a single year.

A study by Teklehaymanot and Giday [19] indicated that documentation of the traditional uses of the medicinal plants needs immediate attention. It is very important to preserve or document the knowledge since it seems that this knowledge is at the risk of extinction due to many reasons. These include the migration from rural to urban areas, industrialization, loss of biodiversity, loss of natural habitats, and also due to changing lifestyle. At present, the traditional knowledge about medicinal plants and its practices are rapidly disappearing and losing their inherent values at a shocking rate due to many reasons in various countries worldwide which are botanically rich and ethnomedicine uses [20]. The aim of this survey was to identify the collected plants for ethnopharmacological application by the indigenous communities of the Talash valley, located in the Lower Dir of Pakistan and to document the herbal preparation, local names, and uses of these plants. It is hoped that the result of this study will demonstrate the importance of documentation of traditional knowledge as well as local medicinal plants for the development of ethnomedicinal drugs to treat basic human ailments.

Materials and Methods

Study area

The present investigation was carried out in the Talash valley, located in the district of Dir Lower, Khyber Pakhtunkhwa, northern Pakistan. The Talash valley consists of four union councils (UCs or administrative units): Shahi Khel, Bandagai, Nora khel, and Bagh dushkhel (Fig. 1). It is located between 71° 47′ to 71° 58′ E longitudes and from 34° 41′ to 34° 47′ N latitudes in Dir Lower district. The Dir Lower district shares an international boundary with Afghanistan (Kunar province) in the west, by Swat district in the east, Malakand district in the South, while the Upper Dir lies in the North [8]. The population of the Lower Dir district increased by more than double during the last 19 years (1998–2017) from 717,649 people in 1998 to 1,435,917 people in 2017. The average annual growth rate of population in Lower Dir was 3.71 during 1998–2017 [21,22].

The landscape of the investigated area was covered with the plain and hilly region. The most common vegetation in the area includes *Ficus palmate, Morus alba, Morus nigra, Olea ferruginea, Ailanthus*

altissima, Acacia modesta, Dodonaea viscosa, Artemisia spp., Berberis lycium, Calotropis procera, Adhatoda vasica, Celtis australis, Cannabis sativa, Ajuga bracteosa, etc.

Field survey

Regular ethnobotanical surveys were arranged from March 2014 to September 2015 in 17 villages of the Talash valley, with the aim to collect and document ethnobotanical knowledge from the local peoples. Before starting the interview, we informed local participants that it was a student academic project and investigation was only for our research purposes, not for any commercial or other benefits [1]. Before conducting a field work in the study area, permission to conduct our study in each area was obtained from the local government authorities and elders of the study region. We also received formal consent from informants regarding data collection and publication. The International Society of Ethnobiology Code of Ethics was strictly followed during project planning (http://ethnobiol ogy.net/code-of-ethics/).

Informant interviews and ethnobotanical data collection

The ethnobotanical information was mainly obtained through interviews, group discussions, questionnaires, and casual walk. For ethnobotanical investigation, we mostly contacted the local *hakeem* (traditional herbal), farmers, and elder people, who had sufficient knowledge of indigenous medicinal plants. Those informants who voluntarily agreed were further interviewed and invited for group discussions. Meanwhile, the people who have more ethnobotanical information and experience were requested to go with us on casual walks in the field. The precise nature of ethnomedicinal knowledge interviews are given here. Almost 27 *hakeem* were interviewed in their herbal shops. We also conducted several group discussions where among 60 respondents 25 villager elders were interviewed. Thirty respondents were requested to go on a causal walk on woods and hills. Ten respondents, who also participated in the group discussions, also walked. For the 27 women respondents, we divided this group into 2 parts, one group with the age range of 50–70 years old who we directly approached. The second group with the age range of 30–45 years old. According to local cultural and societal norms, it is not acceptable to directly approach and talk with the second group in this age range, so we distributed questionnaires among school students and their relatives to invite these house women to share their knowledge with us.

In the ethnobotanical interviews, the related questions have been asked in the local language Pashto which is spoken throughout the study area. Using the standard methods of Martin [23] and Cotton [24] in ethnobotanical interviews and group discussions with local informants, we asked relevant questions regarding the ethnomedicinal use, parts used, the local name of the plants, herbal formulation methods, diseases treated, administration, and side effects if any.

Furthermore, face-to-face interviews and meetings were arranged with research coordinators from the World Wide Fund for Natura, Pakistan, District Forest Office Lower Dir, Wildlife Department of Lower Dir, and Chairman of the Forest Department to learn about local herbal practices and current conservation strategies.

Plant collection, identification, and deposition in herbarium

During interviews, the informants use the local name of the plants for specific diseases. After confirming plant identity with informants, the plants were collected and photographed. The collected plants were brought to the Herbarium in

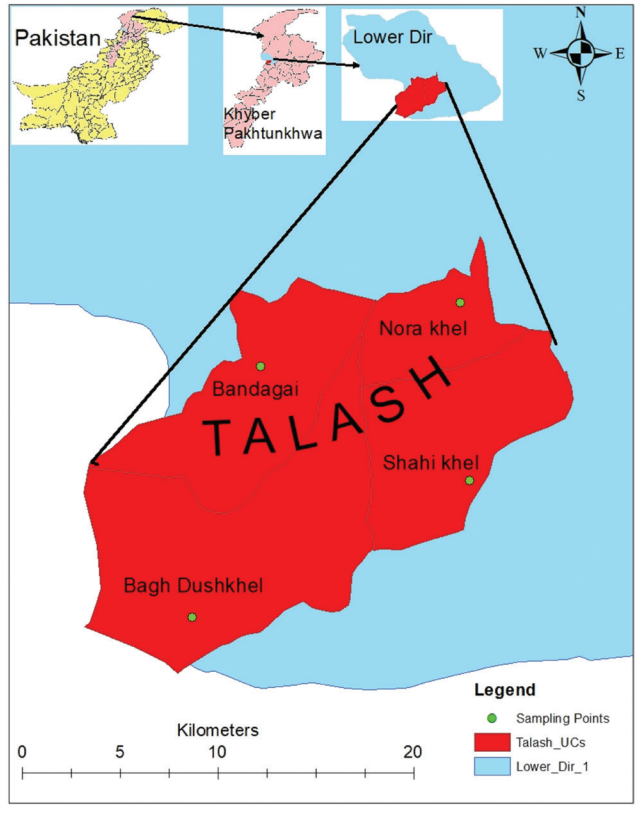

Figure 1. Map of the study area.

the Department of Botany, University of Peshawar, Pakistan. The collected plants were identified with the help of expert plant taxonomists, compared with the specimens of the Herbarium in the Department of Botany, and Flora of Pakistan (Ali and Nasir 1970–2002). For naming the plant species and current taxonomy, we follow The Plant List (www.theplantlist.org) and International Plant Names Index (www.ipni.org).

Data Analysis

Use value

Use value (UV) evaluates the relative importance of each medicinal species based on its relative use among informants [25]. UV was calculated using the following formula:

$$UV = (\sum U_i)/N,$$

where U_i is the number of use reports mentioned by each informant i and N is the total number informants interviewed for a given plant species.

Relative frequency of citation

Relative frequency of citation (RFC) is a quantitative index that gives us the local importance of a species in the ethnobotanical investigation [26]. According to the standard method of Vitalini et al. [25],

RFC is calculated as follows:

$$RFC = (0 < RFC < 1),$$

where FC is the number of informants who mentioned the importance of local species and N is the total number of informants who participated in interviews and group discussions.

Informant Agreement Ratio

To determine variability of the ethnomedicinal plant use, the informant agreement ratio (IAR) was used. According to Trotter and Logan [27], IAR is used to determine the agreement between informants concerning what ethnomedicinal plants to use for specific usage categories. It gives us information about the agreement or uniformity of the informant's indications as to the usage of a certain use-category, e.g., digestive system disorders or skin problem. It is one widely used method for analyzing quantitative data in ethnobotany [27]. This factor ranges from 0 to 1. A high value (close to 1) indicates that relatively few taxa are used by a large proportion of the informants, while a low value indicates that the informants disagree on the taxa's use within a category [28]. The IAR is calculated as

$$IAR = (N_{ur} - N_t)/(N_{ur} - 1),$$

where IAR is the Informant Agreement Ratio, N_{ur} is the number of mentions in each category, and N_t is the number of taxa used in each category.

Result

Socio-demographic data

The information regarding the ethnobotany and medicinal uses of plants was collected from 87 local inhabitants in the study area. Out of these, 60 were men (69%) and 27 were women (31%). Men informants, 27 *Hakeem* (Traditional herbal medicine practitioners), and the remaining were mostly elderly people; 78% of informants were married and 22% unmarried. Furthermore, most informants were illiterate (30%), elementary school (27%), secondary school (20%), high school (15%), and university (8%).

The ethnic composition of Dir Lower mostly Pashtun and the primary local language in the area is Pashto. The study area is characterized by difficult geographical and environmental conditions and limited livelihood opportunities. In the field, most respondents that we interviewed were farmers. People of the valley mainly depend on agriculture. Farming is the most prevalent livelihood activity followed by overseas labors and non-agriculture based labor. However, overseas labor (foreign remittances) is the primary income source for most of the households. Other sources include livestock rearing, mining, small-scale trading, and forestry. Major crop in the area includes vegetables (cash crop), wheat, maize, and mustard. The people of the area also depend for their livelihood on livestock rearing, namely, cow, goat, sheep, and poultry. Paid daily wages for labor are in the range of 600–1,000 Pakistani rupee (PKR) (1 US $ = 101 PKR).

During ethnobotanical interviews, it was reported that 30% of the respondents used the ethnomedicine because of less expensive, 23% easily available, 20% lack of basic health facilities, 17% learn from elder, and 10% because of low side effects. According to the questionnaire results, about 40% respondents were involved in the collection of herbs (2 kg per capita per month), 30% shrubs collection (2 kg per capita per month), 10% tree collection (1 kg per capita per month), 10% grasses, 5% climber and weeds each.

Plants identified by family and growth habit

In our study, a total of 50 medicinal plants species belonging to 34 botanical families and 46 genera were described by the local people. These ethnomedicinal plants used in the 17 villages of the Talash valley, and are presented in Table 1 in order the family have more plant species along with the local name, parts used, and relevant information. Lamiaceae with 6 species is the most common plant families, followed by Asteraceae, Moraceae, and Rosaceae (Fig. 2).

In life form, herbs (68%) were found to be the most used plants followed by shrubs (20%) and trees (12%) (Fig. 3). According to Baydoun et al. [7],

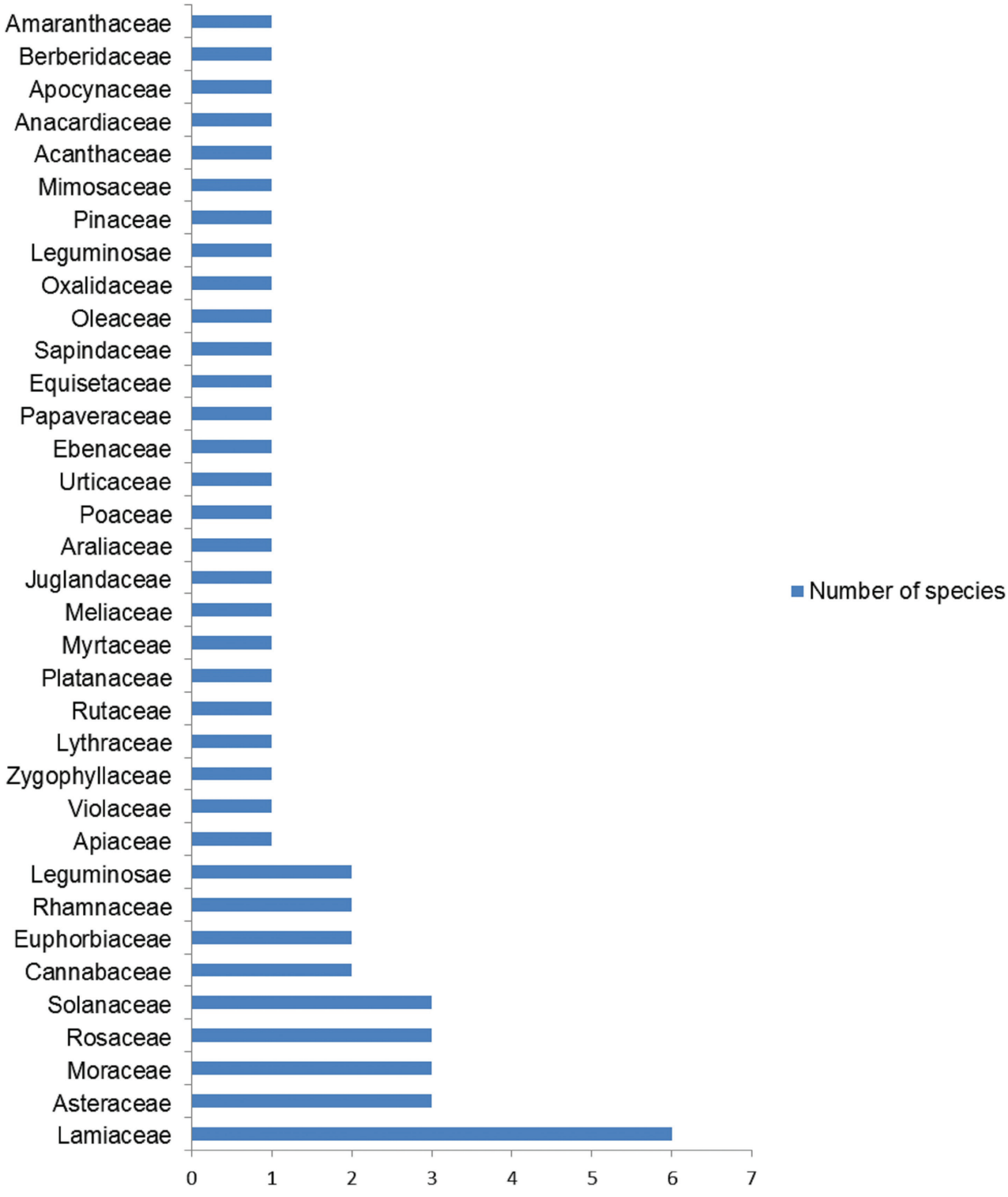

Figure 2. Ethnomedicinal plant species distribution among botanical families of Talash Valley in Dir Lower.

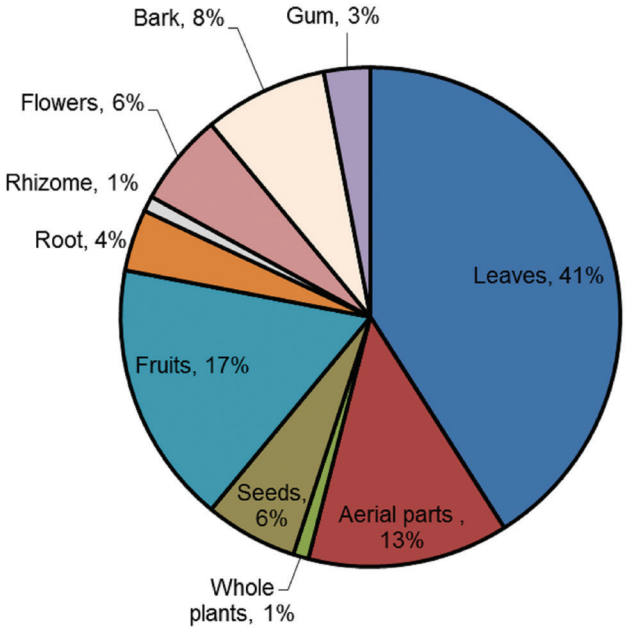

Figure 3. Proportion of different morphological parts used as herbal medicine by local inhabitants.

due to their medicinal properties, herbs were used dominantly in the herbal preparation and serving basic human various ailments and therapeutic indications.

Morphological parts used and status of medicinal plants

In our ethnobotanical survey, the local people described 10 different parts of the medicinal plants. Leaves were the most dominant plant parts followed by fruits, above-ground plant parts, and bark (Fig. 4). Easy collection of leaves compared to other parts of the plant makes it a favorite for herbal preparation [29]. However, scientifically, leaves are the most active part of the plant in terms of production of metabolites and photosynthesis [30]. Furthermore, easy collection and availability make the leaves and flowering parts common for herbal preparations [7].

In our field survey, almost 90% of plants described by the local inhabitants were wild, and the remaining was cultivated for various purposes.

Methodology of herbal formulation and administration

Almost 65% of ethnomedicines were administrated internally, and in the survey, local informants described seven different methods for herbal drug preparation to treat different kinds of human ailments. The most common was decoction followed by powder, direct eating, and poultice (Fig. 4).

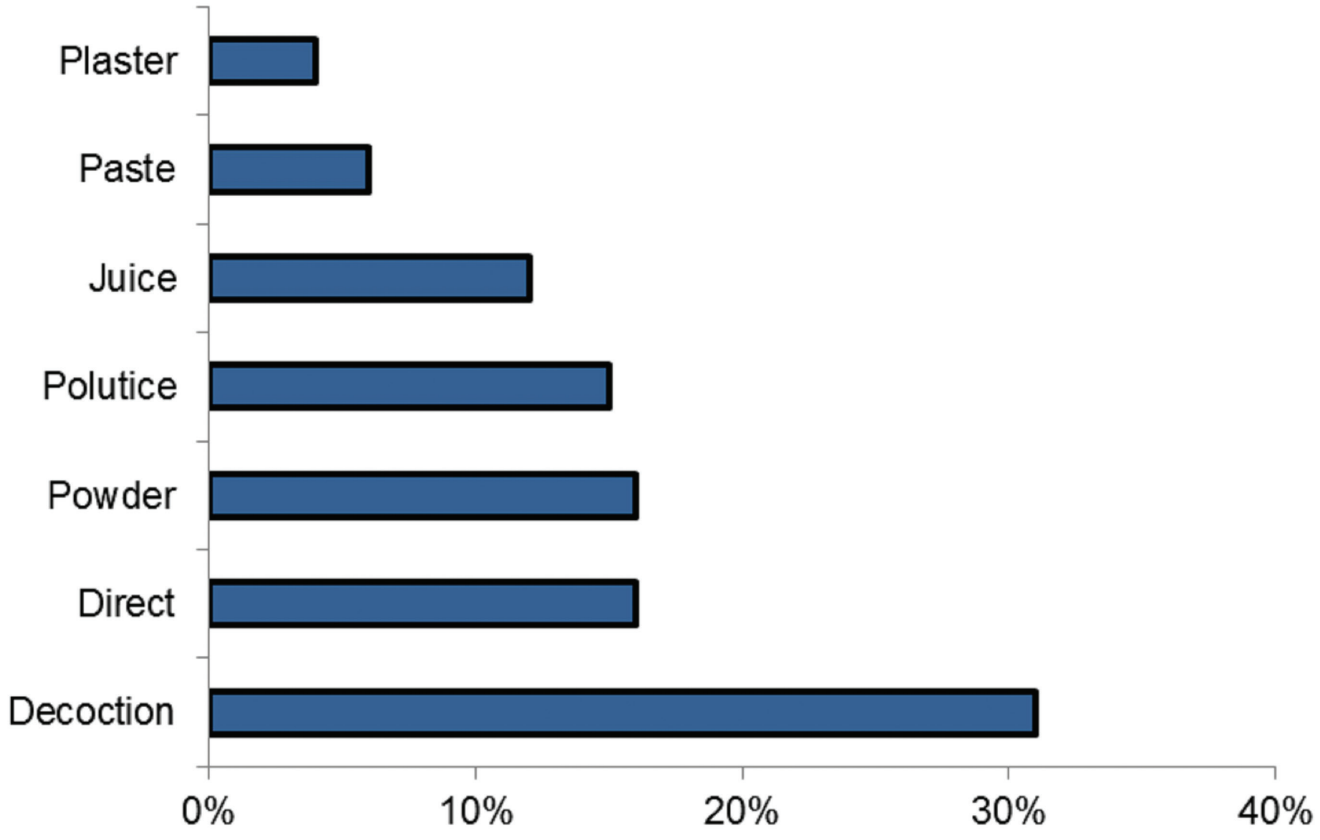

Figure 4. Preparation method of herbal remedies herbal in the management of various human ailments.

Table 1. AMedicinal plant species of the Talash valley, Dir Lower with its use values, relative frequency citation, mode of preparation and administration.

Scientific name/ (Voucher no.)	Local name	Growth form	Status[1*]	Parts used	Mode of preparation	*UV*[3*]	*RFC*[4*]	Medicinal uses	Taking route
Lamiaceae									
Ajuga bracteosa Wall. Ex Benth.	Boote	Herb	W	WP	Decoction	0.85	0.195	Hypertension, jaundice, and fever	Oral
Mentha longifolia (L.) L.	Welanai	Herb	W	AP	Powder	0.73	0.206	Abdominal pain, diarrhea, and emesis.	Oral
					Decoction			Fever and heart problem.	Oral
Mentha spicata L.	Podina	Herb	C,W	AP	Powder	0.53	0.091	Emesis and abdominal discomfort	Oral
					Decoction			Hypertension and mineral deficiency	Oral
Otostegia limbata (Benth.) Boiss.	Spin azghay	Shrub	W	LV	Powder	0.3	0.045	Jaundice	Oral
					Juice			Gum diseases	External
Teucrium royleanum Wall. ex Benth.	Aspa Bootay	Herb	W	AP	Decoction	0.63	0.08	Fever and considered as antiseptic, stimulant Also used as a vermifuge	Oral
Salvia moorcroftiana Wall. ex Benth.	Kherghwag	Herb	W	LV	Poultice	0.33	0.057	External wound	External
Asteraceae									
Artemisia vulgaris L.	Tarkha	Herb	W	LV	Decoction	0.7	0.137	Stomachache, hypertension, and dysentery	Oral
					Poultice			Scorpion sting and snakebites	External
Sonchus asper (L.) Hill	Shodapai	Herb	W	AP	Poultice	0.22	0.022	Curing wound and also used for Boils	External
Calendula arvensis M.Bieb	Khwaga Abai	Herb	W	FL	Juice	0.41	0.08	Toothache	External
				LV	Poultice			Skin diseases and healing wounds	External
Moraceae									
Ficus palmata Forssk.	Ormal	Shrub	W	LV	Direct	0.44	0.091	Curing wasp stings	External
									Oral
Morus alba L.	Spin toot	Tree	W	FR	Direct (Fresh as well as dried)	0.43	0.11	Digestive stimulant, and source of cheap carbohydrates	Oral
Morus nigra L.	Tor toot	Tree	W	FR	Direct	0.45	0.103	Cough, fever, and for sore throat, as cooling agent	Oral
Rosaceae									
Rosa moschata Herrm.	Zangali gulab	Shrub	W	FL	Decoction	0.4	0.12	Stomach disorder	Oral
Rubus fruticosus G.N.Jones	Karwara	Shrub	W	LV	Powder	0.29	0.09	Fever, and diarrhea	Oral
				RT	Decoction			Dysentery	Oral

Continued

Scientific name/ (Voucher no.)	Local name	Growth form	Status[1*]	Parts used	Mode of preparation	*UV*[3*]	*RFC*[4*]	Medicinal uses	Taking route
Spiraea spec.	Krachay	Shrub	W	FL	Decoction	0.25	0.034	Given to the pregnant woman to ease delivery also used for abdominal problems, and stomachache	
				LV	Juice (Fresh)			Cough and fever	
Solanaceae									
Datura innoxia Mill.	Batora	Herb	W	LV	Direct	0.29	0.057	Toothache, headache, and epilepsy	External
				SE	Poultice			Used as anti-septic	External
Solanum nigrum L.	Kachmachu	Herb	W	LV	Juice	0.57	0.091	Liver diseases	Oral
								Skin diseases	External
				FR	Direct			Hypertension.	Oral
Solanum surattense Burm.	Manraghonay	Herb	W	FR	Decoction	0.48	0.14	Stomachache	Oral
					Paste (Honey)			Chronic cough	Oral
				FL	Juice			Used in Opthalmia	Oral
Cannabaceae									
Cannabis sativa L.	Bang	Herb	W	LV, SE	Poultice	0.27	0.06	Boils, tonic, sedative, and anodyne	External
Celtis australis L.	Tagha	Tree	W	FR	Direct	0.16	0.022	Allergy and amenorrhea	Oral
Euphorbiaceae									
Ricinus communis L.	Harhanda	Shrub	W	LV	Plaster	0.21	0.034	External wound and burns	External
				SE	Oil			Skin problem like ringworm	External
Euphorbia helioscopia L.	Mandanoo	Herb	W	AP	Plaster	0.27	0.06	Skin diseases	External
Rhamnaceae									
Ziziphus jujuba Mill.	Bera	Shrub	W	LV	Paste	0.32	0.103	Scabies and boils	External
					Decoction			Diabetes.	Oral
					Smoke			Used for headache	
				FR	Direct			Used as Laxative	Oral
Z. nummularia (Burm.f.) Wight & Arn	Bera	Shrub	W	LV	Paste	0.26	0.04	Ulcer	External
					Decoction				Oral
Leguminosae									
Indigofera heterantha Brandis	Ghorija	Shrub	W	RT	Direct	0.14	0.034	Abdominal pain	Oral
Acacia modesta Wall.	Palosa	Shrub	W	Gum	Paste (honey,	0.41	0.149	Used as tonic to the women after birth.	Oral
					almond, flour)				

Continued

Scientific name/ (Voucher no.)	Local name	Growth form	Status[1*]	Parts used	Mode of preparation	*UV*[3*]	*RFC*[4*]	Medicinal uses	Taking route
Umbelliferae									
Foeniculum vulgare L.	Kagu	Herb	C,W	LV	Decoction	0.68	0.126	Urinary disorders, e.g., dysuria	Oral
Violaceae									
Viola biflora L.	Banafsha	Herb	W	LV	Decoction	0.38	0.091	Jaundice, cough, and body weakness	Oral
				FL	Powder			Sore throat, kidney, and liver problems	
Zygophyllaceae									
Tribulus terrestris L.	Markunday	Herb	W	LV	Juice	0.36	0.8	Chronic cough.	Oral
				FR	Powder			Urinary disorder	Oral
Lythraceae									
Punica granatum L.	Zangali Anar	Shrub	W	FR	Direct	0.42	0.195	Removing intestinal Helminthes	Oral
				LV	Paste, decoction			Skin diseases and dysentery	Oral External
Rutaceae									
Zanthoxylum alatum Roxb.	Dambara	Shrub	W	SE,	Powder	0.59	0.149	Fever	Oral
				BK				Gum diseases, dyspepsia, and Cholera	Oral
				FR				Stomachache and toothache	Oral
Platanaceae									
Platanus orientalis L.	Chinar	Tree	W	LV	Fresh	0.2	0.03	Toothache and external wound	External
Myrtaceae									
Myrtus communis L.	Manro	Shrub	W	LV	Decoction	0.61	0.091	Dysentery and stomach diseases	Oral
				FR	Direct			Diarrhea	Oral
Meliaceae									
Melia azedarach L.	Bakyana	Tree	W	BK	Decoction	0.36	0.137	Fever	Oral
				LV	Decoction			Jaundice	Oral
					Poultice			Skin diseases	External
Juglandaceae									
Juglans regia L.	Ghuz	Tree	C	LV,	Direct	0.28	0.114	Tooth whitening and teeth infection,	External
				BK	Direct (Dried)			bark (locally called *dandasa*) for cleaning an sparkling of teeth	
Araliaceae									
Hedera nepalensis K. Koch	Perwati	Shrub	W	LV	Decoction	0.6	0.103	Diabetes and blood purifier	Oral

Continued

Scientific name/ (Voucher no.)	Local name	Growth form	Status[1*]	Parts used	Mode of preparation	*UV*[3*]	*RFC*[4*]	Medicinal uses	Taking route
Poaceae									
Cynodon dactylon (L.) Pers.	Kabal	Herb	W	AP	Fresh	0.3	0.091	Used to control bleeding from nose Placed on injured place to stop bleeding	External
Urticaceae									
Debregeasia saeneb (Forssk). Hepper & J.R.I.Wood	Alajai	Shrub	W	LV	Poultice	0.17	0.03	Urticaria and other skin problems	External
Ebenaceae				LV					
Diospyros lotus L.	Toor amlook	Tree	W	LV	Powder	0.2	0.002	Used for curing constipation and dysentery	Oral
				FR	Direct			Sore throat	Oral
Papaveraceae									
Fumaria indica (Hausskn.) Pugsley	Papra	Herb	W	AP	Powder	0.64	0.126	Hypertension and common fever	Oral
					Decoction			stop emesis	Oral
Equisetaceae									
Equisetum arvense L.	Bandakay	Herb	W	WP	Juice	0.27	0.057	To expel calculus from kidneys	Oral
					Decoction			Jaundice	Oral
Sapindaceae									
Dodonaea viscosa (L.) Jacq.	Ghwaraskay	Shrub	W	LV	Poultice	0.18	0.057	For the treatment of fungal infection	External
					Juice (Hair oil)			Hair tonic	External
Oleaceae									
Olea ferruginea Wall. ex Aitch.	Khonoa	Tree	W	LV	Decoction	0.61	0.126	Hypertension, sore throat, and fever	Oral
				FR	Direct			Liver disorder and stop teeth decay	Oral
Oxalidaceae									
Oxalis corniculata L.	Trokay	Herb	W	RT	Decoction	0.15	0.022	Used to enhance digestion	Oral
Pinaceae									
Pinus roxburghii Sarg.	Nakhtar	Tree	C,W	Gum	Paste (Honey)	0.39	0.126	Diarrhea and sore throat	Oral
Acanthaceae									
Justicia adhatoda L.	Bekar	Shrub	W	LV	Decoction	0.29	0.091	Tuberculosis and asthma	Oral,
Anacardiaceae									
Pistacia integerrima J. L. Stewart ex Brandis	Shany	Tree	W	BK	Plaster	0.31	0.057	Chronic wound	External
				FR	Powder			Jaundice and liver diseases	Oral
Apocynaceae									
Calotropis procera (Aiton) Dryand.	Spalmay	Shrub	W	LV	Poultice	0.25	0.8	Scorpion sting	External

Continued

Scientific name/ (Voucher no.)	Local name	Growth form	Status[1*]	Parts used	Mode of preparation	*UV*[3*]	*RFC*[4*]	Medicinal uses	Taking route
Berberidaceae									
Berberis lycium Royle	Kwaray	Shrub	W	RH	Powder	0.76	0.183	Jaundice and dysentery	Oral
				BK	Poultice			It is used as tonic and nephrological complaints	External
Amaranthaceae									
Chenopodium murle L.	Kharawa	Herb	W	AP	Juice	0.37	0.114	Abdominal pain	Oral
					Decoction			Jaundice	Oral

1*W: Wild, C: Cultivated; 2*RT: Root, RH: Rhizome, LV: Leaves, SE: Seed, FR; Fruit, FL: Flower, AP: Above-ground plant parts, BK: Bark, WP: Whole plant, B: Bulb; 3*UV: Use Value; 4*RFC = Relative frequency of Citation.

According to Nadembega et al. [31], in traditional herbal drugs, decoction can be considered one of the common forms of herbal formulation because it is very easy to prepare ethnomedicine simply by mixing herbal parts with boiling water. Pakistani indigenous communities mostly prefer decoction as a preparation method [32].

Use values and relative frequency of citation

Using the ethnobotanical indices like *UV* and *RFC*, the traditional knowledge on ethnomedicinal plants used in the treatment of various human ailments were analyzed (Table 1). In the present study, *UV* ranged from 0.14 to 0.85. Of the 50 reported ethnomedicine species, 12 plant species were identified with *UV* greater than 0.55; *A. bracteosa* Wall. Ex Benth., *Mentha longifolia* (L.) L., *Teucrium royleanum* Wall. ex Benth., *Artemisia vulgaris* L., *Solanum nigrum* L., *Foeniculum vulgare* L., *Zanthoxylum alatum* Roxb., *Myrtus communis* L., *Hedera nepalensis* K. Koch, *Fumaria indica* (Hausskn.) Pugsley, *O. ferruginea* Wall. ex Aitch., and *B. lycium* Royle (Table 1). While the lowest *Indigofera heterantha* Brandis, *Oxalis corniculata* L., *D. viscosa* (L.) Jacq., *Debregeasia saeneb* (Forssk.) Hepper & J.R.I., *Platanus orientalis* L., and *C. australis* L. (Table 1). The medicinal plant species with low *UV* are also very important and should not be ignored as failing to declare them to upcoming generations could raise the threat of slowly vanishing of the knowledge. Plant species having high *UV*

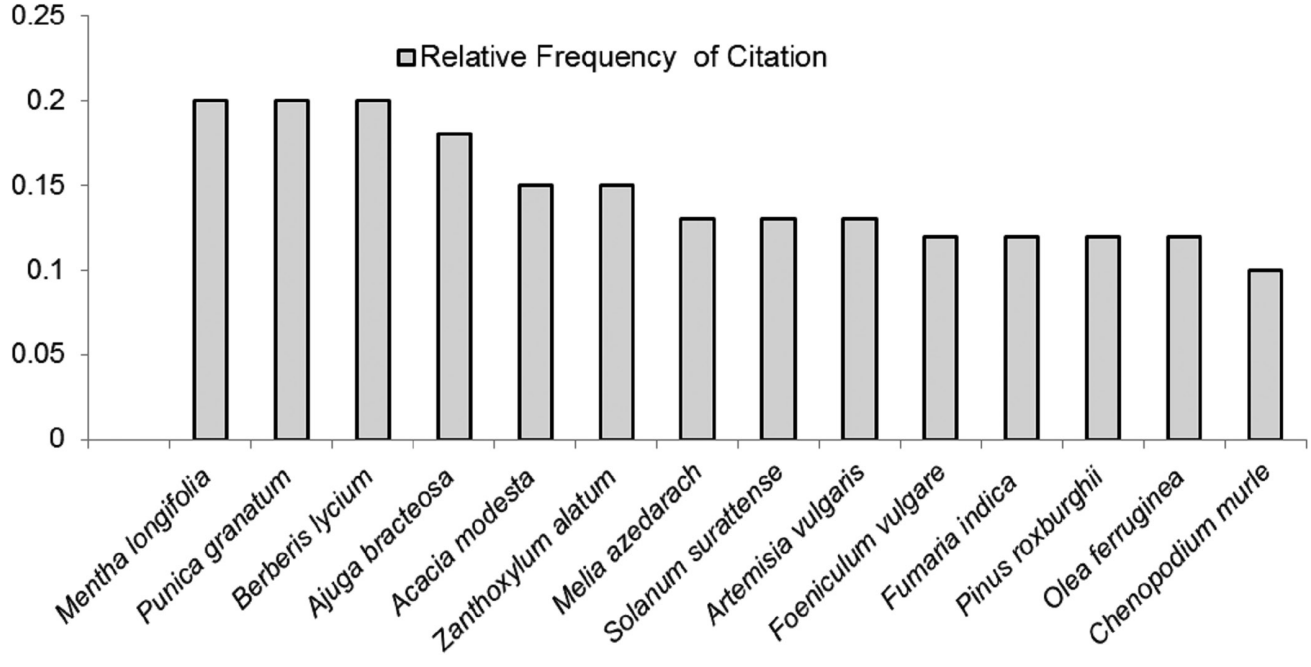

Figure 5. Relative frequency citations for medicinal plant species.

should be further screened in ethnopharmacological studies for active compounds [33].

RFC is used to find the most frequently used species of plants used for various human ailments in the study area. Its value ranged from 0.002 to 0.206. Fifteen plant species reported in this study showed high values *M. longifolia* (L.) L., *A. bracteosa* Wall. Ex Benth., *A. vulgaris* L., *Solanum surattense* Burm., *F. vulgare* L., *Punica granatum* L., *Z. alatum* Roxb., *Melia azedarach* L., *Juglans regia* L., and *F. indica* (Hausskn.) (Fig. 5). The ethnomedicinal plant species with higher values of *RFC* show the fact that these plant species were well known to most of the local people [34]. Those medicinal plant species having high *RFC* must be further assessed for phytochemical analysis and pharmaceutical analysis to identify their active constituents for any drug extraction [25].

Informant Agreement Ratio (IAR)

In this study, we compared the number of times the informant mentioned the use of plants for a specific disease and the number of plant species in each usage category (Table 2). Guiding from Collins et al., we define the different human ailments into specific usage categories [35]. According to the report, the usage categories of the illnesses which received the highest number of mentions are the most prevalent in the communities and also of the greatest importance to people living in the study area [35].

Informant agreement ratio between 0.25 and 0.46 was obtained for the different use categories. In the Talash valley, the most important usage category is digestive system disorders followed by genitourinary system disorders, circulatory system disorders, and skin problem shown in Table 3.

Discussion

The use of medicinal plants of the Talash valley is similar to neighboring districts and other parts of the country. In our study, many of the reported species have already been well-published regarding their ethnomedicinal importance. In Swat, which is a neighboring district, *Berberis lyceum* is used for treatment of diarrhea, jaundice and internal wounds [17]. Similarly, Ahmed et al. [36] and Abbasi et al. [37] reported that the rhizomes of the same plant are used for rheumatism, stomachache, diabetes, and bone fracture. *F. indica* is used as antipyretic, blood purifier, and the aerial part of same plant is also used for hypertension [8,18,37]. The leaves of *S. nigrum* are used for liver problems, diabetes, and diarrhea [33]. In the case of *Viola canescense*, the whole plant is used for cough, cold, and respiratory disorder [36]. *A. bracteosa* of the Lamiaceae is one of the highly-used medicinal plants of the study area. The local people used their fresh leaves for jaundice, sore throat, pimples, and hypertension [8,17]. A *Teucrium stocksianum* mostly found in hilly region of the study area is used for abdominal pain, stomach acidification, and for the management of hypertension [38,39]. Rashid et al. [40] state that whole parts of the same plant showed hypolipidemic, hypoglycaemic, and anti-diabetic activity. Hamayun et al. [17]

Table 2. Usage categories with number of mentions of each ailment in Talash valley.

Digestive system disorders	Diarrhea	5	Emesis	3
	dysentery	2	Stomachache	5
	dyspepsia	2	Intestinal problem	2
	Cholera	1		
Infestations/ infections	Fever	7	Cough	6
	sore throat	3	Headache	4
	allergy	2	Fungal infection	2
	tuberculosis	1		
Circulatory system disorders	Hypertension	7	Heart problem	2
	blood purification	3		
Respiratory system disorder	Asthma	3	Nephrological	2
Venom or stings:	Scorpion sting	2	Snakebites	2
	wasp stings	1		
Skin problems	Skin diseases	4	Scabies	2
	ringworm	4	Urticaria	3
	burns		Boils	2
External injuries and other problems	External wound	3	Stop bleeding	2
	healing wounds	2	Sedative	2
	laxative	1		
Dental problem	Gum diseases	1	Teeth decay	1
	Toothache	3	Tooth whitening	1
	Teeth infection	1		
Nervous system disorder:	Epilepsy	3		
Eyes problem	Opthalmia	2		
Genitourinary system disorders	Disorders dysuria Kidney	4	Urinary disorders	2

Table 3. Usage categories with number of taxa, mentions, and informant agreement ratio values.

Usage category	Various ailments	No. of mentions	Taxa	IAR
1. Digestive system disorders	Diarrhea, emesis, dysentery, stomachache, dyspepsia, and intestinal problem, and cholera	20	15	0.26
2. Infestations/ infections	Fever, cough, sore throat, headache, allergy, fungal infection, and tuberculosis	25	17	0.33
3. Circulatory system disorders	Blood pressure, hypertension, heart problem, and blood purification	12	7	0.45
4. Respiratory system disorder	Asthma and nephrological	5	2	0.75
5. Venom or stings:	Scorpion sting, snakebites, and wasp stings	5	3	0.5
6. Skin problems	Skin diseases, boils, ringworm burns, scabies, boils, and urticaria	15	9	0.42
7. External injuries and other problems	External wound, healing wounds, stop bleeding, sedative, and laxative	10	6	0.44
8. Dental problem	Gum diseases, toothache, teeth decay, tooth whitening, and teeth infection	7	4	0.5
9. Nervous system disorder:	Epilepsy	3	1	1
10. Eyes problem	Opthalmia	2	1	1
11. Genitourinary system disorders	Disorders dysuria kidney, urinary disorders expel calculus from kidneys.	6	4	0.4

reported *M. longifolia* is used for diarrhea and dysentery. According to Ahmed et al. [36], *M. longifolia* is used for digestive stimulant and to stop emesis. According to Ahmad et al. [41], the leaves of *Pistacia integerrima* are used for the treatment of hyperuricemia. The dried fruit powder and other morphological parts of *O. ferruginea* was used previously for diabetes, kidney disorders, skin diseases, toothaches, coughs, colds, and flue [36,42]. The fresh leaves of the same plant in the form of herbal tea are also used for hypertension [8]. The leaves of *Otostegia limbata* is used in Swat for curing of wounds and gum diseases [43]. According to the Haq [44], the leaves and roots of the same plant are used for hypertension and diabetes. Previously, it was reported that *Mentha viridis* was used for dysentery, diarrhea, gastric disorders, and used as a vermifuge herb [34]. The dried powder of leaves and other morphological parts of *H. nepalensis* was used against diabetes, ulcers, fever, and also shows anti-cancer activities [17,36,45].

A comparison of our study with relevance to other researchers in other parts of the world supported many findings. The fruit of *F. vulgare* was used for diabetes, renal diseases, stomach problems, and hypertension [46–48]. Previously, it was reported that *Myrtinus communes* was used for dysentery, rheumatism, hemorrhages, diarrhea, gastric ulcer, and vomiting [49]. The aerial part of highly medicinal herb *F. indica* has antihepatotoxic and hepatoprotective potential [50,51]. Abe and Ohtani [52] in their study reported that *S. nigrum* is used for the management hypertension. Similarly, the ethnomedicinal importance like for breathing problems in children and treating mouth ulcer, the *A. bracteosa* was discussed by Uniyal et al. [53]. The aerial parts of *A. vulgaris*, a member of family Asteraceae is used for the treatment of diabetes [45]. *Tribulus terestris* also has previous ethnopharmacological evidences; it is used for kidney disorder, urinary infections, skin problems, and hypertension [54–56]. It was previously reported that the aerial parts of *M. viridis* are used for diabetes, cold, stomachache, and hypertension [48,55,57]. Herbal formulation of the leaves of *H. nepalensis* leaves was effective in inflammation and cough [58]. In Bangladesh, whole plant of *Cynodon dactylon* is used for the treatment of tuberculosis and diabetes [59]. Zakavi et al. [60] reported that bark and leaves of *J. regia* have anti-microbial potential. In Turkey, it was reported by Gürdal and Kültür [57] that the leaves of *M. nigra* are used for kidney disease. The paste of *P. granatum* flowers are used as a mouthwash for periodontitis [61]. The leaves of *C. procera* are used for headaches [62]. In Congo, a leaf decoction of *M. azedarach* is used for the treatment of malaria [63]. Muthu et al. reported that the leaf juice of *Ricinus communis* is taken orally or washed to increase secretion of milk in women. In the same study, it was reported that the leaves of *Justicia adhatoda* are mixed with the flowers of *Hibiscus rosa-sinensis* and used to treat asthma [64]. In India, the root of *Salvia moorcroftiana* is used for cold and cough [65]. Soleimani et al. [66] established that the methanolic extract of *Equisetum arvense* have anti-diabetic potential. In Morocco, the anti-diabetic activity of *M. communis*

had been well established by Ziyyata et al. [67]. The leaves of *J. adhatoda* and *O. corniculata* in Nepal are used to treat rheumatic pain, dysentery, and stomach disorders [68].

The ethnomedicinal plants of the Talash valley are under huge stress by human related activities such as agricultural land expansion, domestic grazing, deforestation, lack of awareness, and unsustainable collection. The local people depend on plants as there is no alternative source of fuels so they cut the forest severely out of necessity. The people of the Talash valley are poor and they keep a large number of livestock to fulfill their daily requirements. Similarly, women and children mostly collect the medicinal plants in an unsustainably from which the degradation of medicinal plants resources may occur (personal communication, informant interview). According to the questionnaire results, interviews with district forest officers, and other resources, the main threat to the medicinal plants diversity of the study area is deforestation, domestic grazing, and unsuitable collection (Fig. 6).

Major threats to medicinal plants in Talash valley is deforestation. In the study, the winter season is very long and harsh. People need fuel for heating their houses as well as cooking. There are no alternate facilities for heating and cooking. The local people are unaware about the conservation of valuable and indigenous plants in the area [personal communication with District Forest officer, Dir Lower July, 2015]. They go to the nearby forests and collect plants for collecting wood, sometimes they cut whole trees for collecting only branches and twigs. Due to this indiscriminate cutting, not only forests are declining but also valuable medicinal plants species are in danger. According to the questionnaire survey conducted, 40% of medicinal plant resources are degraded due to deforestation. The population is increasing enormously and the people are degrading forests for fuel and shelters [69].

Conclusion

The local people of the Talash valley in Lower Dir, Pakistan, widely used medicinal plants to treat various human ailments. The present study showed that consistent indigenous knowledge on ethnomedicinal plants used in the treatment of basic human healthcare systems existed here. Most of the people live in rural communities in the remote areas and away from the modern healthcare facilities. In the study area, the local residents are heavily dependent on medicinal plants for health issues and so demand of ethnomedicinal plants increases day by day. The importance of biodiversity conservation is therefore fundamental and strategies of sustainable use should be considered for long-term availability of medicinal

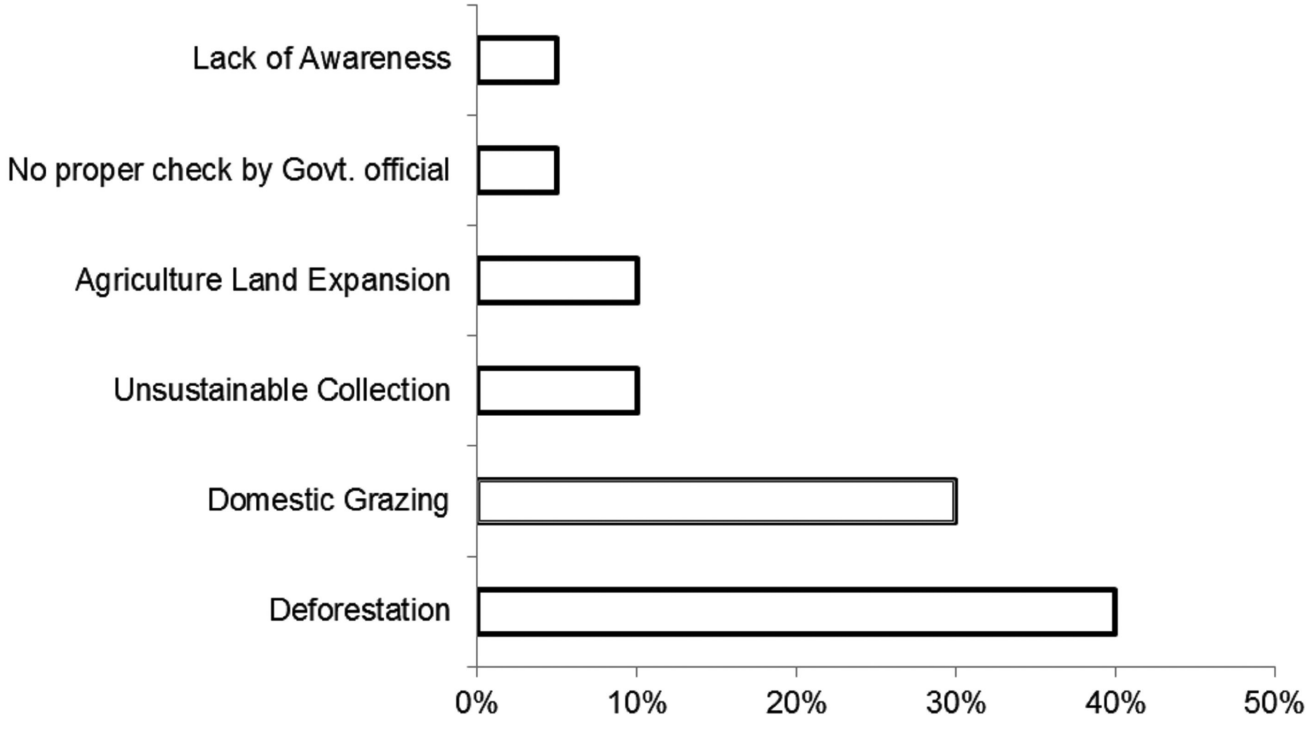

Figure 6. Various Human related activities which threat to the medicinal plants diversity of the study area.

plants here and even in whole country. Possible solutions for the conservation of biodiversity and ethnomedicinal flora of the study area are to strengthen national, regional, and local networking activities regarding conservation and sustainable utilization. There must be cooperation among government, non-government organizations, and local community to help conservation of medicinal plants in the area. Control programs for invasive species should be implemented in the study area. Furthermore, the elder populations of the study area are often unaware about the importance of biodiversity conservation; they also show poor selection of fuel wood species. There is need to re-introduce the indigenous knowledge about the conservation and management of medicinal plants resources. To build the capacity of the local people and develop their interest in growing tree species, medicinal plants demonstration plots may be introduced at UC bases.

Even though there is no available database to deposit the documented traditional knowledge in the study area, elderly people were always pleased when we asked them about medicinal plants and their therapeutic uses. Unfortunately, the younger generations showed a lack of interest in plant related questions. We suggest that the traditional knowledge from the elder people should be documented along with quality photography. In school, awareness session should be arranged for the students and the relevant documents should be made available in school libraries. The results of this study support the ethnomedicinal uses to support previous studies. Future investigations should be carried out in order to ensure safe therapy concerning medicinal plants.

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