FLORISTIC INVENTORY, BIOLOGICAL SPECTRA AND INVASIVE FLORA OF TEHSIL UTMAN KHEL, DISTRICT BAJAUR, PAKISTAN

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ABSTRACT

The flora of Tehsil Utman Khel, District Bajaur comprised of total 238 plant species belonging to 208 genera and 89 families. Among them, 59 species were identified as Non-native. The dominant family was Poaceae (17 species) which was followed by Asteraceae (15 species), Papilionaceae Rosaceae (13 species each), and Solanaceae (10 species). The habit of flora was led by herbs (149 species, 62.6%) followed by shrubs (46 species, 20%) and trees (43 species, 18%). There were 177 wild species and 61 cultivated species. The leading life forms were therophytes having 83 species and nanophanerophytes 49 species. Microphylls with 89 species, Mesophylls with 75 species and nanophylls with 43 species were the leading leaf size classes. Simple leaves (156 species, 65.55%) followed by compound leaves (18.91%), dissected leaves (10.51%) and needle leaves (3.78 %) were the documented leaf types.

Keywords: Floristic composition, life form, leaf size, phenology, invasive species.

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INTRODUCTION

Flora refers to the list of all plant species or taxa found within a given geographic area and their diversity (Ali, 2008; Amjad *et al*., 2016). Flora is a term that refers to all of the plants, both wild and cultivated, that grow in a specific geographic area and help to define a specific historical period (Qureshi *et al*., 2011). It is considered important for any phytosociological research (Rafay *et al*., 2013). Floristic composition is important for the information on the biodiversity of forests (Reddy *et al.,* 2008). Floristic survey of the area is crucial since it acts as a birth certificate for each location (Abbas *et al.,* 2012).

The biological spectrum is used to describe both the distribution pattern of life forms in vegetation and the phyto-climatic conditions that exist when those life forms progress (Raunkiaer, 1934; Khan *et al*., 2013). It is the best indicator component of the ecosystem and is an important index in explaining the type of vegetation (Malik *et al*., 2007). Raunkiaer's life classification (1934) is used for the majority of life form research. The leaf size spectrum plays an important role in plant community physiological processes and understanding leaf size can help us better understand plant and plant community physiological processes (Oosting, 1956). Environmental conditions such as drought, altitudinal and climatic variations are all indicators of leaf size (Batalha and Artins, 2002; Malik *et al*., 2007; Badshah *et al*., 2013). The available literature on the biological spectra for life forms and leaf size reveals that Pakistan has done very little research (Abbasi *et al*., 2012).

Phenology is the study of the seasonal occurrence of plant life cycles or life events that are linked to periodic weather and edaphic condition (Schwartz, 2003; Malik et al., 2007). (Schwartz, 2003; Malik *et al*., 2007). It is the study of the timing of biological events that repeat themselves, as well as the causes of their timing in terms of abiotic and biotic influences (Nath *et al*., 2008). The organism's detection of environmental

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signals that trigger the appropriate response, such as flowering in response to short or long days, is the immediate cause of the phenological event (Bernier *et al*., 1981).

Invasive species are non-native species that have been introduced mistakenly or with determination brought into the natural or established environment, by humans, posing a hazard to the environment, economy and health (Qureshi *et al.,* 2014). It quickly colonized and dispersed into a previously uninhabitable territory (Reichard and Hamilton, 1997). It becomes noxious and causes billions of dollars in annual losses due to its enormous negative impact on native or cultivated ecosystems and managed landscapes (Aukema *et al*., 2011; Paini *et al*., 2016). Biological invasion is a type of biological pollution that is likely to be even more harmful than chemical pollution (Khan *et al*., 2010). Although the majority of invasive species are well-known for their wide range of negative consequences, some have been shown to provide essential ecosystem services and thus benefit native biodiversity (Pejchar and Mooney, 2009; Keller *et al*., 2011). Invasive species, on the other hand, cause significant damage to global agriculture, particularly in developing countries, where the costs of impacts can be high in comparison to a country's gross domestic product GDP (Paini *et al*., 2016; Tobin, 2018).

The main objective of the current study is to:

Enlist the flora of the area, Document the biological spectra of the flora and Record the invasive species and their impacts on the local flora.

MATERIALS AND METHODS

Study area

Bajaur, the tribal district of Khyber Pakhtunkhwa, is situated in the North-West of Pakistan. Its total area is 1290 km^2, with a population of 10,93,684 according to the 2017 census. It is about 45 miles (72 km) long and 20 miles (32km) broad. The plains cover about 23.6% of the land while mountains cover the remaining 76.4%. Bajaur shares a 52 km border with Afghanistan Kunar province. Bajaur is surrounded by the district Mohmand in the southwest, Kunar province in Afghanistan's northwest, Dir in the northeast and Malakand in the southeast. Bajaur has eight Tehsils, namely Bar Chamer Kand, Barang, Khar, Loe Mamund, Wara Mamund, Nawagai, Salarzai and Utmankhel. Tehsil Mamund is the largest tehsil and the smallest one is Chamer Kand by area. Tehsil Utmankhel is situated in the Southeast of Bajaur which is surrounded by the villages Mattako, Jar, Pandoki, Shamozo and Arang. Tehsil Khar, the headquarter of Bajaur has the highest population.

Collection, identification and preservation of the species

Regular field trips were arranged for the collection of plants during 2020-21. A total of 238 plant species were gathered from the study area. The plants were collected from, plain areas, mountains, slopes, fields, rivers bank and streams sides. The plants were collected, pressed, dried, mounted on herbarium sheets, and identified flora of Pakistan (Nasir and Ali, 1971-95; Ali and Qaisar, 1995-2018). A complete floristic list of the flora was created and identified specimens were submitted to the Department of Botany, Government Post Graduate College Khar Bajaur, for future reference.

Biological spectra of the flora

Life form

Plant's life form is an adaptation to its usual environment. Life form classes were assigned to the collected plant species according to Raunkiaer (1934).

Leaf size

A leaf size is an important tool used in the classification of plants. The leaf size spectrum of species was determined after Raunkiaer (1934).

Leaf types

Based on the shape, leaves were classified plants into four categories (simple, compound, dissected and needle) following Hussain *et al*. (2015).

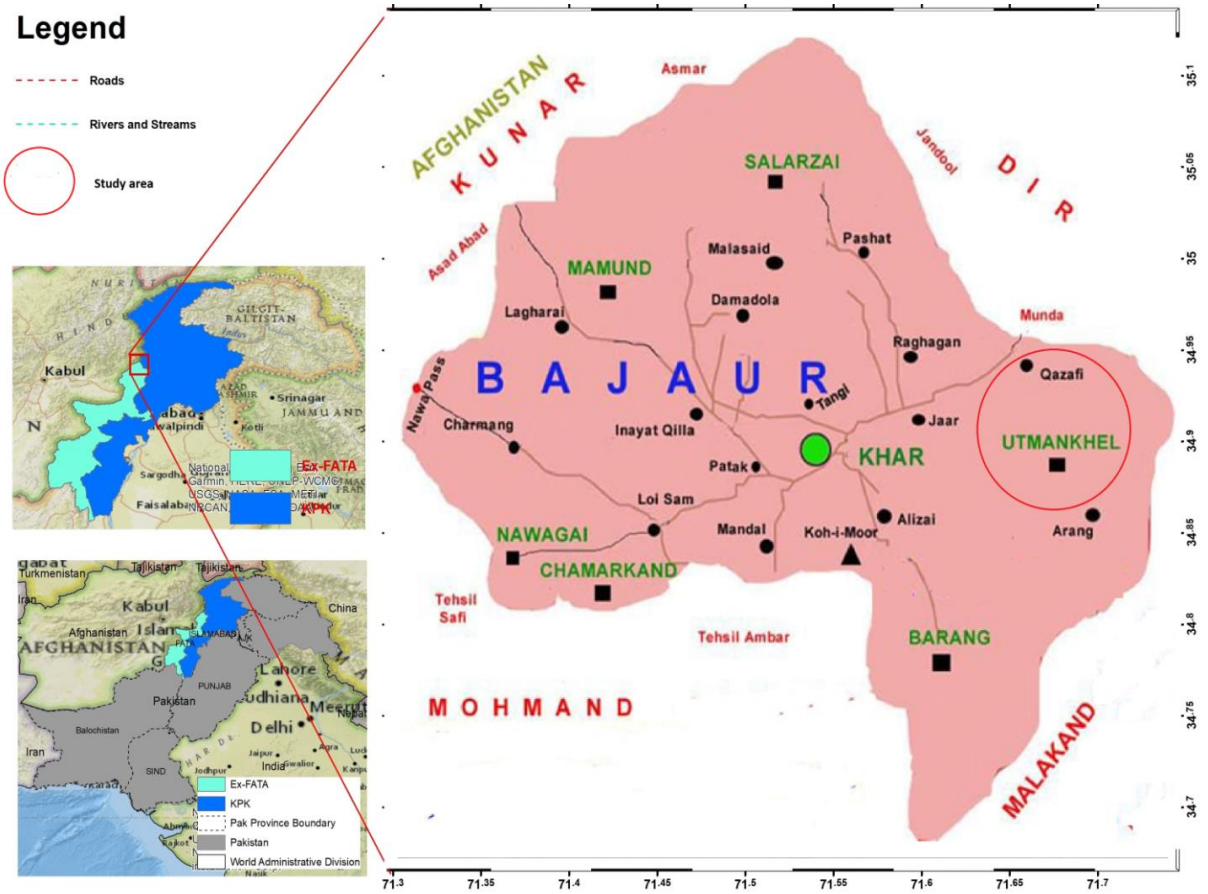

Figure 1. Map of the research area

RESULT AND DISCUSSION

The floristic composition of Tehsil Utmankhel Bajaur consisted of a total of 238 plant species belonging to 208 genera and 89 families. Of them, 05 species were pteridophytes distributed in three families, 04 species of gymnosperm from 02 families and 229 angiosperms species belonged to 84 families. There were 177 wild species (74.36%) and 61 cultivated (25.63%) in the flora (Table 1). There were 149 herb species, 46 shrub species and 43 tree species identified (Fig. 2). Poaceae family appeared to be the most dominant with 17 species (7.14%), followed by Asteraceae with 15 species (6.3%), Papilionaceae and Rosaceae each with 13 species (5.46%), Solanaceae with 10 species (4.2%), While the remaining families had less than 10 in each family (Table 1). Members of these families have a wide ecological range and as a result, they have been well-represented in a variety of environments. Close to the current finding, Durrani *et al*. (2005) from Harboi Rangeland, Kalat, Marwat and Qureshi (2000) from guzara forests, District Manshera and Parveen *et al*. (2008), who also reported the highest number of species in family Poaceae and Asteraceae from their respective study areas. Members of the family Poaceae have a widespread ecological range and for that purpose, they were well characterized in a variety of habitats. Samreen *et al.* (2016) made a floristic list of 213 plant species from the Daranzinda, and found Poaceae as a dominant family followed by Asteraceae and Solanaceae.

Life form of the flora was dominated by therophytes (83 species, 34.87 %) followed by nanophanerophytes (49 species, 20.58%), chamaephytes (27 species, 11.34%), hemicryptophytes (26 species, 7.92%), microphanerophytes (22 species, 9.24%), geophytes (19 species, 7.98%), and megaphanerophytes (7

species,2.94%), mesophanerophytes (3 species, 1.26%) as shown in figure 3. Two species *Cuscuta reflexa* and *Orobanche crenata* were recorded as parasites. The present finding in terms of life forms is in line with Khan *et al*. (2014) who documented therophytes (47.73%) and chamaephytes (8.16%) as dominant life forms from Shahbaz Ghari, Mardan. Shaheen *et al.* (2015) also found therophytes (30%) and megaphanerophytes (23.3%) dominant life forms. Therophytes dominancy revealed that the area is under biotic and abiotic activities (Qureshi, 2008 and 2009). The leaf size spectrum was dominated by microphylls with 89 species (37.39%) followed by mesophylls with 75 species (31.51%), nanophylls with 43 species (18.06%), leptophylls with 24 species (10.08%), megaphylls with 4 species (1.68%) and aphyllous with 3 species (1.26%) as shown in figure 4. Similar leaf size classes were reported by Malik *et al.* (2007) from Ganga Chotti and Bedori hills Kashmir. The leaf type was dominated by simple leaves (156 species) followed by compound leaves (45 species) dissected leaves (25 species), needle leaves (9 species) and aphyllous (3 species) as shown in figure 5. Similar leaf types were recorded by Badshah *et al*. (2013) from district Tank, Ali *et al.* (2016) from Chail valley Swat and Ihsan *et al*. (2016) from district Bannu which are in line with the present study.

The phenological study revealed that the highest number of flower blooms in spring (93 species, 38.9%), followed by season (71 species, 29.8%), autumn (41 species, 17.3%) and winter (32 species, 13.5%) as shown in table 1. Most of the herbaceous and shrubby species bloom in April-May, with peak blooming in May-June (Amjad *et al*., 2013). Similarly, Malik *et al*. (2007) reported July and August as the maximum flowering months for angiosperm species.

Table 1. Floristic composition and ecological characteristics of Tehsil Utmankhel

S#	Division/Family/Species	Invasive/ Native	Status	Habit	Life Form	Leaf Size	Leaf Type	Phenology
	1. Acanthaceae							
1	*Barleria cristata* L.	Na	W	Hb	Th	Mic	Smp	Feb-Mar
2	*Dicliptera bupleuroides* Nees	Na	C	Hb	Hem	Mes	Smp	Apr-Jun
	2. Anacardaceae							
3	*Pistacia chinesis* Bunge	In	W	Tr	Th	Mic	Cmp	Apr-May
	3. Araliaceae							
4	*Hedera nepalensis* K.Koch.	Na	W	Sb	Np	Mes	Smp	Jul-Aug
	4. Arecaceae							
5	*Arisaema flavum* (Forssk.) Shott	Na	W	Sb	Geo	Mes	Cmp	Oct-Nov
6	*Nannorrhops ritchiana* (Griff.) Aitch.	Na	W	Sb	Np	Meg	Cmp	Sep-Oct
	5. Asteraceae							
7	*Achillea millofelium* L.	In	W	Hb	Hem	Lep	Cmp	Apr-May
8	*Artemisia vulgare* L.	Na	W	Hb	Ch	Nan	Dis	Feb-Mar
9	*Calendula arvensis* L.	Na	W	Hb	Th	Mic	Smp	Mar-Apr
10	*Carthamus lanatus* L.	In	W	Sb	Th	Mic	Smp	Jun-Aug
11	*Cichorium intybus* L.	Na	W	Hb	Th	Nan	Smp	Jul-Aug
12	*Cirsium arvense* (L.) Scop.	Na	W	Sb	Ch	Mic	Smp	Apr-May
13	*Helianthus annuus* L.	Na	C	Hb	Th	Mic	Smp	Jul-Oct
14	*Filago hurdwarica (*Wall ex DC) W agenitz.	Na	W	Hb	Th	Lep	Smp	Apr-May

15	*Lactuca dissecta* D.Don	Na	W	Hb	Th	Mic	Smp	Jan-Aug
16	*Parthenium hysterophorus* L.	In	W	Hb	Hem	Mes	Smp	Apr-Jul
17	*Sonchus asper* (L.) Hill.	Na	W	Hb	Th	Mic	Dis	Mar-May
18	*Sonchus oleraceus* L.	Na	W	Hb	Th	Nan	Dis	May-Oct
19	*Silybum marianum* (L.) Gaerth.	In	W	Hb	Ch	Mes	Dis	Apr-May
20	*Tagetes erecta* L.	Na	C	Hb	Th	Mic	Cmp	Jan-Aug
21	*Xanthium strumarium* L.	In	W	Sb	Ch	Mes	Smp	Mar-May
	6. Asclepiadaceae							
22	*Calotropis procera* (Wild.) R.Br.	Na	W	Hb	Ch	Mes	Smp	W. year
23	*Caralluma tuberculata* N.E Br.	Na	W	Hb	Th	Nan	Smp	Mar-Apr
24	*Periploca aphylla* Decne.	Na	W	Hb	Np	Ap	Abs	Mar-May
25	*Vincetoxicum arnottianum* Wight	Na	C	Hb	Ch	Mic	Smp	Apr-May
	7. Asparagaceae							
26	*Asparagus officinalis* Wall.	Na	W	Hb	Ch	Lep	Ned	Apr-May
27	*Asparagus gracilis* Royle ex Baker	Na	W	Hb	Th	Mic	Smp	Mar-Apr
	8. Amaranthaceae							
28	*Achyranthes aspera* L.	In	W	Hb	Th	Mes	Smp	Apr-May
29	*Alternanthera pungens* Kunth.	Na	W	Hb	Th	Mic	Smp	Jun-Sep
30	*Amaranthus viridis* L.	In	W	Hb	Hem	Mic		May-Jun
31	*Digera muricata* (L.) Mart.	Na	W	Hb	Hem	Mic	Smp	Jun-Sep
32	*Spinacia oleracea* (L.) Hill.	Na	C	Hb	Hem	Mes	Smp	Apr-May
33	*Trianthema portulacastrum* L.	Na	W	Hb	Np	Mic	Smp	Jun-Sep
	9. Apiaceae							
34	*Ammi visnaga* L.	Na	C	Hb	Hem	Mic	Dis	Jun-Oct
35	*Coriandrum sativum* L.	Na	C	Hb	Th	Lep	Dis	Mar-Nov
36	*Cuminum cyminum* L.	Na	C	Hb	Ch	Lep	Smp	Apr-May
37	*Ferula jaeschkeana* Vatk	Na	W	Hb	Geo	Mes	Cmp	Mar-May
38	*Foeniculum vulgare* Mill.	Na	C	Hb	Th	Nan	Dis	Mar-Apr
	10. Amaryllidaceae							
39	*Allium carolinianum* DC.	Na	C	Hb	Geo	Mic	Smp	Feb-Mar
40	*Ixiolirion tataricum* (Pall.) Herb.	Na	W	Hb	Geo	Mic	Smp	Mar-Apr
41	*Narcissus poeticus* L.	Na	W	Hb	Geo	Mic	Smp	Mar-Apr
	11. Berberidaceae							
42	*Berberis jaessckeana* Schneid.	Na	W	Sb	Np	Nan	Smp	Mar-Jun
43	*Berberis lycium* Royl.	Na	W	Sb	Np	Nan	Smp	Mar-Jun
	12. Brassicaceae							
44	*Brassica campestris* L.	Na	C	Hb	Th	Mes	Dis	Mar-Apr
45	*Brassica juncea* (L.) Smith.	Na	C	Sb	Th	Mes	Smp	Mar-Apr

46	*Brassica naphus* L.	Na	C	Hb	Th	Mes	Dis	Mar-Apr
47	*Brassica tournefortii* L.	Na	W	Hb	Th	Mes	Dis	Mar-Apr
48	*Capsella bursa-pastoris* (L.) Medk.Medk.	In	W	Hb	Th	Mic	Dis	Mar-Apr
49	*Descurainia sophia* (L.) Webb ex Prantl.	Na	W	Hb	Th	Mic	Cmp	Mar-jun
50	*Eruca sativa* Mill.	Na	W	Hb	Ch	Mes	Dis	Apr-May
51	*Lepidium sativum* L.	Na	W	Hb	Th	Mic	Dis	Apr-May
	13. Boraginaceae							
52	*Heliotropium strigosum* Willd.	Na	W	Hb	Th	Mic	Smp	Mar-Dec
53	*Trichodesma indicum* (L.) R.Br.	Na	W	Hb	Th	Mic	Smp	Mar-Aug
	14. Buddlejaceae							
54	*Buddleja crispa* Benth.	In	W	Sb	Np	Mic	Smp	Mar-May
	15. Cannabaceae							
55	*Cannabis sativa* L.	In	W	Hb	Th	Mes	Smp	Apr-Aug
	16. Cannaceae							
56	*Canna indica* L.	In	W	Sb	Ch	Meg	Smp	Mar-Sep
	17. Capparidaceae							
57	*Cleome viscosa* L.	Na	W	Hb	Th	Mic	Dis	Mar-Apr
	18. Caprifoliaceae							
58	*Viburnum cotinifolium* D.Don	Na	W	Sb	Np	Mic	Smp	Apr-May
	19. Caryophyllaceae							
59	*Silene conoidea* L.	Na	W	Hb	Th	Nan	Smp	Mar-May
60	*Stellaria media* (L.) Vill.	In	W	Hb	Np	Nan	Smp	Feb-Mar
61	*Spergula arvensis* L.	Na	W	Hb	Th	Mic	Cmp	Mar-Apr
	20. Caesalpinaceae							
62	*Bauhinia variegata* Roxb.	Na	W	Hb	Micp	Mes	Smp	Sep-Oct
63	*Cassia fistula* L.	In	W	Hb	Micp	Mes	Cmp	Mar-May
	21. Chenopodiaceae							
64	*Chenopodium album* L.	In	W	Hb	Th	Mes	Cmp	May-Aug
65	*Chenopodium botrys* L.	In	W	Hb	Th	Mic	Dis	Jun-Jul
	22. Combretaceae							
66	*Conocarpus erectus* L.	Na	W	Sb	Th	Mic	Dis	Sep-Oct
	23. Convolvulaceae							
67	*Convolvulus arvensis* L.	Na	W	Hb	Hem	Mic	Smp	Mar-Jul
	24. Cholchicaeae							
68	*Cholchicum luteum* Baker	Na	W	Hb	Geo	Nan	Smp	Feb-Mar
	25. Crassulaceae							
69	*Rosularia adenotricha* (Wall.Ex Edge.) C.	Na	W	Hb	Th	Nan	Cmp	Mar-Jul
	26. Cucurbitaceae							
70	*Citrullus colocynthis* (L.) Schrad	In	W	Hb	Th	Mes	Dis	Mar-Apr

71	*Cucurbita pepo* L.	Na	C	Hb	Th	Meg	Smp	Sep-Oct
72	*Cucumis sativus* L.	Na	C	Hb	Th	Mes	Smp	Jul-Aug
73	*Luffa cylindrica* L.	Na	C	Hb	Th	Nan	Smp	Mar-Jul
	27. Cupressaceae							
74	*Chamaecyparis obtusa* (Siebold & Zucc.) Endl.	Na	W	Tr	Np	Lep	Ned	Feb-Mar
75	*Thuja occidentalis* L.	In	C	Tr	Np	Lep	Ned	Feb-Mar
76	*Thuja orientalis* (L.) Franco.	In	C	Tr	Np	Lep	Ned	Feb-Mar
	28. Cuscutaceae							
77	*Cuscuta reflexa* Roxb.	Na	W	Hb	P	Ap	Abs	Apr-Sep
	29. Cyperaceae							
78	*Cyperus compressus* Lindl.	Na	W	Hb	Np	Nan	Smp	Apr-Oct
79	*Cyperus rotundus* L.	Na	W	Hb	Hem	Lep	Smp	May-Apr
80	*Erioscripus comosus* (Wall.) Palla	Na	W	Hb	Hem	Lep	Ned	Mar-Apr
	30. Ebenaceae							
81	*Diospyros lotus* L.	Na	C	Tr	Megp	Mic	Smp	Sep-Oct
	31. Euphorbiaceae							
82	*Euphorbia helioscopia* L.	In	W	Hb	Th	Lep	Smp	Nov-Dec
83	*Euphorbia hirta* L.	In	W	Hb	Th	Mic	Smp	Mar-Apr
84	*Ricinus communis* L.	In	W	Sb	Ch	Mes	Dis	Mar-May
85	*Mallotus philippensis* Lam.	Na	W	Sb	Micp	Mes	Smp	Mar-May
	32. Equisetaceae							
86	*Equisetun arvensis* L.	Na	W	Hb	Geo	Ap	Abs	May-Jun
	33. Fagaceae							
87	*Quercus incana* Roxb.Hort.Beng.	In	W	Tr	Micp	Mic	Smp	May-Aug
88	*Quercus dilalata* A. Kern.	In	W	Tr	Np	Mes	Smp	May-Aug
	34. Fumariaceae							
89	*Fumaria indica* (Hausskn.) Pugsley.	Na	W	Hb	Th	Nan	Dis	Feb-Mar
90	*Fumaria parviflora* L.	Na	W	Hb	Th	Nan	Cmp	Feb-Mar
	35. Hypericaceae							
91	*Hypericum perforatum* L.	Na	C	Hb	Th	Nan	Smp	May-Jun
	36. Iridaceae							
92	*Iris germanica* Foster.	Na	W	Hb	Geo	Mes	Smp	Apr-May
93	*Moraea sisyrinchium* (L.) Ker.Gawl.	Na	W	Hb	Th	Lep	Smp	Apr-May
	37. Juglandaceae							
94	*Juglans regia* L.	Na	C	Tr	Micp	Mic	Cmp	Mar-Apr
	38. Lamiaceae							
95	*Ajuga bracteosa* Wall. exBenth.	Na	W	Hb	Th	Mic	Smp	Mar-Apr
96	*Isodon rugosus* Wall. ex Benth.	Na	W	Sb	Np	Mes	Smp	May-Sep

97	*Mentha longifolia* (Benth.) Boiss.	Na	W	Hb	Geo	Mic	Smp	Mar-Apr
98	*Mentha piperita* L.	Na	C	Hb	Geo	Mic	Smp	Mar-Apr
99	*Ocimum basilicum* L.	Na	C	Hb	Th	Mic	Smp	Jun-Oct
100	*Origanum vulgare* L.	Na	W	Hb	Ch	Mic	Smp	Mar-Apr
101	*Otostegia limbata* (Benth.) Boiss.	Na	W	Sb	Ch	Mic	Smp	May-Jun
102	*Stachys parviflora* Benth.	Na	W	Hb	Hem	Mes	Smp	May-Jun
103	*Thymus linearis* Benth.	Na	W	Hb	Hem	Lep	Smp	May-Jul
	39. Liliaceae							
104	*Allium cepa* L.	Na	C	Hb	Geo	Mic	Smp	Jun-Aug
105	*Allium sativum* L.	Na	C	Hb	Geo	Mic	Smp	Mar-May
106	*Tulipa alba* L.	Na	W	Hb	Geo	Mic	Smp	Mar-May
	40. Linaceae							
107	*Linum corymbosum* Rchb.	Na	C	Hb	Th	Lep	Smp	Mar-Jun
	41. Lythraceae							
108	*Punica granatum* L.	Na	C	Sb	Ch	Mic	Smp	Mar-May
	42. Malvaceae							
109	*Abelmoschus esculentus* (L.) Moench	Na	C	Hb	Np	Mic	Smp	Mar-Jul
110	*Althea rosea* D.Don.	Na	W	Hb	Th	Mes	Smp	Mar-May
111	*Gossypium indium* Lam.	Na	C	Sb	Hem	Mes	Cmp	Mar-May
112	*Malva neglecta* Wall.	In	C	Hb	Th	Mic	Dis	Mar-Jul
	43. Marsileaceae							
113	*Marsilea quadrifolia* L.	Na	W	Hb	Ch	Lep	Cmp	May-Jul
	44. Meliaceae							
114	*Azadirachta indica* A. Juss.	Na	W	Tr	Micp	Mes	Cmp	Mar-Jul
115	*Melia azedarach* L.	In	W	Tr	Micp	Mic	Cmp	Mar-Jul
	45. Mimosaceae							
116	*Acacia arabica* var. *nilotica* (L.) Benth.	Na	W	Tr	Micp	Lep	Cmp	Mar-May
117	*Acacia modesta* Wall.	In	W	Tr	Micp	Lep	Cmp	Mar-Apr
	46. Moraceae							
118	*Broussonetia papyrifera* (L.) L'Hér. ex Vent.	In	W	Tr	Mesp	Mes	Cmp	Mar-Apr
119	*Ficus carica* Forssk.	Na	W	Tr	Np	Mes	Smp	Apr-May
120	*Ficus palmata* Forssk.	Na	W	Tr	Np	Mic	Smp	Apr-May
121	*Morus alba* L.	In	W	Tr	Megp	Mes	Smp	Mar-Apr
122	*Morus nigra* L.	Na	W	Tr	Megp	Mes	Smp	Mar-Apr
	47. Musaceae							
123	*Musa paradisiaca* L.	Na	C	Hb	Hem	Meg	Smp	Aug-Sep
	48. Myrtaceae							
124	*Callistemon lanceolatus* DC.	Na	W	Sb	Np	Mic	Smp	Jun-Oct
125	*Eucalyptus camaldulensis* Dehnh.	Na	W	Tr	Ch	Mic	Smp	Aug-Sep

126	*Myrtus communis* L.	In	W	Sb	Np	Mes	Smp	Aug-Sep
	49. Nyctaginaceae							
127	*Boerhavia procumbens* Banks ex Roxb.	Na	W	Hb	Ch	Nan	Smp	Sep-Dec
128	*Mirabilis jalapa* L.	Na	W	Hb	Ch	Mes	Smp	Jul-Sep
129	*Nasturtium officinale* R.Br.	Na	W	Hb	Hem	Mic	Cmp	Mar-Apr
	50. Oleaceae							
130	*Jasminum humile* L.	Na	W	Sb	Np	Mic	Cmp	Apr-May
131	*Jasminium officinalis* L.	Na	W	Sb	Np	Mic	Cmp	May-Jun
132	*Olea ferruginea* Wall. ex Aitch.	In	W	Tr	Micp	Mic	Smp	Mar-Apr
	51. Onagraceae							
133	*Oenothera rosea* L.	Na	W	Hb	Hem	Mic	Smp	Mar-Apr
	52. Orobanchaceae							
134	*Orobanche crenata* Roxb.	In	W	Hb	P	Nan	Ned	Nov-Dec
	53. Orchidaceae							
135	*Cephalanthera longifolia* (L.) Fritsch.	Na	W	Hb	Th	Mes	Smp	May-Jul
136	*Epipactis veratrifolia* Boiss. & Hohen.	Na	W	Hb	Geo	Mic	Smp	Mar-Apr
	54. Oxiladaceae							
137	*Oxalis corniculata* L.	Na	W	Hb	Th	Nan	Cmp	W. year
	55. Paeoniaceae							
138	*Paeonia emodi* L.	Na	W	Tr	Ch	Mes	Dis	Mar-Apr
	56. Papilionaceae							
139	*Astragalus grahminus* Boiss.	Na	W	Hb	Th	Mic	Cmp	Mar-Apr
140	*Cajanus indicus* Lamk.	Na	C	Sb	Micp	Mic	Cmp	Oct-Nov
141	*Delbergia sissoo Roxb.*	In	W	Tr	Np	Mic	Cmp	Mar-May
142	*Indigofera heterantha* Wall. ex Benth.	In	W	Sb	Np	Lep	Smp	May-Jun
143	*Lathyrus aphaca* L.	Na	C	Hb	Th	Lep	Cmp	Apr-May
144	*Medicago minima* (L.) Bartal.	Na	W	Hb	Th	Nan	Cmp	Apr-Jul
145	*Medicago sativa* L.	Na	W	Hb	Th	Nan	Cmp	Mar-Apr
146	*Pisum sativum* L.	Na	C	Hb	Ch	Mes	Cmp	Nov-Dec
147	*Prosopis juliflora* (Sw.) DC.	In	W	Tr	Np	Lep	Cmp	Apr-May
148	*Trifolium repens* L.	In	C	Hb	Geo	Nan	Cmp	Nov-Dec
149	*Vigna aconitifolia* (Jacq.) Marechal.	Na	C	Hb	Th	Nan	Smp	Sep-Oct
150	*Vigna radiata* (L.) R.Wilczek.	Na	C	Hb	Th	Mes	Smp	Sep-Oct
151	*Vicia sativa* L.	Na	W	Hb	Th	Mic	Cmp	Apr-Jul
	57. Papaveraceae							
152	*Papaver rhoeas* L.	In	W	Hb	Th	Mic	Cmp	Apr-Jul
	58. Pedaliaceae							
153	*Sesamum indicum* L.	Na	C	Hb	Geo	Mes	Smp	Mar-Jun
	59. Pinaceae							

154	*Pinus roxburghii* Sargent.	In	W	Tr	Micp	Nan	Ned	May-Feb
155	*Pinus wallichiana* A.B Jacjson.	Na	W	Tr	Megp	Lep	Ned	Apr-May
	60. Piperaceae							
156	*Piper nigrum* L.	Na	C	Tr	Th	Mes	Smp	Nov-Dec
	61. Plantaginaceae							
157	*Plantago lanceolata* Forssk.	In	W	Hb	Np	Mes	Smp	Aug-Sep
	62. Platanaceae							
158	*Platanus orientalis* L.	Na	W	Tr	Micp	Mes	Dis	Apr-May
	63. **Plumbaginaceae**							
159	*Limonium cabulicum* (Boiss.) O. Kuntza.	Na	W	Hb	Np	Mes	Smp	Jan-Aug
	64. Pteridaceae							
160	*Adiantum capillus* L.	Na	W	Hb	Geo	Nan	Cmp	Jun-Jul
161	*Adiantum caudatum* (L.) Mant.	Na	W	Hb	Geo	Nan	Cmp	Jun-Jul
162	*Pteris cretica* L.	Na	W	Hb	Geo	Mic	Dis	Jul-Aug
	65. Primulaceae							
163	*Anagalis arvensis-veneris* L.	Na	W	Hb	Np	Nan	Smp	Mar-May
164	*Androsace rotundifolia* Hardw.	Na	W	Hb	Th	Mic	Smp	Mar-May
	66. Poaceae							
165	*Agrostis viridis* Gouan, Hort.	Na	W	Hb	Hem	Nan	Smp	Apr-May
166	*Aristida cyanantha* Nees ex Steud.	Na	W	Hb	Th	Lep	Smp	May-Sep
167	*Arundo donax* Wall.	In	W	Hb	Ch	Mic	Smp	May-Sep
168	*Avena sativa* L.	In	W	Hb	Th	Mic	Smp	May-Aug
169	*Bromus japonicus* (L.) Stapf.	Na	W	Hb	Th	Mic	Smp	Apr-May
170	*Cynodon dactylon* (L.) Pers.	In	W	Hb	Hem	Lep	Smp	May-Sep
171	*Desmostachya bipinnata* L.	Na	W	Hb	Th	Nan	Smp	Jul-Oct
172	*Dichanthium annulatum* (Forssk.) Stapf.	Na	W	Hb	Th	Mic	Smp	Mar-Nov
173	*Hordeum vulgare* L.	Na	C	Hb	Th	Mic	Smp	Apr-May
174	*Oryza sativa* L.	Na	C	Hb	Th	Mic	Smp	Oct-Nov
175	*Phalaris paradoxa* L.	Na	W	Hb	Th	Nan	Smp	Jun-Jul
176	*Saccharum begalense* Retz.	Na	W	Hb	Hem	Mic	Smp	Feb-Mar
177	*Saccharum officinarum* Host.	Na	C	Hb	Geo	Nan	Smp	Aug-Sep
178	*Saccharum spontaneum* L.	Na	W	Hb	Hem	Nan	Smp	Jul-Sep
179	*Sorghum halepense* L.	In	W	Hb	Hem	Nan	Smp	Feb-Mar
180	*Triticum aestivum* L.	Na	C	Hb	Th	Mic	Smp	Jun-Jul
181	*Zea mays* L.	Na	C	Hb	Th	Mes	Smp	Aug-Sep
	67. Polygonaceae							
182	*Polygonatum berbatum* R.Br.	Na	W	Hb	Th	Mic	Smp	Apr-May
183	*Rumex dentatus* D. Don	Na	W	Hb	Th	Mes	Smp	Apr-Jul
185	*Rumex hastatus* L.	Na	W	Hb	Th	Nan	Smp	Apr-May

186	*Rheum emodi* L.	Na	W	Hb	Geo	Mes	Smp	Jun-Sep
	68. Portulaceae							
187	*Portulaca oleracea* L.	Na	W	Hb	Micp	Nan	Smp	May-Jun
	69. Ranunculaceae							
188	*Ranunculus muricatus* L.	Na	W	Hb	Geo	Nan	Dis	Mar-Apr
	70. Rhamnaceae							
189	*Ziziphus nummularia* (Burm.f.) Wigt & Am.	Na	W	Tr	Np	Mic	Smp	Oct-Nov
190	*Ziziphus jujuba* Mill.	In	C	Sb	Np	Mic	Smp	Jun-Jul
	71. Rosaceae							
191	*Cotoneaster nummularia* Fisch.	In	W	Sb	Micp	Lep	Smp	Apr-Jun
192	*Eriobotrya japonica* Lindl.	Na	C	Tr	Geo	Mes	Smp	Jun-Jul
193	*Fragaria nubicola* Lindl. ex Lacaita.	Na	W	Hb	Th	Mes	Smp	Mar-May
194	*Malus pumila* L.	Na	W	Tr	Np	Mes	Smp	Dec-Jan
195	*Rosa indica* Lindl.	Na	C	Sb	Np	Nan	Cmp	Mar-Apr
196	*Rosa brunonii* Lindl.	Na	W	Sb	Np	Nan	Cmp	Apr-Jun
197	*Rosa webbiana* Wall ex Royle.	In	W	Sb	Np	Nan	Cmp	Mar-Apr
198	*Rubus ulmifolius* Schott.	Na	W	Sb	Np	Mes	Cmp	Jul-Sep
199	*Rubus fruticosus* L.	Na	W	Sb	Np	Nan	Cmp	Mar-Apr
200	*Prunus armeniaca* L.	Na	C	Tr	Micp	Mes	Smp	Mar-Apr
201	*Prunus domestica* L.	Na	C	Tr	Micp	Mes	Smp	Mar-Apr
202	*Pyrus communis* L	Na	C	Tr	Mesp	Mes	Smp	Nov-Oct
203	*Pyrus pashia* D. Don.	Na	C	Tr	Megp	Mes	Smp	Mar-Apr
	72. **Rubiaceae**							
204	*Rubia cordifolia* L.	Na	W	Hb	Hem	Mic	Smp	Jun-Nov
	73. Rutaceae							
205	*Citrus aurantium* L.	Na	C	Tr	Np	Mes	Smp	Jun-Jul
206	*Citrus medica* L.	Na	C	Tr	Np	Mes	Smp	Jun-Jul
207	*Zanthoxylum armatum* DC.	Na	W	Sb	Np	Mes	Smp	Mar-Apr
	74. Salicaceae							
208	*Populus nigra* L.	In	W	Tr	Micp	Mes	Smp	Apr-May
209	*Salix babylonica* Boiss.	Na	W	Tr	Mesp	Mes	Smp	Jul-Sep
	75. Sapindaceae							
210	*Dodonaea viscosa* (L.) Jacq.	In	W	Sb	Np	Mic	Smp	May-Aug
	76. Sapotaceae							
211	*Monotheca buxifolia* (Haw.) Stemb.	Na	W	Tr	Ch	Mic	Smp	Mar-Apr
	77. Saxiferagaceae							
212	*Bergenia ciliata* (Haw.) Sternb.	Na	W	Hb	Geo	Mes	Smp	Mar-May
	78. Scrophulariaceae							
213	*Veronica biloba* L.	Na	W	Hb	Th	Nan	Smp	Apr-Aug

214	*Verbascum thapsus* L.	In	W	Hb	Th	Mes	Smp	May-Aug
	79. Solanaceae							
215	*Datura alba* L.	In	W	Hb	Ch	Mes	Smp	Apr-May
216	*Capsicum annuum* L.	Na	C	Hb	Ch	Mic	Smp	Mar-Apr
217	*Capsicum frutescens* L.	Na	C	Hb	Th	Mes	Smp	Mar-Apr
218	*Nicotiana tobacum* Roxb.	Na	C	Hb	Ch	Mes	Smp	May-Jun
219	*Solanum lycopersicum* L.	Na	C	Hb	Th	Mic	Cmp	May-Aug
220	*Solanum melongena* D. Don.	Na	C	Hb	Np	Mes	Smp	Mar-Apr
221	*Solanum nigrum* L.	Na	C	Hb	Th	Mic	Smp	May-Jun
222	*Solanum surattense* Burm.f.	Na	C	Hb	Hem	Mic	Dis	May-Jun
223	*Petunia alba (*A.) Wild.	Na	W	Hb	Ch	Mes	Smp	Mar-Apr
224	*Withania somnifera* (L.) Dunal.	Na	W	Hb	Ch	Mes	Smp	Mar-Apr
	80. Smilacaceae							
225	*Smilax glaucophylla* Klotzsch.	Na	W	Hb	Micp	Mes	Smp	Apr-May
	81. Simaroubaceae							
226	*Ailanthus altissima* (Mill.) Swingle.	In	W	Tr	Megp	Mic	Smp	Mar-Apr
	82. Tiliaceae							
227	*Grewia optiva* Drum Ex Buret.	Na	W	Hb	Megp	Mes	Smp	Apr-May
	83. Thymelaeaceae							
228	*Daphne mucronata* Royle.	Na	W	Sb	Np	Nan	Smp	Apr-May
	84. Urticaceae							
229	*Debregeasia salicifolia* (D. Don) Rendle	Na	W	Sb	Np	Mes	Smp	Mar-Apr
230	*Urtica dioica* L.	Na	W	Hb	Np	Mic	Smp	Mar-Jun
	85. Ulmaceae							
231	*Celtis eriocarpa* Decne.	Na	W	Tr	Micp	Mic	Cmp	Mar-Jun
	86. Verbenaceae							
232	*Lantana camara* L.	In	W	Sb	Np	Mic	Smp	Sep-Oct
233	*Verbena officinalis* L.	Na	W	Hb	Th	Nan	Smp	Nov-Dec
234	*Vitex negundo* L.	In	W	Tr	Np	Mes	Smp	Aug-Sep
	87. Vitaceae							
235	*Vitis jacquemontii* Parker.	Na	W	Hb	Np	Mes	Smp	Aug-Sep
236	*Vitis vinifera* L.	Na	C	Hb	Np	Mes	Smp	Aug-Sep
	88. Violaceae							
237	*Viola pilosa* Blume.	Na	W	Hb	Th	Mic	Smp	Feb-Mar
	89. Zygophyllaceae							
238	*Tribulus terrestris* L.	In	W	Hb	Hem	Nan	Cmp	Jul-Sep

Keys: W- Wild, C- Cultivated, Hb- Herb, Sb- Shrub, Tr- Tree, Th- Therophyte, Hem- Hemicryptophyte, Ch- Chamaephyte, Geo- Geophyte, Np- Nanophanerophyte, Micp- Microphanerophyte, Megp- Megaphanerophyte, Mesp-Mesophenorophyte, P-Parasite,

Mic- Microphyll, Mes- Mesophyll, Nan- Nanophyll, Lep- Leptophyll, Ap- Aphyllus Smp- Simple leaf, Cmp- Compound leaf, Dis- Dissected leaf, In- Invasive, Na- Native, W. year- Whole Year.

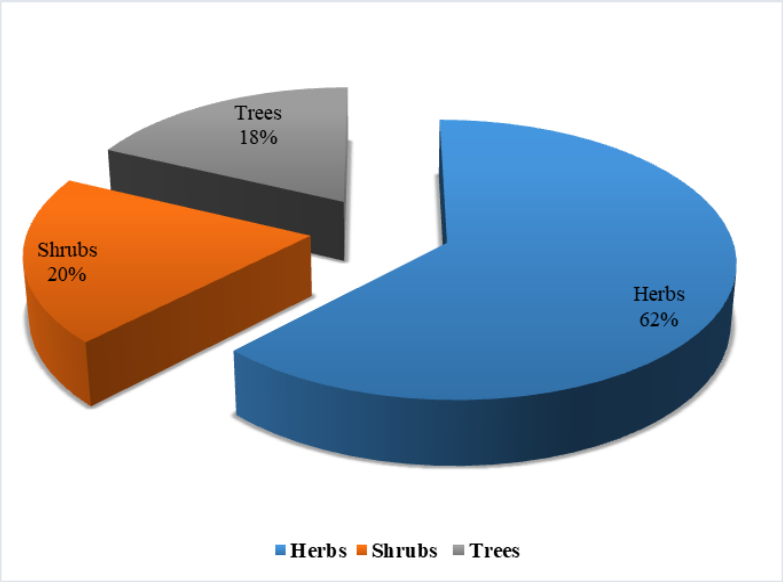

Figure 2. Habit of the flora

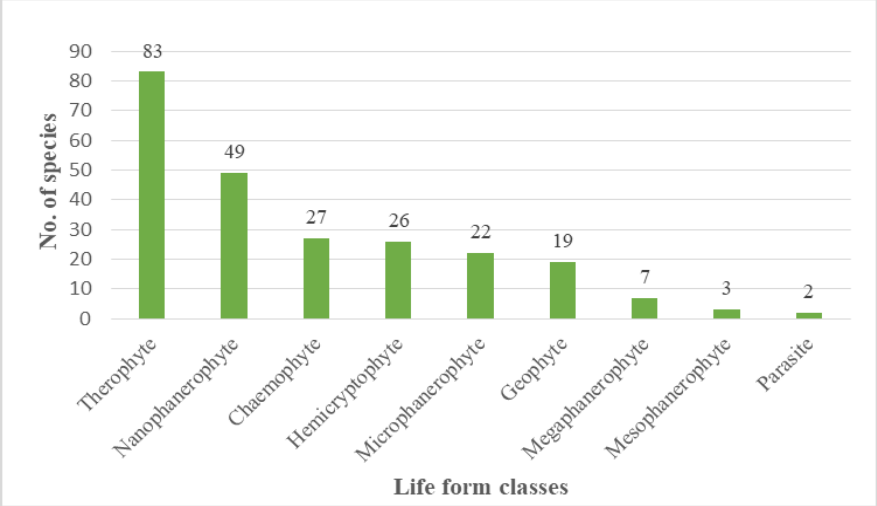

Figure 3. Life form of the flora

Figure 4. Leaf size spectra of the flora

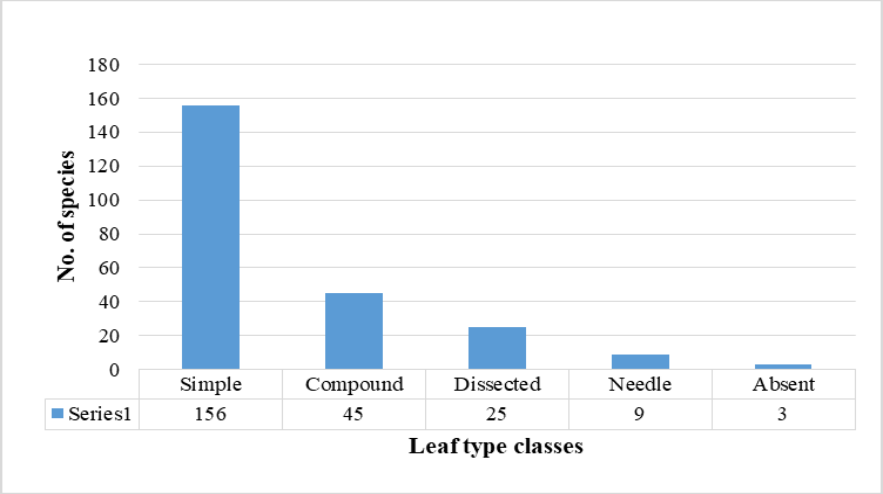

Figure 5. Leaf types of the flora

Table 2. Worst invasive species

Name	Native to	Purpose of introduction	Ecological effects
Parthenium hysterophorus	America	It is thought to have arrived in Pakistan in the 1980s by weed seeds contaminated livestock, food, or vehicle transport (Vehra and Khan, 2011; Khan *et al*., 2012).	Human and cattle health is at risk, as are crop losses and natural biodiversity. The IUCN lists it as one of the top 100 invasive species on the planet.
Eucalyptus camaldulensis	Australia	Eucalyptus was imported to Pakistan from Australia in large numbers to address the issue of water logging in the province of Sindh, around 1980.	Compete with native species, consume more water(disturb water table), facing with serious water shortage, spread up to 100 meters, etc.
Broussonetia	China and	Around 1960, the goal was to	Competitor to

papyrifera	Japan	turn the capital area (Islamabad) green in a short period of time. Its seeds were spread over Islamabad from a helicopter (Malik and Hussain, 2007).	natural Biodiversity, serious human and cattle allergens.
Lantana camara	America and Mexico.	It is imported for use as a decorative plant.	Changes in vegetation in specific places repel associated wildlife due to their pungent odor, resulting in cow poisoning.

The present study recorded 59 species that are non-native, belonged to 38 families. Asteraceae, Poaceae and Papilionaceae were the major contributor families of the invasive species (Table 1). The investigated area had the worst type of invasive species such as *Eucalyptus cammaldulenesis, Parthenium hysterophorus, Broussonetia papyrifera, Lantana camara* and *Prosopis juliflora* (Table 2). The majority of foreign invasive species in Pakistan were intentionally introduced with the goal of filling the gap between the demand and availability of lumber, fuel wood and feed (Hussain and Zarif, 2003). These species were introduced to Pakistan from different regions of the world such as *Broussonetia papyrifera* from China and Japan, in 1960, *Parthenium hysterophorus* from America, in 1980, *Eucalyptus camaldulenesis* from Australia in 1980. *Prosopis juliflora* from North and South America, in 1878, *Ailanthus altissima* from China and Europe, in 1784, *Lantana camara* from America and Mexico, and *Orobanche crenata* from the Mediterranean basin in Europe and North Africa. Close to current findings, Hussain and Zarif (2003) documented the invasive tree species in Pakistan such as *Broussonetia papyrifera, Prosopis juliflora, Eucalptus camaldulanses, Robinia pseudoaccacia, Alianthus altissima and Leucaena lecucephala* which were introduced for commercial forestry, agroforestry, soil erosion control and landscaping. Some of these species out-compete for the important local species. these invasive species not only compete with the local flora but also causes pollen allergy that irritates the eyes and inflammation of the skin.

CONCLUSION

The flora of the research area has a rich biodiversity due to moderate climatic conditions, edaphology and topography. The flora is comprised of 238 plant species belonging to 89 families. Family Poaceae, Asteraceae and Papilionaceae dominated the flora. Therophytes and nanophanero-phytes were the most common life forms, while microphylls and mesophylls were the most typical leaf sizes. The spring season had the most plant glooms, according to phenological behavior. Invasive species have had a negative impact on native plant growth as well as human health. Some species' communities have been shown to be disrupted as a result of overexploitation for local use and as a source of fuel. Future research will require the conservation of plants for long-term use.

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CONFLICT OF INTEREST

The authors declare that they have no competing interests.

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