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FLORISTIC DIVERSITY, ECOLOGICAL AND ETHNOMEDICINAL CHARACTERIZATION OF WEED FLORA IN ARID REGION OF SOUTHERN KHYBER PAKHTUNKHWA, PAKISTAN

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Abstract

Floristic composition of arid and semi-arid ecosystems is influenced by the local environmental conditions; hence, these regions are of great interest for studying plant diversity and ecological adaptations. The present study was conducted to address the gaps in the floristicdiversity of microclimatic arid-zone weeds and their underestimated ethnomedicinal importance by combining floristic surveys, ecological trait analysis, and ethnobotanical data collection in Sra Dargah (2024-2025). A total of 41 weed species representing 20 families were recorded, with Poaceae (6 species, 14.63%) being the dominant family. Ecologically, Therophytes (27 species, 65.85%) and Nanophylls (15 species, 36.58%) were dominant, indicating adaptive strategies to aridity. Ethnomedicinal analysis showed that leaves (19 species, 46.34%) and whole plant (18 species, 43.90%) were the most utilized plant parts, and analgesia (11 species, 26.82%) and digestive disorder management (9 species, 21.95%) were the major therapeutic uses. Quantitative ethnobotanical indices indicated that the most culturally important species were *Taraxacum officinale* (Relative Frequency of Citation, RFC = 0.125), *Emexspinosus* (Use Value, UV = 2.75), and *Astragalus scorpiurus* (Fidelity Level, FL = 88.89%), whereas Poaceae had the highest Family Importance Value (FIV = 46.7%). These findings challenge the view of weeds as agricultural pests, emphasizing their ecological resilience and potential use as sources of traditional medicine and raw materials for the pharmaceutical industry. They also highlight the need of conservation and phytochemical validation of high-value species.

Key words: Dry environment; Life form; Leaf size spectrum; Ethnomedicine; Weed flora; Sra Dargah

Introduction

The floristic composition analysis is critical to understand when considering the general biological determinants of the diversity and distribution of plant species in heterogeneous environments (Ali *et al.,* 2025), while the floristic inventories provide a taxonomic framework for the classification and analysis of plant species in a defined geographical area (Gul *et al.,* 2025). In dry and semi-dry habitats, the dominant species of plants are the ones that have adapted to shortage of water. These adaptations are morphological, physiological, and phenological traits that help in effective water collection, retention, and consumption in dry and semi-arid regions (Waheed *et al.,* 2025; Arshad *et al.,* 2024). The plant microclimatic diversity of these regions has not been extensively studied.

For thousands of years, weeds have provided rural populations with food, fodder, and medicine (Ahmad *et al.,* 2024), making them an essential part of human life styles. Weeds are considered agricultural pests as they compete with crops for water, nutrients, space, and sunlight (Rana & Rana, 2016) and are generally eliminated by local farmers. However, some weed species have high ethnomedicinal value and are used for the treatment of different illnesses (Muhammad *et al.,* 2024; Khan *et al.,* 2013). Weeds also provide food and shelter to wildlife and also contribute to the functioning of the ecosystem. Several desert plant species have shown activity against bacterial, fungal, and viral pathogens (Gupta *et al.,* 2021). However, the ecological and ethnomedicinal characteristics of weed flora of the arid Sra Dargah region have not been characterized.

Two important physiognomic characteristics, life form and leaf size spectra, are reliable indicators of the climatic conditions of an area. Raunkiaer's life form classification and leaf size spectra analysis have given some insights into the plant adaptive strategies toward abiotic stresses (Anwar *et al.,* 2022). Ethnomedicine is the science and art of using natural resources available in the environment for medicinal, spiritual, and cultural purposes by indigenous communities of the area (Ullah *et al.,* 2025). Weeds have been part of human life for centuries, providing food, fodder, and medicine to rural communities (Ahmad *et al.,* 2024). Agricultural pests are often weeds that compete with crops for water, nutrients, space, and sunlight and therefore are often removed by farmers (Rana & Rana, 2016). Nevertheless, many species have high ethnomedicinal value and are used in the treatment of different ailments like pain, digestive disorders, and infectious diseases. In rangeland ecosystems, annual grasses

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are important cattle feed and are often used in traditional medicines and nutrition; thus, it is important to study their therapeutic potential instead of eradicating them, as they are considered weeds in agricultural systems (Muhammad *et al.,* 2024). Weeds also constitute important raw materials in the pharmaceutical industry, especially in the manufacture of Ayurvedic and Unani medicines.

Weeds have been used as a source of medicines as described in the ancient texts of Egypt, China, and the Indian subcontinent (Ahmad *et al.,* 2024; Giannenas *et al.,* 2020). There is a misconception that all weeds are poisonous or useless (Ekor, 2014). Most of them are non-poisonous and possess bioactive compounds that may be useful for health care. Medicinal weeds have been reported from various parts of Pakistan (Khan *et al.,* 2013). Weeds are also a source of food and shelter for wildlife and play a part in the functioning of ecosystems, as well as being eaten by humans. The antimicrobial properties of a few desert species, viz. *Azadirachta indica*, *Calotropis procera,* and *Moringa oleifera* plants were studied (Gupta *et al.,* 2021). Weed flora is ecologically and culturally important; however, the systematic, ecological, and ethnomedicinal characters of weed flora in the arid region of Sra Dargah are still to be characterized. The present study is intended to bridge this gap by documenting the weed flora of Sra Dargah and analyzing their ecological adaptations along with an evaluation of their ethnomedicinal importance to the local communities.

Materials and Methods

Study area: The research was conducted in the Sra Dargah region (A northwestern arid zone) of southern Khyber Pakhtunkhwa, Pakistan, which encompasses 504 km² located at 32°40′–32°50′ N latitude and 70°30′–70°40′ E longitude (Fig. 1). Vegetation is dominated by arid-adapted species such as *Saccharum spontaneum*, *Prosopis juliflora*, *Tamarix dioica* and *Typha latifolia.* The major local community is Marwat Pashtuns, who practice subsistence agriculture and traditional herbal medicine as a source of healthcare. It shares administrative and ecological borders with Sarai Naurang to the east, District South Waziristan and the Bethani hills to the west, District Tank and Ghazni Khel to the south and southwest, and District Bannu to the north and northeast. The region's name derives from two Marwat language terms: Sra, meaning "hot," and Dargah, referring to the dense stands of *Saccharum*, *Prosopis*, *Tamarix*, and *Typha* species that dominate its vegetation. This nomenclature directly reflects both its climatic and floristic identity. The study area experiences hot, dry conditions; site-specific meteorological values require verification against an identified weather station and observation period. The extreme seasonal temperature fluctuations are key abiotic factors shaping the adaptive traits of its native flora.

Field surveys: Field trips were conducted to Sra Dargah in 2024–2025 (months and seasons of survey should be confirmed from field records) for the collection of plant specimens and collection of ecological data from agricultural fields, fallow lands, roadside verges, and dry riverbeds. The field equipment included a study area map, field notebook, pencil, plant press, newspaper (for drying of specimens), compass, polythene bags, pruning knife, and digital camera for documentation (camera model and image resolution should be confirmed from field records). The plant specimens were pressed, dried, and mounted on herbarium sheets following standard taxonomic protocols. Identification of species was done using regional floristic literature, including multiple volumes of the Flora of Pakistan (Nasir & Ali, 1972-1994). Ecological attributes (life form and leaf size spectra) were determined by the classification system proposed by Raunkiær (1934) and Hussain (1989) for life form and leaf size classes, respectively. Life forms were categorized as Therophytes, Geophytes, Chamaephytes, Hemicryptophytes, Nanopha-nerophytes, and Microphanerophytes, while leaf sizes were grouped as Leptophyll, Nanophyll, Microphyll, and Mesophyll. Voucher specimens of the collected plant taxa were preserved and deposited in the herbarium of the Department of Botany (PUP), University of Peshawar, Pakistan.

Ethnomedicinal study: Ethnomedicinal data were collected through a mixed-method approach including semi-structured questionnaires, group discussions, key informant interviews, and guided field visits as suggested by (Ali & Qaiser, 2009). A standardized questionnaire was circulated among 120 informants, targeting individuals of three age groups (25–35, 36–45, 46–60 years) possessing traditional knowledge on local plant species and their medicinal uses. Questionnaires were developed to collect information on local names, parts used, therapeutic uses, mode of administration, and perceived efficacy of medicinal weeds. Additional information was collected from local homeopathic drug dealers who provided information about commercial and medicinal use of weeds in the area. Ethnomedicinal data were compiled using the inventory method (in-situ sampling) and artifact method (ex-situ sampling) described by (Thomas & Shengji, 2013) to ensure accuracy and completeness of traditional knowledge documentation.

Data collection (Questionnaire): The questionnaire comprised the following information:

- Demographic information (age, gender, education)
- Local names of medicinal plants
- Parts of plant used
- Medicinal uses
- Route of administration

Statistical data analysis

Data were tabulated, and descriptive percentages and ethnobotanical indices were calculated using Microsoft Excel. Frequency of Citation (FC) denotes the number of informants citing a species; Relative Frequency of Citation (RFC) = FC/N, where N is the total number of informants (Sameen *et al.,* 2025). Use Value (UV) = ΣUi/N, where Ui denotes uses reported by each informant (Redouan *et al.,* 2023). Fidelity Level (FL, %) = Np/Nt × 100, where Np is the number of informants citing a species for a particular use, and Nt is the total number of informants citing that species (Zareef *et al.,* 2023). Family Importance Value (FIV, %) = number of informants citing a family / total number of informants × 100 (Rahim *et al.,* 2023).

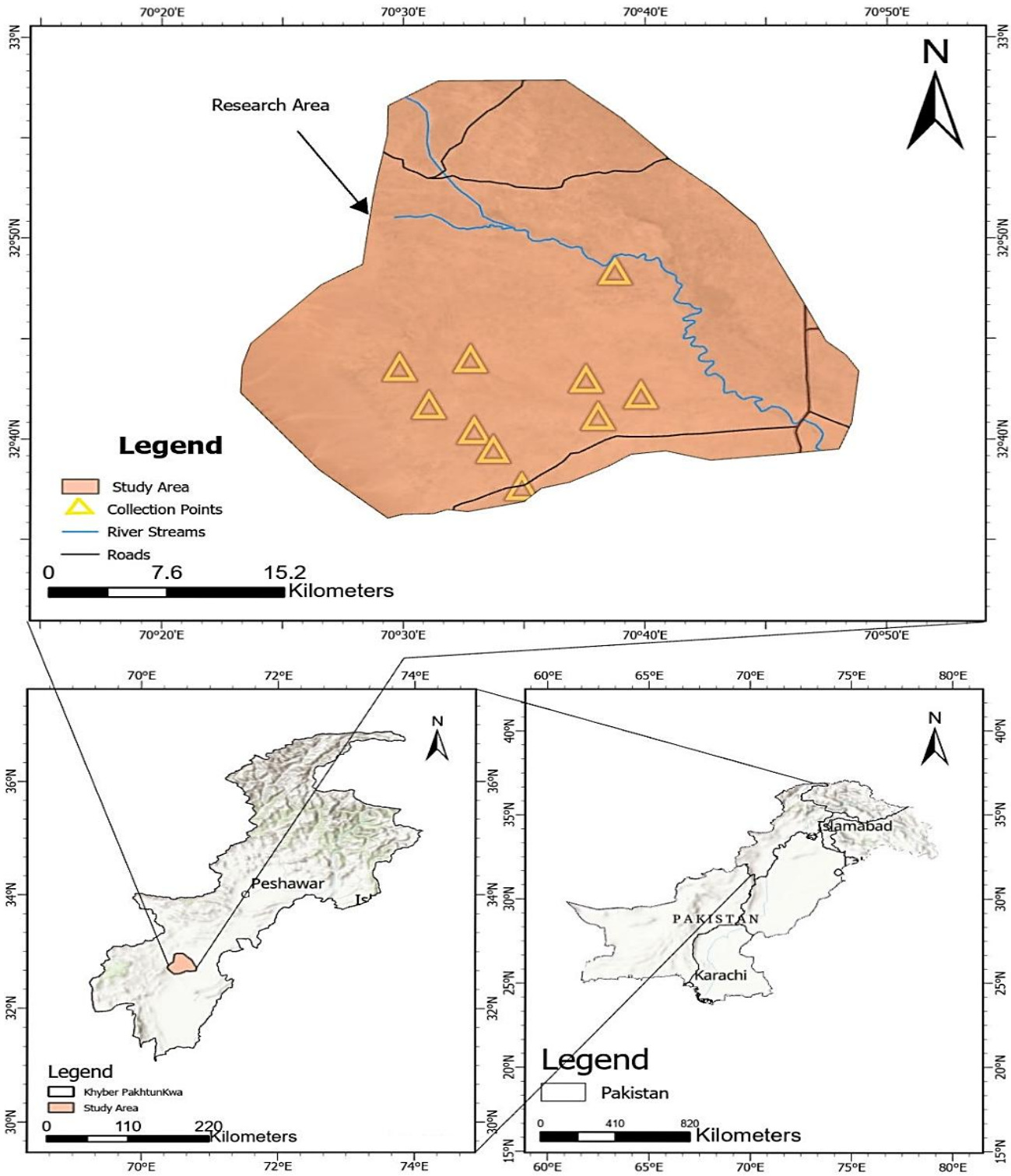


Fig. 1. Map of the study area (Sra Dargah).

Informant demographics: We interviewed 120 informants (112 men and 8 women) across 8 locations. Respondents were aged 25–35 (n = 15), 36–45 (n = 35), or 46–60 years (n = 70). Educational background was recorded as no formal education (n = 72), primary (n = 22), middle (n = 14), college/intermediate (n = 11), and university (n = 1) (Table 1). The sample was predominantly male; without a defined knowledge measure and appropriate analysis, differences in traditional knowledge between demographic groups could not be established.

Results

Plant species diversity: A total of 41 weed species belonging to 20 families, with 40 herbs (97.56%) and single shrub species (2.43%) were documented in the Sra Dargah arid region, representing a moderately diverse assemblage of weed flora characteristic of arid agricultural landscapes in southern Khyber Pakhtunkhwa. In terms of species richness, the family Poaceae was the dominant family with 6 species (14.63% of total documented flora) followed by

Asteraceae with 4 species (9.75%), Apiaceae, Brassicaceae, Solanaceae and Papilionaceae with 3 species each (7.31% per family), Polygonaceae, Plantaginaceae and Zygophyllaceae with 2 species each (4.87% per family) and rest of the families (Asclepiadaceae, Asphodelaceae, Boraginaceae, Chenopodiaceae, Convolvulaceae, Euphorbiaceae, Fumariaceae, Lamiaceae, Malvaceae and Oxalidaceae) were represented by 1 species each (2.43% per family) (Table 2; Fig. 2).

Table 1. Demographic Information of the study area.

Variable	Category	Numbers	Percentage
Gender	Male	112	93.33
	Female	08	6.66
Age	25-35	15	12.5
	36-45	35	29.16
	46-60	70	58.33
Educational level	Illiterate	72	60
	Primary	22	18.33
	Middle	14	11.66
	College	11	9.16
	University	1	0.83
Religion	Muslim	120	100
	Non-Muslim	0	0

Life form spectra: Therophytes were the dominant life form class among the weed flora of Sra Dargah, accounting for 27 species (65.85% of the total). Geophytes were the second most common life form, with 4 species (9.75%), followed by Chamaephytes and Hemicryptophytes (3 species each, 7.31% per class). Nanophanerophytes and Microphanerophytes were the least frequent life form classes, each represented by 2 species (4.87% per class) (Table 3; Fig. 3).

Leaf size spectra: Nanophylls emerged as the predominant leaf size class in the Sra Dargah weed flora, with 15 species (36.58% of the total). Leptophylls were the second most common, comprising 12 species (29.26%), followed by Microphylls with 9 species (21.95%) and Mesophylls with 5 species (12.19%). Mesophyll species were restricted to microhabitats with elevated moisture availability, including dry riverbeds and the edges of irrigated agricultural fields (Table 3; Fig. 3).

Ethnomedicinal traits of weed flora

Plant parts utilized for medicinal purposes: Leaves were the most frequently utilized plant part for medicinal applications, with 19 species (46.34%) having their leaves harvested for therapeutic use. The whole plant was the second most commonly used organ, cited for 18 species (43.90%). Seeds of 9 species (21.95%) were utilized, stems of 7 species (17.07%), roots and shoots each of 2 species (4.87% per organ), and latex of a single species (2.43%) were used (Table 5; Fig. 4).

Therapeutic applications of medicinal weeds: Analgesia (pain relief) was the most prevalent therapeutic use of the region's medicinal weeds, with 11 species (26.82%) employed for this purpose. Treatment of digestive disorders was treated with 9 species (21.95%) used, while abdominal pain was addressed with 8 species (19.51%). Wound healing and diuretic effects each involved 7 species (17.07% per application), diarrhea and dysentery each utilized 5 species (12.19% per ailment), and skin diseases were treated with 4 species (9.75%). Asthma and urinary tract infections were treated with 2 species each (4.87% per condition), and a single species (2.43%) was used for the management of diabetes (Table 6; Fig. 4).

Quantitative ethnobotanical data analysis

Relative frequency of citation (RFC): *Taraxacum officinale* had the highest RFC value (0.125) among all documented species. *Calotropis procera*, *Mentha longifolia*, and *Cynodon dactylon* each had an RFC value of 0.117, while *Euphorbia helioscopia* and *Solanum nigrum* each scored 0.108. *Sonchus asper* had an RFC of 0.100, and a group of species including *Solanum surattense*, *Rostrariacristata*, *Cymbopogon jwarancusa* subsp. *jwarancusa*, *Plantago lanceolata*, *Malva neglecta*, *Fumaria indica*, and *Coronopus didymus* each had an RFC of 0.092 (Table 4).

Table 3. Numbers and percentages of habit, leaf-size and life-form spectra.

Section	Ecological characteristic	Number	Percentage (%)
A. Flora	Total families (modernized groupings)	16	—
	Total species	41	—
B. Habit	Herbs	40	97.56
	Shrubs	1	2.44
C. Leaf-size spectrum	Nanophyll	15	36.59
	Leptophyll	12	29.27
	Microphyll	9	21.95
	Mesophyll	5	12.20
D. Life-form spectrum	Therophytes	27	65.85
	Geophytes	4	9.76
	Chamaephytes	3	7.32
	Hemicryptophytes	3	7.32
	Nanophanerophytes	2	4.88
	Microphanerophytes	2	4.88

Table 2. Ecological profile of weed flora of Sra Dargah Arid Region.

S.#	Family	Number of species	Species name	Habit	Leaf size	Life form	Seasonality				Flowering & Fruiting Phenology
							Au	Wt	Sp	Sm	
1.	Apiaceae	1.	*Ammi visnaga* (L.) Lam.	Herb	N	Th	-	-	+	+	April-May
		2.	*Anethum graveolens* L.	Herb	L	Th	-	-	+	+	April-May
		3.	*Torilis leptophylla* (L.) Reichenb. f.	Herb	N	Th	-	-	+	+	April-May
2.	Amaranthaceae	4.	*Achyranthes aspera* L.	Herb	N	Th	-	-	+	+	Mar-April and Aug-Sep
		5.	*Aerva javanica* (Burm. f.)	Herb	N	Th	-	-	+	-	Mar-April
		6.	*Amaranthus viridis* (L.) Medik	Herb	N	Th	-	-	-	+	June-July
3.	Asclepiadaceae	7.	*Calotropis procera* (Willd.) R. Br.	Shrub	Mes	Ch	+	+	+	+	All the year round
4.	Astercaeae	8.	*Carthamus oxyacantha* M.Bieb	Herb	Mic	Th	-	-	-	+	May-June
		9.	*Cirsium arvense* (L.) Scope	Herb	Mic	Th	-	-	+	+	April-May
		10.	*Sonchus asper* (L.) Hill	Herb	Mes	Th	-	-	+	+	April-June
		11.	*Taraxacum officinale* Weber	Herb	Mic	Th	-	-	+	+	Mar-April and Aug-Sep
5.	Asphodelaceae	12.	*Asphodelus tenuifolius* Cav.	Herb	L	G	-	+	+	-	Nov-April
6.	Boraginaceae	13.	*Nonea edgeworthii* A.DC.	Herb	N	H	-	-	+	-	Mar-Apr
7.	Brassicaceae	14.	*Coronopus didymus* (L.) sm.	Herb	N	Th	-	-	+	+	Mar-June
		15.	*Eruca sativa* Mill.	Herb	Mic	Np	-	-	+	+	Apr-June
		16.	*Malcolmia africana* (L.) R. Br.	Herb	N	Th	-	-	+	+	Mar-June
8.	Chenopodiaceae	17.	*Chenopodium murale* L.	Herb	L	Th	-	+	-	+	Jan-July
9.	Convolvulaceae	18.	*Convolvulus arvensis* L.	Herb	L	Th	+	+	+	+	All year around
10.	Euphorbiaceae	19.	*Euphorbia helioscopia* L.	Herb	L	Th	-	+	-	+	Jan – July
11.	Fumariaceae	20.	*Fumaria indica* (Hausskn.) Pugsley	Herb	N	Th	-	-	+	+	Mar-June
12.	Lamiaceae	21.	*Mentha longifolia* L.	Herb	Mic	G	+	-	+	+	Mar-Nov
13.	Malvaceae	22.	*Malva neglecta* Wall.	Herb	Mes	Th	-	-	-	+	May-July
14.	Oxalidaceae	23.	*Oxalis corniculata* L.	Herb	Mic	G	-	+	+	-	Mar-Dec
15.	Papilionaceae	24.	*Astragalus scorpiurus* Bunge	Herb	N	Np	-	-	+	-	Mar-April
		25.	*Melilotus indica* (L.) All.	Herb	L	Mic P	-	-	+	+	Mar-Aug
		26.	*Medicago polymorpha* L.	Herb	L	Th	-	-	+	+	Mar-May
16.	Polygonaceae	27.	*Emex spinosus* (L.) Campd	Herb	Mic	Th	-	-	+	+	Mar-May
		28.	*Rumex dentatus* L.	Herb	Mes	Ch	-	-	-	+	May-Jun
17.	Plantaginaceae	29.	*Plantago lanceolata* L.	Herb	Mes	Mic P	-	-	+	+	May-Jun
		30.	*Plantago ovata* Forssk.	Herb	N	Th	-	-	+	-	Mar-May
18.	Poaceae	31.	*Avena fatua* L.	Herb	L	Th	-	-	+	-	Mar-April
		32.	*Avena sativa* L.	Herb	N	Th	-	-	+	-	Mar-April
		33.	*Cynodon dectylon* (L.) Pers	Herb	L	H	+	+	+	+	All year round
		34.	*Cymbopogon jwarancusa* (Jones) Schult.subsp. *jwarancusa*	Herb	Mic	Th	-	-	+	+	Mar-April and June-July
		35.	*Imperata cylindrica* L.	Herb	L	G	-	-	+	+	April-June
		36.	*Rostraria cristata* (L.) Tzvelev.	Herb	N	Th	-	-	+	+	April-July
19.	Solanaceae	37.	*Physalis divaricata* D. Don	Herb	N	Th	+	-	-	-	Oct-Nov
		38.	*Solanum nigrum* L.	Herb	Mic	Ch	-	-	+	+	April-June
		39.	*Solanum surattense* Burm.f.	Herb	N	Th	+	+	+	+	Throughout the year
20.	Zygophylaceae	40.	*Fagonia indica* Burm.f.	Herb	L	Th	-	+	-	+	Jan and Aug
		41.	*Peganum harmala* L.	Herb	L	H	+	+	+	-	April-Oct

Key: **Leaf Size Class:** N= Nanphyll, L= Leptophyll, Mic= Microphyll, Mes= Mesophyll

Life Form Class: Th = Therophytes, G= Geophytes, Ch= Chamaephytes, H= Hemicryptophytes, Np= Nanophanerophytes, Mic P= Microphanerphytes; Seasonality: Yes = +, No = -

Table 4. Ethno-Medicinal description with quantitative studies of weed flora of Sra Dargah, Arid Region.

S#	Family	No. Spp.	Species name	Local name	Voucher's number	Habit	Part used	Ethno-medicinal uses	ROA	Np	Ui	FC	RFC	UV	FL %	FIV
1.	Apiaceae	1.	*Ammi visnaga* (L.) Lam.	Lewanaigajara	F. Khan Bot.151. (PUP)	Herb	Seeds	Used for wounds, as a diuretic	Pow	3	8	7	0.058	1.14	42.86	18.3
		2.	*Anethum graveolens*L.	Sowey	F. Khan Bot.152. (PUP)	Herb	Seeds, leaves	Seeds used for wounds as an antiseptic; used as a tonic	Pow	4	11	8	0.067	1.38	50.00	
		3.	*Torilis leptophylla* (L.) Reichenb. f.	Junglidhanrhia	F. Khan Bot.153. (PUP)	Herb	Leaves,stem	Used to increase animal milk production	O	6	15	7	0.058	2.14	85.71	
2.	Amaranthaceae	4.	*Aerva javanica* (Burm. f.)	Speray	F. Khan Bot.154. (PUP)	Herb	Leaves	Leaves used for animals' skin lesions	Pow	5	11	7	0.058	1.57	71.43	20
		5.	*Amaranthus viridis* (L.) Medik	Ranjaka	F. Khan Bot.155. (PUP)	Herb	Leaves, shoot	Reduced diabetes rate and cholesterol level; used as a painkiller and diuretic	Pow	6	17	10	0.083	1.70	60.00	
		6.	*Achyranthes aspera*L.	Unknown	F. Khan Bot.156. (PUP)	Herb	Whole Plant	Laxative, diuretic, cough, asthma and toothache	Pow	4	13	7	0.058	1.86	57.14	
3.	Asclepiadaceae	7.	*Calotropis procera* (Willd) R. Br.	Spalmaka	F. Khan Bot.157. (PUP)	Shrub	Leaves, stem	Latex used in asthma, cough, stomach burn, and dysentery	O	5	22	14	0.117	1.57	35.71	11.7
4.	Astercaeae	8.	*Carthamus oxyacantha* M. Bieb	Kunjal	F. Khan Bot.158. (PUP)	Herb	Leaves, seeds	Leaves used for milk production in cattle, seeds used for urinary swelling	Pow/O	3	13	8	0.067	1.63	37.50	33.3
		9.	*Cirsium arvense* (L.) Scope	Bizogee	F. Khan Bot.159. (PUP)	Herb	Whole plant	Chewed for toothache	O	4	8	5	0.042	1.60	80.00	
		10.	*Sonchus asper* (L.) Hill	Tharez	F. Khan Bot.160. (PUP)	Herb	Leaves, roots, latex	Used to cure warts and inflammation		6	15	12	0.100	1.25	50.00	
		11.	*Taraxacum officinale* Weber	Zerhgulai	F. Khan Bot.161. (PUP)	Herb	Whole plant	Laxative, diuretic, constipation	O	8	19	15	0.125	1.27	53.33	
		12.	*Asphodelus tenuifolius* Cav.	Piazakai	F. Khan Bot.162. (PUP)	Herb	Roots, leaves	Used for hair loss, anti-dandruff	Pow	3	10	5	0.042	2.00	60.00	
		13.	*Nonea edgeworthii* A. DC.	Nikrajibotai	F. Khan Bot.163. (PUP)	Herb	Leaves	Leaves used for foot wounds	Pow	3	8	4	0.033	2.00	75.00	
5.	Asphodelaceae	14.	*Coronopus didymus* (L.) sm.	Gandbutai	F. Khan Bot.164. (PUP)	Herb	Leaves, shoots	Reducing blood pressure	Pow/O	9	16	11	0.092	1.45	81.82	4.17
6.	Boraginaceae	15.	*Eruca sativa* Mill	Jamao	F. Khan Bot.165. (PUP)	Herb	Leaves, seeds	Used for skin diseases, blood purification, kidney disorders, hair loss, and as a diuretic	O	4	17	8	0.067	2.13	50.00	3.33
7.	Brassicaceae	16.	*Malcolmia africana* (L.) R. Br.	Khatoal	F. Khan Bot.166. (PUP)	Herb	Leaves, seeds	Seed oil used for bone pain; leaves used for abdominal relief	Pow/O	2	10	4	0.033	2.50	50.00	19.2
		17.	*Chenopodium murale* L.	Tor Bathu	F. Khan Bot.167. (PUP)	Herb	Leaves, stem	Used as a diuretic, tonic for the liver, digestive, laxative, peptic ulcer, and dyspepsia	O	5	21	10	0.083	2.10	50.00	
		18.	*Convolvulus arvensis* L.	Perkhatun	F. Khan Bot.168. (PUP)	Herb	Whole plant	Treats skin ulcers, wounds, swellings, abdominal pain; also used for muscular weakness	Pow/O	6	18	11	0.092	1.64	54.55	
8.	Chenopodiaceae	19.	*Euphorbia helioscopia* L.	Parparai	F. Khan Bot.169. (PUP)	Herb	Whole plant	Root is anthelmintic, cathartic; seeds mixed with paper mint or honey are used against cholera	Pow/O	7	20	13	0.108	1.54	53.85	8.3
9.	Convolvulaceae	20.	*Fumaria indica* (Hausskn.) Pugsley	Spanda	F. Khan Bot.170. (PUP)	Herb	Leaves, stem, seeds	Used asan exorcism and for stomach pain	O	4	16	11	0.092	1.45	36.36	9.2
10.	Euphorbiaceae	21.	*Mentha longifolia* L.	Velanai	F. Khan Bot.171. (PUP)	Herb	Leaves, stem	Used for digestive issues, abdominal pain, cough, cold, and asthma	O	7	25	14	0.117	1.79	50.00	10.8
11.	Fumariaceae	22.	*Malva neglecta* Wall.	Pochkai	F. Khan Bot.172. (PUP)	Herb	Whole plant	Highly medicinal, nutritive, and digestive	O	4	20	11	0.092	1.82	36.36	9.2
12.	Lamiaceae	23.	*Oxalis corniculata* L.	Malkhoza	F. Khan Bot.173. (PUP)	Herb	Seeds	Seeds used for backache and joint pain	Pow	7	15	10	0.083	1.50	70.00	11.7
13.	Malvaceae	24.	*Astragalus scorpiurus* Bunge	Kasterai	F. Khan Bot.174. (PUP)	Herb	Leaves	Very highly medicinal (Ethnoveterinary)	O	8	11	9	0.075	1.22	88.89	9.2
14.	Oxalidaceae	25.	*Melilotus indica* (L.) All.	Shinghzai	F. Khan Bot.175. (PUP)	Herb	Whole plant	Used for stomach and heartburn	O	3	7	5	0.042	1.40	60.00	8.3
15.	Papilionaceae	26.	*Medicago polymorpha* L.	Kundey	F. Khan Bot.176. (PUP)	Herb	Leaves, stem	Aphrodisiac	O	6	12	8	0.067	1.50	75.00	18.3
		27.	*Emexspinosus* (L.) Campd	Perkhatun	F. Khan Bot.177. (PUP)	Herb	Leaves, stem	Used for killing worms in cattle, highly medicinal	O	2	11	4	0.033	2.75	50.00	
		28.	*Rumex dentatus* L.	Turukai	F. Khan Bot.178. (PUP)	Herb	Whole plant	Stomach and abdominal relief	O	7	22	9	0.075	2.44	77.78	
16.	Polygonaceae	29.	*Plantago lanceolata* L.	Chaparparhai	F. Khan Bot.79. (PUP)	Herb	Whole plant	Animal fodder, increase milk production	O	6	15	11	0.092	1.36	54.55	10.8
		30.	*Plantago ovata* Forssk.	Speghol	F. Khan Bot.180. (PUP)	Herb	Flowers, seeds	Used for abdominal pain and diarrhoea	O	5	11	7	0.058	1.57	71.43	
17.	Plantaginaceae	31.	*Avena fatua* L.	Kiranrha	F. Khan Bot.181. (PUP)	Herb	Whole plant	Used as a diuretic, anti-inflammatory, and for wound healing	O	4	14	7	0.058	2.00	57.14	15
		32.	*Avena sativa* L.	Jaudar	F. Khan Bot.182. (PUP)	Herb	Whole plant	Leaves are used for skin diseases, as a tonic, and as an antispasmodic	O	4	11	6	0.050	1.83	66.67	
18.	Poaceae	33.	*Cynodon dactylon* (L.) Pers.	Drab	F. Khan Bot.183. (PUP)	Herb	Whole plant	Used to cure fresh wounds, chronic diarrhea, rheumatism, and as a diuretic	O	7	22	14	0.117	1.57	50.00	46.7
		34.	*Cymbopogon jwarancusa* (Jones) Schult.w subsp. *jwarancusa*	Sargarai	F. Khan Bot.184. (PUP)	Herb	Whole Plant	Used for cough, cold, fever, stomach burn, and vomiting	O	5	17	11	0.092	1.55	45.45	
		35.	*Imperata cylindrica* L.	Sermaghza	F. Khan Bot.185. (PUP)	Herb	Whole plant	Used as a diuretic, tonic, for wound healing, nosebleeds, and digestive disorders	Pow/O	5	19	7	0.058	2.71	71.43	
		36.	*Rostraria cristata* (L.) Tzvelev.	Washkai	F. Khan Bot.186. (PUP)	Herb	Whole Plant	Used for animal abdominal pain, to increase milk production	O	4	16	11	0.092	1.45	36.36	
		37.	*Physalis divaricata* D. Don	Sqand	F. Khan Bot.187. (PUP)	Herb	Whole plant	Seeds used for high fever; roots used for animal, diarrhea, and abdominal pain	O	5	11	6	0.050	1.83	83.33	
		38.	*Solanum nigrum* L.	Mamanrha	F. Khan Bot.188. (PUP)	Herb	Whole plant	Used for rheumatism, skin diseases, cough, and as a laxative	O	7	24	13	0.108	1.85	53.85	
19.	Solanaceae	39.	*Solanum surattense* Burm.f.	Maraghoon	F. Khan Bot.189. (PUP)	Herb	Whole plant	Seeds and fruit cover used for abdominal pain, fruit used for digestion, and roots for diarrhea	O	5	19	11	0.092	1.73	45.45	25
		40.	*Fagonia indica* Burm.f.	Spalaghzai	F. Khan Bot.190. (PUP)	Herb	Leaves	Leaves used for skin lesions, wounds	O	5	15	9	0.075	1.67	55.56	
		41.	*Peganum harmala* L.	Spalani	F. Khan Bot.191. (PUP)	Herb	Seeds	Seeds used for abdominal pain and for evil eyes by burning the seeds on fire	O	3	7	4	0.033	1.75	75.00	
20.	Zygophyllaceae	41.	*Peganum harmala* L.	Spalani	F. Khan Bot.191. (PUP)	Herb	Seeds	Seeds used for abdominal pain and for evil eyes by burning the seeds on fire	O	3	7	4	0.033	1.75	75.00	10.8
		41.	*Peganum harmala* L.	Spalani	F. Khan Bot.191. (PUP)	Herb	Seeds	Seeds used for abdominal pain and for evil eyes by burning the seeds on fire	O	3	7	4	0.033	1.75	75.00	

Table 5. Numbers and percentage of plant parts used medicinally.

S.#	Part used	Numbers	Percentage
1.	Leaves	19	46.34
2.	Whole plant	18	43.90
3.	Seeds	9	21.95
4.	Stem	7	17.07
5.	Shoots	2	4.87
6.	Roots	2	4.87
7.	Latex	1	2.43

Table 6. Numbers and percentage of diseases treated.

S.#	Diseases treated	Numbers	Percentage
1.	Pain killer	11	26.82
2.	Digestive disorders	9	21.95
3.	Abdominal pain	8	19.95
4.	Wound healing	7	17.07
5.	Diuretic	7	17.07
6.	Diarrhea & Dysentery	5	12.19
7.	Skin diseases	4	9.75
8.	Asthma	2	4.87
9.	Urinary infection	2	4.87
10.	Diabetes	1	2.43

Use value (UV): The UV values of medicinal weeds in Sra Dargah varied from 1.14 to 2.75. *Emexs pinosus* had the the highest UV (2.75), followed by *Imperata cylindrica* (2.71), *Malcolmia africana* (2.50), *Rumex dentatus* (2.44), *Torilis leptophylla* (2.14), *Eruca sativa* (2.13), and *Chenopodium murale* (2.10). *Asphodelus tenuifolius*, *Nonea edgeworthii*, and *Avenafatua* each had a UV of 2.00. The lowest UV values were observed in *Ammi visnaga* (1.14), *Astragalus scorpiurus* (1.22), *Sonchus asper* (1.25), *Taraxacum officinale* (1.27), *Plantago lanceolata* (1.36), *Melilotus indica* (1.40), and *Rostraria cristata*/*Coronopus didy*mus (each 1.45) (Table 4).

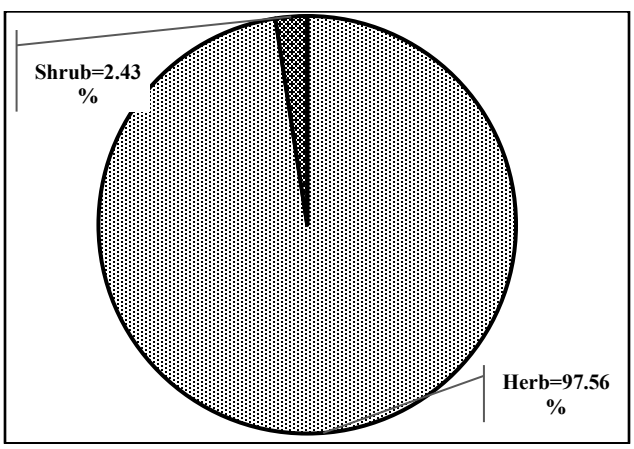


Fig. 2. Habit of weed flora.

Fidelity level (FL): FL values ranged from 35.71% to 88.89%. *Astragalus scorpiurus* had the highest FL (88.89%), followed by *Torilis leptophylla* (85.71%), *Physalis divaricata* (83.33%), *Coronopus didymus* (81.82%), *Cirsium arvense* (80.00%), and *Rumex dentatus* (77.78%). The lowest FL values were recorded for *Calotropis procera* (35.71%), *Rostraria cristata* (36.36%), *Malva neglecta* (36.36%), and *Fumaria indica* (36.36%) (Table 4; Fig. 5).

Family importance value (FIV): Poaceae exhibited FIV (46.7%), followed by Asteraceae (33.3%), Solanaceae (25%), Amaranthaceae (20%), Brassicaceae (19.2%), Papilionaceae and Apiaceae (each 18.3%), Plantaginaceae (15%), Euphorbiaceae, Polygonaceae, and Zygophyllaceae (each 10.8%), Oxalidaceae (8.3%), and Boraginaceae (3.33%), respectively (Table 4).

Discussion

The occurrence of 41 weed species in Sra Dargah belonging to 20 families is consistent with the floristic composition of arid agricultural ecosystems of northern Pakistan (Gul *et al.,* 2025). The *Polypogon monspeliensis* and *Cynodon dactylon* were found as the major weeds in District Bannu, including almost 20% of weed biomass in rain-fed wheat fields (Shah *et al.,* 2021). This tendency was also observed by Sher *et al*., *(*2011) in District Swabi and Dir (Lower), respectively, where Poaceae comprised 18% and 22% of the total weed species in maize and wheat fields. Hussain *et al*., (2009) recorded Poaceae in Azakhel (District Nowshera) and recorded 15 species of Poaceae, followed by Asteraceae (8 species). They attributed this dominance to the ability of the family to compete with crop plants for limited resources (e.g., nitrogen, water) in arid soils poor in nutrients. The dominance of Poaceae in arid agricultural weeds has been documented in semi-arid Iran, highlighting the worldwide adaptive success of the family in water-scarce agroecosystems. This consistency leads to the conclusion that the ecologically dominant weed family in the arid Pakistani agricultural landscape is Poaceae, due to a combination of physiological, morphological, and phenological adaptations to aridity and anthropogenic disturbance (Arshad *et al.,* 2024). The dominant life form of Sra Dargah weed flora was therophytes (65.85%), which is a common adaptation to the hot, dry climate of the region. The annuals complete their life cycle during the short rainy season of two to three months' duration (June-August). These are desiccation-tolerant seeds that can survive through long periods of dry spells (Anwar *et al.,* 2022; Raunkiaer, 1934). Therophytes are the most successful functional group in dry and semi-arid ecosystems throughout the globe and represent 50–70% of the flora of water-limited locations. The dominance of therophytes in Sra Dargah conforms to this global pattern. Similarly, Sher *et al*., (2011) and Shah *et al.,*2014 reported Therophytes as the most dominant life form (60% and 68%, respectively) in wheat field weeds of District Swabi and other arid regions of Khyber Pakhtunkhwa. Hadi & Ibrar (2015) and Hussain *et al*., (2009) reported similar trends (62% and 67% Therophytes) in Aza Khel's wheat fields. The low number of woody life forms (Nanophanerophytes and Microphanerophytes, 4.87% each) further indicates the constraints of water scarcity. This is because perennial woody plants require the availability of soil moisture for root development and canopy growth, which are scarce and unpredictable in Sra Dargah (Shi *et al.,* 2023). This highlights the severe selection pressure of aridity on the distribution of life forms in the region (Waheed *et al.,* 2023).

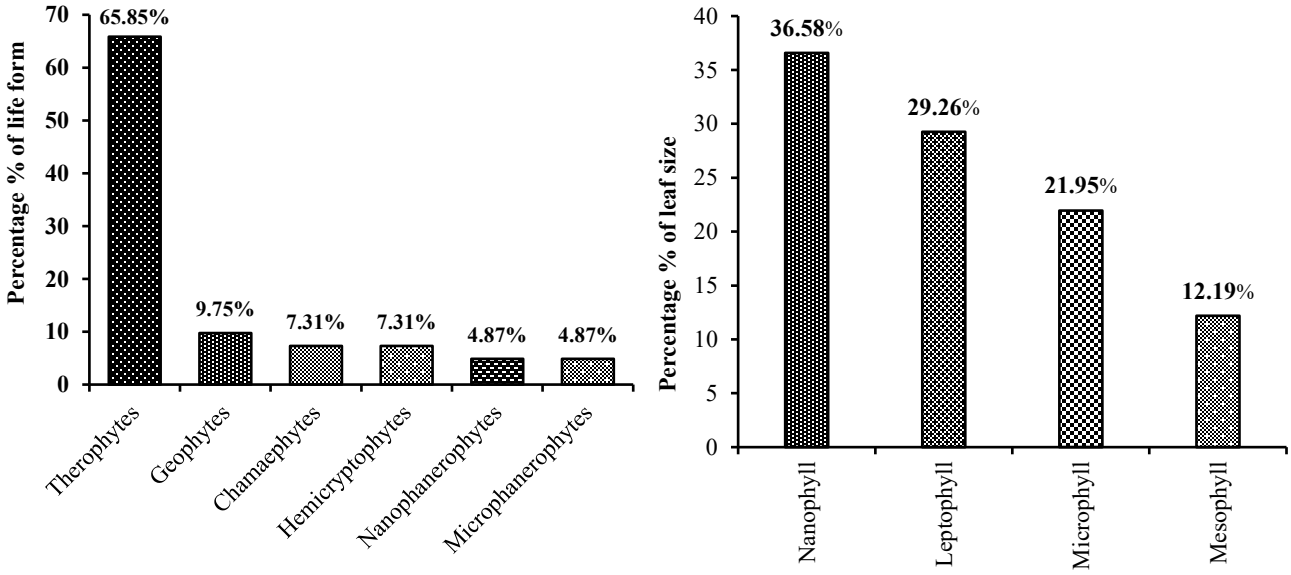


Fig. 3. Percentage of life form and leaf size classes of the weed flora.

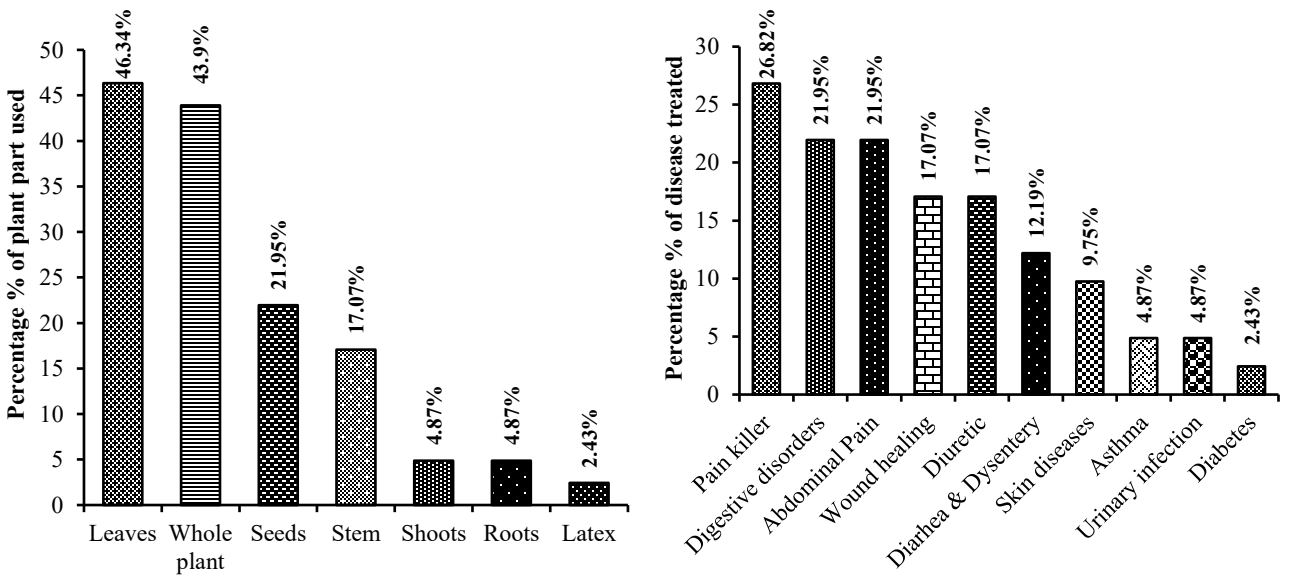


Fig. 4. Percentage of plant part used and disease treated with medicinal weeds.

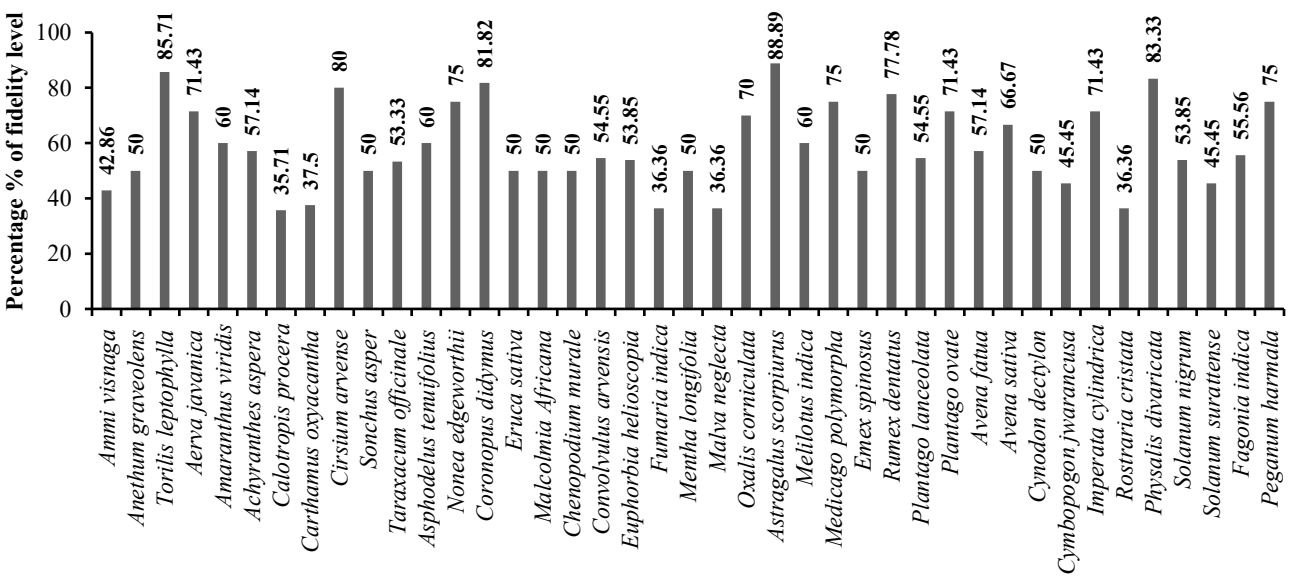


Fig. 5. Percentage of fidelity level of medicinal weed flora.

A significant morphological adaptation to aridity is the dominance of small-leaved classes (Nanophylls and Leptophylls, 65.84% in total), as smaller leaf surface area reduces transpirational water loss and maximizes water use efficiency (Anwar *et al.,* 2022). Sra Dargah's climate is particularly good for nanophylls (leaf area 0.25–2.0 cm^2), which are small enough to catch light for photosynthesis but also to conserve water, the best tradeoff for plants in low-rainfall areas. The weeds of wheat fields in tehsil Razar, district Swabi (Anwar *et al.,* 2022) and in wheat fields of Azakhel (Hussain *et al.,* 2009) have a diverse floristic profile. *Mentha longifolia* (a major species of Sra Dargah) contains menthol and rosmarinic acid, which are used in the locality for pain treatment and digestive health (Kayani *et al.,* 2024). The use of the whole plant (43.90%) probably represents two interrelated factors. The first is the small stature of many Therophytic weeds (e.g*., Euphorbia helioscopia*, *Ammi visnaga*), which makes it feasible to harvest the whole plant. The traditional use of plants is inevitable in providing folk medicines for health care system. The second is the understanding of local communities of the synergistic effects of bioactive compounds in multiple plant organs (Ahmad *et al.,* 2014), supported by modern pharmacology, which has revealed multi-organ synergy in traditional medicine plants. The use of roots and shoots is limited (4.87% each) because of two constraints: (1) the difficulty in extracting roots from the compact, dry soils of Sra Dargah (Khan *et al.,* 2013), which can lead to local extinction (Rana & Rana, 2016). This pattern is consistent with the ethnobotanical research performed in other dry parts of Pakistan where roots are employed in the preparations (Ullah *et al.,* 2016).

The most common usage is for analgesia (26.82%), which is consistent with the hard work associated with subsistence farming and livestock grazing. Muhammad *et al*., (2024) reported that *Achyranthes aspera* and *Solanum nigrum* were used for asthma and joint pain in the arid areas of Pakistan. *Euphorbia helioscopia* has been reported to be used in traditional medicine for the treatment of digestive problems and wound healing. These results are very similar to our observations in Sra Dargah. The ethnomedicinal versatility of the Poaceae family (e.g*.,* treatment of cancer, epilepsy, cough (Ngoua-Meye-Misso *et al.,* 2019).

The highest value of RFC (0.125) for *Taraxacum officinale* represented its wider use in the ethnomedicinal system of Sra Dargah. This agrees with the fact that *Taraxacum officinale* is a medicinal plant that is well recognized worldwide and has anti-inflammatory, hepatoprotective, and diuretic characteristics (Kayani *et al.,* 2024). The relatively high UV (2.75) of *Emexs pinosus* indicates the various therapeutic uses in the local pharmacopeia, which is related to its widespread distribution (it is found in 80% of the agricultural fields in Sra Dargah) and the presence of different bioactive compounds (e.g*.,* flavonoids, anthraquinones (Ijaz *et al.,* 2016). *Malcolmia africana* (0.50) reflects its restricted distribution (only in the northern edge of Sra Dargah) and limited perceived efficacy; local informants described it as a "weak remedy" for colds, a sentiment supported by phytochemical analyzes showing low concentrations of bioactive compounds (Ijaz *et al.,* 2016). This variation in FL emphasizes the importance of quantitative ethnobotanical indices in prioritizing species for bioprospecting.

Conclusion

This study holistically characterized the weed flora of arid Sra Dargah (southern Khyber Pakhtunkhwa, Pakistan), integrating ecological and ethnobotanical analysis. We documented 41 weed species across 20 families, a moderately diverse assemblage shaped by water scarcity and anthropogenic disturbance, with Poaceae (14.63%) emerging as the ecologically dominant family in the inventory. Ecologically, the flora is defined by dominant Therophytes (65.85%) and small-leaved Nanophylls/ Leptophylls (65.84% combined), with woody and large-leaved species restricted to moist microhabitats, reflecting aridity's selective pressure. From an ethnobotanical point of view, practically all the weeds are part of the local traditional pharmacopoeia. The most used organs are leaves (46.34%) and whole plants (43.90%). The primary therapeutic indications are analgesic (26.82%) and digestive problems (21.95%), as reported by informants. Quantitative indices selected *Taraxacum officinale* (highest RFC), *Emexs pinosus* (highest UV), and *Astragalus scorpiurus* (highest FL) as priority species for pharmaceutical study. Poaceae (FIV = 46.7%) was a priority for both ecological and cultural relevance.

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Conflict of Interest: The authors of this manuscript have no conflicts of interest to declare.

Author's Contribution: FK= Original manuscript write-up, Field survey; FH= Supervision, Experiments; BG= Editing and reviewing; SA= Software, methodology; KHA= Editing and reviewing; MZ= Validation and editing.

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