



RESEARCH PAPER

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An updated plant inventory and biological spectrum of Tracheophytes flora of upper Tanawal area on western borders of Lesser Himalaya

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Key words: Life form, Leaf spectrum, Tracheophytes, Plant inventory.

<http://dx.doi.org/10.12692/ijb/12.3.201-212>

Article published on March 30, 2018

Abstract

The current work was executed in Upper Tanawal which is situated in the mid of Western fragment of lesser Himalaya. The study area is situated between 34°34.40' N to 34°48.88' N latitude and 72°84.27' E to 73°10.50' E longitude. Upper Tanawal is rich in biodiversity. Preliminary plant inventory was the first of any kind of plant related research activity in the history of this area, but a lot of work was and still to be done for the completion of plant resource data. Current study is an attempt in this connection toward the compilation as well as completion of list of plant taxa inhabiting this hub of biodiversity. This area has housed noteworthy and impenetrable forest strands renowned for their habitat exceptionality to wharf number of pheasants and other biota. Due to security reasons and inferior situation of law and order compromising government writ the area remained scientifically as well departmentally unkempt consequential rapid and vigorous brutal deforestation. During this study the area was extensively visited and appraised. Plants were collected, preserved, identified and Submitted with herbarium Hazara University Mansehra. Results reflect that Upper Tanawal hosts 308 plant species of tracheophytes belonging to 243 genera placed in 92 tree families. Sixty-two (62) species are first record from the area.

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Introduction

Biological diversity refers to the variability amongst living creature of all types including terrestrial, marine and aquatic life forms and biological complexes; this embrace multiplicity within species amongst species and ecosystem. It is the term assumed to the variability of life on the earth, it is the variety within and between all species of plant, animal and microorganism and the ecosystem within which the live and interact. Biodiversity comprises all the millions of different species that live on our planet (Qadir, 2015). Pakistan is skeptical in floral diversity because of its diverse climate (Muhammad *et al.*, 2016). About, 6000 Angiosperm species have been described from Pakistan so far (Rahman *et al.*, 2016). Floristic exploration of any part of the world serves to appraise the plant capital and its latent values (Shaheen *et al.*, 2106).

Tanawal is a once princely state of British period including far-flung and mountainous areas of today's four districts i.e. Mansehra, Abbottabad, Haripur and Tor Ghar. The study area is a portion of western borders of lesser Himalaya (Takhtajan, 1988). The Himalaya is the chief mountain range where supreme natural forest resources of Pakistan are found (Mehmood *et al.*, 2015). The area is located between 34°.34.40' N to 34°.48.88' N latitude and 72°.84.27' E to 73°.10.50' E longitude. (Farooq, *et al.*, 2017a). Study area can be divided in to four chief ecological zones viz., subtropical low altitude (450-1000m) mid altitude (above 1,050-1,450m); transitional zone (from 1,500-1,800m); and mountain high altitude (above 1,800m). (Abbas Hussain Shah *et al.*, 2015)

Plant checklist of any given area is a precondition of any floristic evaluation. Numerous taxonomic exploratory studies have been steered across Pakistan which only contributed to local floras but also to the flora of Pakistan, for example Parker (1956), Stewart (1972), Shah and Khan (2006), Qureshi (2008), Zaheer and Sardar, (2008), Haq *et al.*, (2010), Fazal *et al.*, (2010), Qureshi and Bhatti, (2010), Saeed *et al.*, (2012), Waris *et al.*, (2013), Khan *et al.*, (2013), Ilyas *et al.*, (2013), Shaheen *et al.*, (2011), Tanvir *et al.*, (2014), Zulfiqar *et al.*, (2015) and Farooq *et al.*, (2017).

This study was designed to explore the plant resources their phenology and seasonality and biological spectra. Plant preliminary check list is a basic document which reflects the vegetation composition of a given area and be used as a tool for further scientific exploration of the area. This plant inventory is the very basic requirement to initiate and execute any sort of plant related research in the area. Moreover, plant inventory contributes to the formulation of flora of an area e.g. in this case our findings will be helpful toward the completion of in progress Flora of Pakistan. Biological spectrum has two measures i.e. Life form and leaf size spectra. Biological spectrum of the vegetation of Upper Tanawal was investigated with the aim of categorizing plant species upon these two measures. These are indirect measures of friendly and unfavorable conditions of an area i.e. life form reflects the unfavorable season of an area while leaf spectrum shows the prevailing environmental conditions.

So, this study was designed with the following objectives:

- To explore the plant biodiversity of the study area
- To predict and estimate prevailing and unfavorable conditions of study area through biological spectrum.
- To document and conserve the plant resources of the for further studies.

Materials and methods

The whole study area was extensively visited over and over during 2014-2016 in different seasons of the year. Plants were collected, identified poisoned and pasted on herbarium sheets. Properly labeled herbarium sheets were deposited with herbarium Hazara university, Mansehra. Kahn *et al.*, (2015) and Farooq *et al.*, 2017.

Collection

Plant specimen were collected at reproductive stages and the temporal data were recorded for further analysis.

Pressing and Dehydration

The collected plant specimens were pressed in plant pressers between blotting papers and dehydrate by repeated replacement of blotting papers after every three days.

Identification

Plant specimens were identified by using “Tropicose Flora of Pakistan” and “The plant List”.

Poisoning and preservation

Plant specimens were poisons by using Mercuric Chloride Solution. Poisoned and preserved specimens were mounted on herbarium sheets, labeled and deposited with herbarium Hazara University Mansehra.

Results

Biodiversity

Floristically 308 species belonging to 243 genera representing 92 plant families were recorded. Table 1

shows the complete list of plant species recorded from the study area along with their habit, biological spectrum and phenology.

It's a large species number keeping in view that the recent study was not intended to towards complete taxonomic exploration, which reflects that the area is a potential biodiversity hotspot and need further extensive taxonomic exploration.

Asteraceae and Leguminosae were found to be the dominant families with 26 species each. Rosaceae was represented by 21 species, Poaceae 19, Lamiaceae 15, Brassicaceae 8, Euphorbiaceae, Pteridaceae, and Moraceae with seven species each.

Moreover Polygonaceae, Amaranthaceae, Apiaceae, Malvaceae, Pinaceae, Ranunculaceae, Salicaceae and Solanaceae contributed with five (5) species each (Fig. 1).

Table 1. List of Species and their biological spectra and phenology.

Sl. No.	Species	Family	Repot status	Habit	Biological Spectrum	
					Life Form	Leaf spectrum
1	<i>Abies pindrow</i> (Royle ex D. Don) Royle	Pinaceae	First reported from area	T	MP	Na
2	<i>Acacia modesta</i> Wall.	Leguminosae	First reported from area	T	MP	Na
3	<i>Acacia nilotica</i> (L.) Delile	Leguminosae	First reported from area	T	MP	Na
4	<i>Achillea millefolium</i> L.	Asteraceae	First reported from area	H	H	Mi
5	<i>Achyranthes aspera</i> L.	Amaranthaceae	First reported from area	H	TH	Na
6	<i>Acorus calamus</i> L.	Acoraceae	First reported from area	H	GE	Mi
7	<i>Adiantum capillus-veneris</i> L.	Pteridaceae	First reported from area	H	GE	Mi
8	<i>Adiantum caudatum</i> L.	Pteridaceae	First reported from area	H	GE	Ma
9	<i>Adiantum raddianum</i> C. Presl	Pteridaceae	First reported from area	H	GE	Ma
10	<i>Adonis aestivalis</i> L.	Ranunculaceae	First reported from area	H	TH	Ma
11	<i>Aesculus indica</i> (Wall. ex Cambess.) Hook.	Sapindaceae	First reported from area	T	MP	Ma
12	<i>Agave americana</i> L.	Asparagaceae	First reported from area	H	TH	Ma
13	<i>Agrimonia procera</i> Wallr.	Rosaceae	First reported from area	H	TH	Me
14	<i>Ailanthus altissima</i> (Mill) Swingle	Simaroubaceae	First reported from area	T	MP	Me
15	<i>Ajuga integrifolia</i> Buch.-Ham.	Lamiaceae	First reported from area	H	TH	Me
16	<i>Alnus nitida</i> (Spach) Endl	Betulaceae	First reported from area	T	MP	Me
17	<i>Alternanthera pungens</i> Kunth	Amaranthaceae	First reported from area	H	TH	Me
18	<i>Amaranthus viridis</i> L.	Amaranthaceae	First reported from area	H	TH	Me
19	<i>Anagallis arvensis</i> L.	Primulaceae	First reported from area	H	TH	Mi
20	<i>Androsace rotundifolia</i> Hardw.	Primulaceae	First reported from area	H	TH	Mi
21	<i>Argyrolobium roseum</i> (Cambess) Jaub. & Spach	Leguminosae	First reported from area	H	TH	Mi
22	<i>Arisaema flavum</i> (Forssk.) Schott	Araceae	First reported from area	H	TH	Mi
23	<i>Aristida purpurea</i> Nutt.	Poaceae	First reported from area	H	H	Mi
24	<i>Artemisia abrotanum</i> L.	Asteraceae	First reported from area	H	H	Mi
25	<i>Artemisia absinthium</i> L.	Asteraceae	First reported from area	H	H	Me
26	<i>Arundo donax</i> L.	Poaceae	First reported from area	H	GE	Me
27	<i>Asparagus racemosus</i> Willd.	Asparagaceae	First reported from area	S	GE	Mi
28	<i>Asparagus spin ii</i>	Asparagaceae	First reported from area	S	GE	Mi
29	<i>Asphodelus tenuifolius</i> Cav.	Xanthorrhoeaceae	First reported from area	H	GE	Mi
30	<i>Asplenium viride</i> Huds.	Aspleniaceae	First reported from area	H	GE	Mi
31	<i>Astragalus caprinus</i> L.	Leguminosae	First reported from area	H	H	Mi
32	<i>Astragalus propinquus</i> Schischkin	Leguminosae	First reported from area	H	H	Mi
33	<i>Avena barbata</i> Pott ex Link	Poaceae	First reported from area	H	H	Me

Sl. No.	Species	Family	Repot status	Habit	Biological Spectrum	
					Life Form	Leaf spectrum
34	<i>Avena sativa</i> L.	Poaceae	First reported from area	H	H	Me
35	<i>Bauhinia variegata</i> L.	Leguminosae	First reported from area	T	MP	Me
36	<i>Berberis lycium</i> Royle	Berberidaceae	First reported from area	S	NP	Na
37	<i>Bergenia ciliata</i> (Haw.) Sternb.	Saxifragaceae	First reported from area	H	GE	Me
38	<i>Betula utilis</i> D.Don	Betulaceae	First reported from area	T	MP	Me
39	<i>Bidens pilosa</i> L.	Asteraceae	First reported from area	H	H	Me
40	<i>Boerhavia diffusa</i> L.	Nyctaginaceae	First reported from area	H	H	Me
41	<i>Boerhavia repens</i> L.	Nyctaginaceae	First reported from area	H	H	Me
42	<i>Bombax ceiba</i> L.	Malvaceae	First reported from area	T	MP	Me
43	<i>Broussonetia papyrifera</i> (L.) L'Hér. ex Vent.	Moraceae	First reported from area	T	MP	Me
44	<i>Buddleja asiatica</i> Lour.	Scrophulariaceae	First reported from area	S	NP	Mi
45	<i>Buglossoides arvensis</i> (L.) I.M.Johnst.	Boraginaceae	First reported from area	H	H	Mi
46	<i>Bupleurum falcatum</i> L.	Apiaceae	First reported from area	H	H	Mi
47	<i>Calendula arvensis</i> M.Bieb.	Asteraceae	First reported from area	H	H	Mi
48	<i>Calotropis procera</i> Forsk.	Asclepiadaceae	First reported from area	S	NP	Mi
49	<i>Cannabis sativa</i> L.	Cannabaceae	First reported from area	H	NP	Me
50	<i>Capsella bursa-pastoris</i> (L.) Medic.	Brassicaceae	First reported from area	H	H	Mi
51	<i>Cardiospermum grandiflorum</i> Sw.	Sapindaceae	First reported from area	H	H	Me
52	<i>Carex flava</i> L.	Cyperaceae	First reported from area	H	TH	Mi
53	<i>Carica papaya</i> L.	Caricaceae	First reported from area	T	MP	Me
54	<i>Carissa spinarum</i> L.	Apocynaceae	First reported from area	S	NP	Me
55	<i>Carthamus lanatus</i> L.	Asteraceae	First reported from area	H	H	Mi
56	<i>Carthamus oxyacanthus</i> M. Bieb	Asteraceae	First reported from area	H	H	Mi
57	<i>Carthamus tinctorius</i> L.	Asteraceae	First reported from area	H	H	Mi
58	<i>Cassia fistula</i> L.	Leguminosae	First reported from area	T	MP	Me
59	<i>Cedrus deodara</i> Roxb. ex Lamb.	Pinaceae	First reported from area	T	MP	Mi
60	<i>Celtis australis</i> L.	Cannabaceae	First reported from area	T	MP	Me
61	<i>Centaurea iberica</i> Trevir. ex Spreng.	Asteraceae	First reported from area	H	H	Me
62	<i>Chenopodium album</i> L.	Chenopodiaceae	First reported from area	H	H	Me
63	<i>Cichorium intybus</i> L.	Asteraceae	First reported from area	H	H	Me
64	<i>Cirsium arvense</i> (L.) Scop.	Asteraceae	First reported from area	H	H	Me
65	<i>Clematis grata</i> Wall.	Ranunculaceae	First reported from area	S	TH	Me
66	<i>Clinopodium vulgare</i> L.	Lamiaceae	First reported from area	H	H	Me
67	<i>Cocculus pendulus</i> (J.R.Forst. & G.Forst.) Diels	Menispermaceae	First reported from area	H	TH	Mi
68	<i>Colchicum autumnale</i> L.	Colchicaceae	First reported from area	H	GE	Mi
69	<i>Colchicum luteum</i> Baker	Colchicaceae	First reported from area	H	GE	Mi
70	<i>Colebrookea oppositifolia</i> Sm.	Lamiaceae	First reported from area	S	NP	Me
71	<i>Commelina benghalensis</i> L.	Commelinaceae	First reported from area	H	TH	Me
72	<i>Conium maculatum</i> L.	Apiaceae	First reported from area	H	TH	Me
73	<i>Convolvulus arvensis</i> L.	Convolvulaceae	First reported from area	H	TH	Me
162	<i>Cornus macrophylla</i> Wall.	Cornaceae	First reported from area	H	TH	Mi
74	<i>Corymbia citriodora</i> (Hook.) K.D.Hill & L.A.S.Johnson.	Myrtaceae	First reported from area	T	MP	Me
75	<i>Cotoneaster ellipticus</i> (Lindl.) Loudon.	Rosaceae	First reported from area	S	NP	Me
76	<i>Cotula aurea</i> L.	Asteraceae	First reported from area	H	TH	Mi
237	<i>Crataegus sp</i>	Rosaceae	First reported from area	T	MP	Me
77	<i>Crotalaria medicaginea</i> Lam.	Leguminosae	First reported from area	H	H	Mi
78	<i>Cucumis melo</i> L.	Cucurbitaceae	First reported from area	H	TH	Me
79	<i>Cuscuta reflexa</i> Roxb.	Cuscutaceae	First reported from area	H	TH	Mi
80	<i>Cynodon dactylon</i> (L.) Pers.	Poaceae	First reported from area	H	H	Na
81	<i>Cynoglossum wallichii</i> G.Don	Boraginaceae	First reported from area	H	TH	Mi
82	<i>Cyperus esculentus</i> L.	Cyperaceae	First reported from area	H	H	Na
83	<i>Cyperus iria</i> L.	Cyperaceae	First reported from area	H	H	Na
84	<i>Cyperus rotundus</i> L.	Cyperaceae	First reported from area	H	H	Na
85	<i>Cytisus scoparius</i> (L.) Link	Leguminosae	First reported from area	S	NP	Me
86	<i>Dactyloctenium aegyptium</i> (L.) Willd.	Poaceae	First reported from area	H	H	Na
87	<i>Dactylus spicatus</i> Burm.f.	Poaceae	First reported from area	H	H	Na
88	<i>Dalbergia sissoo</i> DC.	Leguminosae	First reported from area	T	MP	Me
89	<i>Daphne mucronata</i> Royle	Thymelaeaceae	First reported from area	S	NP	Mi
90	<i>Datura metel</i> L.	Solanaceae	First reported from area	H	TH	Me
91	<i>Debregeasia saeneb</i> (Forssk.) Hepper & J.R.I.Wood.	Urticaceae	First reported from area	S	NP	Me
92	<i>Delphinium ajacis</i> L.	Ranunculaceae	First reported from area	H	TH	Mi
93	<i>Desmodium concinnum</i> DC.	Leguminosae	First reported from area	S	NP	Me

Sl. No.	Species	Family	Repot status	Habit	Biological Spectrum	
					Life Form	Leaf spectrum
94	<i>Dianthus angulatus</i> Royle	Caryophyllaceae	First reported from area	H	TH	Mi
95	<i>Dicliptera chinensis</i> (L.) Juss.	Acanthaceae	First reported from area	H	TH	Mi
96	<i>Digera muricata</i> (L.) Mart.	Amaranthaceae	First reported from area	H	TH	Me
97	<i>Diospyros lotus</i> L.	Ebenaceae	First reported from area	T	MP	Me
98	<i>Dodonea viscosa</i> (L.) Jacq.	Sapindaceae	First reported from area	S	NP	Me
99	<i>Dryopteris dilatata</i> (Hoffm.) A. Gray	Dryopteridaceae	First reported from area	H	H	Me
100	<i>Dryopteris expansa</i> (C. Presl) Fraser-Jenk. & Jermy	Dryopteridaceae	First reported from area	H	H	Me
102	<i>Dryopteris stewartii</i> Fraser-Jenk.	Pteridaceae	First reported from area	H	GE	Me
101	<i>Duchesnea indica</i> (Jacks.) Focke	Rosaceae	First reported from area	H	H	Mi
103	<i>Dysphania ambrosioides</i> (L.) Mosyakin & Clemants	Amaranthaceae	First reported from area	H	H	Me
104	<i>Echinochloa colonna</i> (L.) Link	Poaceae	First reported from area	H	TH	Mi
105	<i>Eclipta prostrata</i> (L.)	Asteraceae	First reported from area	H	TH	Mi
106	<i>Elaeagnus latifolia</i> L.	Elaeagnaceae	First reported from area	S	NP	Me
107	<i>Emex australis</i> Steinh	Polygonaceae	First reported from area	H	TH	Me
108	<i>Equisetum arvense</i> L.	Equisetaceae	First reported from area	H	H	Mi
109	<i>Eranthemum pulchellum</i> Andrews	Acanthaceae	First reported from area	S	NP	Me
110	<i>Erigeron canadensis</i> L.	Asteraceae	First reported from area	H	TH	Mi
111	<i>Eriobotrya japonica</i> (Thunb.) Lindl.	Rosaceae	First reported from area	T	MP	Me
112	<i>Euphorbia helioscopia</i> L.	Euphorbiaceae	First reported from area	H	TH	Mi
113	<i>Euphorbia heterophylla</i> L.	Euphorbiaceae	First reported from area	H	TH	Mi
114	<i>Euphorbia hirta</i> L.	Euphorbiaceae	First reported from area	H	TH	Mi
115	<i>Euphorbia prostrata</i> Aiton	Euphorbiaceae	First reported from area	H	TH	Mi
116	<i>Euphorbia wallichii</i> Hook.f.	Euphorbiaceae	First reported from area	H	TH	Mi
117	<i>Ficus benghalensis</i> L.	Moraceae	First reported from area	T	MP	Ma
118	<i>Ficus carica</i> L.	Moraceae	First reported from area	T	MP	Ma
119	<i>Ficus palmata</i> Forssk.	Moraceae	First reported from area	T	MP	Ma
120	<i>Ficus racemosa</i> L.	Moraceae	First reported from area	T	MP	Ma
121	<i>Filago desertorum</i> Pomel	Asteraceae	First reported from area	H	TH	L
122	<i>Flacourtia indica</i> (Burn.f.) Merr.	Salicaceae	First reported from area	T	MP	Me
123	<i>Forsskaolea tenacissima</i> L.	Urticaceae	First reported from area	H	TH	Mi
124	<i>Fragaria nubicola</i> (Lindl. ex Hook.f.) Lacaita	Rosaceae	First reported from area	H	H	Mi
125	<i>Fumaria indica</i> (Hausskn.) Pugsley	Papaveraceae	First reported from area	H	TH	Mi
126	<i>Gagea lutea</i> (L.) Ker Gawl.	Liliaceae	First reported from area	H	GE	Na
127	<i>Galium aparine</i> L.	Rubiaceae	First reported from area	H	TH	Na
128	<i>Geranium rotundifolium</i> L.	Geraniaceae	First reported from area	H	TH	Na
129	<i>Geranium wallichianum</i> D.Don ex Sweet	Geraniaceae	First reported from area	H	TH	Na
130	<i>Girardinia diversifolia</i> (Link) Friis	Utricaceae	First reported from area	H	TH	Me
131	<i>Glandularia canadensis</i> (L.) Small.	Verbenaceae	First reported from area	H	TH	Mi
132	glue/kala ghaas	Poaceae	First reported from area	H	H	Me
134	<i>Grewia villosa</i> Willd.	Malvaceae	First reported from area	T	MP	Me
135	<i>Gymnosporia royleana</i> Wall. ex M.A.Lawson.	Celastraceae	First reported from area	S	NP	Mi
136	<i>Hemerocallis fulva</i> (L.)	Hemerocallidaceae	First reported from area	H	GE	Me
137	<i>Heteropogon contortus</i> (L.) P.Beauv. ex Roem. & Schult.	Poaceae	First reported from area	H	H	Na
138	<i>Himalaiella heteromalla</i> (D.Don) Raab-Straube.	Asteraceae	First reported from area	H	TH	Mi
139	<i>Hyacinthoides non-scripta</i> (L.) Chouard ex Rothm.	Asparagaceae	First reported from area	H	TH	Mi
140	<i>Hypericum perforatum</i> L.	Hypericaceae	First reported from area	H	TH	Mi
141	<i>Impatiens bicolor</i> Royle	Balsaminaceae	First reported from area	H	TH	Mi
142	<i>Indigofera heterantha</i> Brandis	Leguminosae	First reported from area	S	NP	Mi
143	<i>Inula cappa</i> (Buch.-Ham. ex D.Don) DC.	Asteraceae	First reported from area	H	TH	Mi
144	<i>Ipomoea carnea</i> Jacq.	Convolvulaceae	First reported from area	S	NP	Me
145	<i>Ipomoea purpurea</i> (L.) Roth	Convolvulaceae	First reported from area	H	TH	Me
146	<i>Iris aitchisonii</i> (Baker) Boiss.	Iridaceae	First reported from area	H	GE	Me
147	<i>Iris japonica</i> Thunb.	Iridaceae	First reported from area	H	GE	Me
148	<i>Isodon rugosus</i> (Wall. ex Benth.) Codd	Lamiaceae	First reported from area	S	NP	Mi
149	<i>Jasminum mesnyi</i> Hance	Oleaceae	First reported from area	S	NP	Mi
150	<i>Juglans regia</i> L.	Juglandaceae	First reported from area	T	MP	Me
151	<i>Justicia adhatoda</i> L.	Acanthaceae	First reported from area	S	NP	Me
152	<i>Lactuca dolichophylla</i> Kitam.	Asteraceae	First reported from area	H	TH	Mi

Sl. No.	Species	Family	Repot status	Habit	Biological Spectrum	
					Life Form	Leaf spectrum
153	<i>Lamium album</i> L.	Lamiaceae	First reported from area	H	TH	Mi
154	<i>Lansea coromandelica</i> (Houtt.) Merr.	Asteraceae	First reported from area	H	TH	Mi
309	<i>Lansea coromandelica</i> (Houtt.) Merr.	Anacardiaceae	First reported from area	T	MP	Me
155	<i>Lantana camara</i> L.	Verbenaceae	First reported from area	S	NP	Me
156	<i>Lathyrus aphaca</i> L.	Leguminosae	First reported from area	H	TH	Mi
157	<i>Lathyrus japonicus</i> Willd.	Leguminosae	First reported from area	H	TH	Mi
158	<i>Lathyrus odoratus</i> L.	Leguminosae	First reported from area	H	TH	Mi
159	<i>Lathyrus sativus</i> L.	Leguminosae	First reported from area	H	TH	Mi
160	<i>Lepidium campestre</i> (L.) R.Br.	Brassicaceae	First reported from area	H	TH	Mi
161	<i>Lepidium didymum</i> L.	Brassicaceae	First reported from area	H	TH	Mi
163	<i>Lepidium virginicum</i> L.	Brassicaceae	First reported from area	H	TH	Mi
164	<i>Leptopus cordifolius</i> Decne	Phyllanthaceae	First reported from area	S	NP	Mi
165	<i>Leucaena leucocephala</i> (Lam.) de Wit	Leguminosae	First reported from area	T	MP	Mi
166	<i>Mallotus philipensis</i> (Lam) Muell	Euphorbiaceae	First reported from area	T	NP	Me
167	<i>Malva neglecta</i> Wallr.	Malvaceae	First reported from area	H	TH	Me
168	<i>Malva parviflora</i> L.	Malvaceae	First reported from area	H	TH	Me
169	<i>Malvastrum coromandelianum</i> (L.) Garcke	Malvaceae	First reported from area	H	TH	Me
170	<i>Marrubium anisodon</i> K.Koch	Lamiaceae	First reported from area	H	TH	Mi
171	<i>Medicago polymorpha</i> L.	Leguminosae	First reported from area	H	TH	Na
172	<i>Medicago rigidula</i> (L.) All.	Leguminosae	First reported from area	H	TH	Na
173	<i>Melia azedarach</i> L.	Meliaceae	First reported from area	T	MP	Me
174	<i>Mentha arvensis</i> L.	Lamiaceae	First reported from area	H	TH	Mi
175	<i>Mentha longifolia</i> (L.) L.	Lamiaceae	First reported from area	H	TH	Mi
176	<i>Micromeria biflora</i> (Buch. - Ham. ex D.Don) Benth.	Lamiaceae	First reported from area	H	TH	Na
177	<i>Mimosa pudica</i> L.	Leguminosae	First reported from area	H	TH	Na
178	<i>Mirabilis jalapa</i> L.	Nyctaginaceae	First reported from area	S	NP	Me
179	<i>Momordica cochinchinensis</i> (Lour.) Spreng	Cucurbitaceae	First reported from area	H	TH	Mi
180	<i>Morus alba</i> L.	Moraceae	First reported from area	T	MP	Me
181	<i>Morus nigra</i> L.	Moraceae	First reported from area	T	MP	Me
182	<i>Musa paradisiaca</i> L.	Musaceae	First reported from area	T	MP	Ma
183	<i>Myrsine africana</i> L.	Primulaceae	First reported from area	S	NP	Mi
184	<i>Narcissus poeticus</i> L.	Amaryllidaceae	First reported from area	H	TH	Me
185	<i>Nasturtium officinale</i> R.Br.	Brassicaceae	First reported from area	H	TH	Mi
186	<i>Nepeta erecta</i> (Royle ex Benth.) Benth	Lamiaceae	First reported from area	H	TH	Mi
187	<i>Nerium oleander</i> L.	Apocynaceae	First reported from area	S	NP	Me
188	<i>Notholirion thomsonianum</i> (Royle) Stapf	Liliaceae	First reported from area	H	TH	Mi
189	<i>Oenothera affinis</i> Cambess.	Onagraceae	First reported from area	H	TH	Mi
190	<i>Oenothera rosea</i> L'Hér. ex Aiton	Onagraceae	First reported from area	H	TH	Mi
191	<i>Olea ferruginea</i> Royle	Oleaceae	First reported from area	T	MP	Mi
192	<i>Olea paniculata</i> R.Br.	Oleaceae	First reported from area	S	NP	Mi
193	<i>Onychium japonicum</i> (Thunb.) Kunze	Pteridaceae	First reported from area	H	GE	Na
194	<i>Opuntia humifusa</i> (Raf.) Raf.	Cactaceae	First reported from area	H	H	Mi
195	<i>Origanum vulgare</i> L.	Lamiaceae	First reported from area	H	TH	Mi
196	<i>Oxalis corniculata</i> L.	Oxalidaceae	First reported from area	H	TH	Mi
197	<i>Paeonia emodi</i> Royle	Paeoniaceae	First reported from area	H	TH	Me
198	<i>Papaver orientale</i> L.	Papaveraceae	First reported from area	H	TH	Mi
199	<i>Parthenium hysterophorus</i> L.	Asteraceae	First reported from area	H	TH	Me
200	<i>Periploca aphylla</i> Decne.	Apocynaceae	First reported from area	S	NP	L
201	<i>Persicaria amplexicaulis</i> (D.Don) Ronse Decr	Polygalaceae	First reported from area	H	TH	Mi
202	<i>Persicaria capitata</i> (Buch.-Ham. ex D.Don) H.Gross	Polygonaceae	First reported from area	H	TH	Mi
203	<i>Persicaria hydropiper</i> (L.) Delarbre	Polygonaceae	First reported from area	H	TH	Mi
204	<i>Phalaris Minor</i> Retz.	Poaceae	First reported from area	H	H	Mi
205	<i>Phleum pratense</i> L.	Poaceae	First reported from area	H	H	Mi
206	<i>Picea smithiana</i> (Wall.) Boiss.	Pinaceae	First reported from area	T	MP	Mi
207	<i>Pinus roxburghii</i> Sarg.	Pinaceae	First reported from area	T	MP	Mi
208	<i>Pinus wallichiana</i> A.B.Jacks.	Pinaceae	First reported from area	T	MP	Mi
209	<i>Pistacia chinensis</i> Bunge	Anacardiaceae	First reported from area	T	MP	Me
210	<i>Plantago lanceolata</i> L.	Plantaginaceae	First reported from area	H	TH	Mi

Sl. No.	Species	Family	Repot status	Habit	Biological Spectrum	
					Life Form	Leaf spectrum
211	<i>Plantago major</i> L.	Plantaginaceae	First reported from area	H	TH	Me
212	<i>Platanus orientalis</i> L.	Platanaceae	First reported from area	T	MP	Me
213	<i>Poa alpina</i> L.	Poaceae	First reported from area	H	H	Mi
214	<i>Poa annua</i> L.	Poaceae	First reported from area	H	H	Mi
215	<i>Polygala chinensis</i> L.	Polygalaceae	First reported from area	H	TH	Mi
216	<i>Polygonum aviculare</i> L.	Polygonaceae	First reported from area	H	TH	Mi
217	<i>Polystichum lonchitis</i> (L.) Roth	Dryopteridaceae	First reported from area	H	GE	Mi
218	<i>Populus alba</i> L.	Salicaceae	First reported from area	T	MP	Me
219	<i>Populus ciliata</i> Wall. ex Royle	Salicaceae	First reported from area	T	MP	Me
220	<i>Portulaca oleracea</i> L.	Portulacaceae	First reported from area	H	TH	Mi
221	<i>Potentilla canadensis</i> L.	Rosaceae	First reported from area	H	TH	Mi
222	<i>Potentilla nepalensis</i> Hook.	Rosaceae	First reported from area	H	TH	Mi
223	<i>Prunus armeniaca</i> L.	Rosaceae	First reported from area	T	MP	Me
224	<i>Prunus cornuta</i> (Wall. ex Royle) Steud	Rosaceae	First reported from area	T	MP	Me
225	<i>Prunus domestica</i> L.	Rosaceae	First reported from area	T	MP	Me
226	<i>Prunus dulcis</i> (Mill.) D.A. Webb	Rosaceae	First reported from area	T	MP	Me
227	<i>Prunus persica</i> (L.) Batsch	Rosaceae	First reported from area	T	MP	Me
266	<i>Pteridium aquilinum</i> (L.) Cohn	Pteridaceae	First reported from area	H	TH	Me
228	<i>Pteridium aquilinum</i> (L.) Kuhn	Dennstaedtiaceae	First reported from area	H	TH	Mi
229	<i>Pteris cretica</i> L.	Pteridaceae	First reported from area	H	TH	Mi
230	<i>Punica granatum</i> L.	Lythraceae	First reported from area	T	MP	Mi
231	<i>Pyrus bourgaeana</i> Decne..	Rosaceae	First reported from area	T	MP	Me
232	<i>Pyrus pashia</i> Buch. Ham. ex D. Don	Rosaceae	First reported from area	T	MP	Me
233	<i>Quercus incana</i> Bartram	Fagaceae	First reported from area	T	MP	Me
234	<i>Quercus robur</i> L.	Fagaceae	First reported from area	T	MP	Me
235	<i>Ranunculus arvensis</i> L.	Ranunculaceae	First reported from area	H	TH	Mi
236	<i>Ranunculus muricatus</i> L.	Ranunculaceae	First reported from area	H	TH	Mi
238	<i>Rhododendron arboreum</i> Sm.	Ericaceae	First reported from area	T	MP	Me
239	<i>Rhynchosia pseudo-cajan</i> Cambess.	Leguminosae	First reported from area	S	NP	Mi
240	<i>Ricinus communis</i> L.	Euphorbiaceae	First reported from area	S	NP	Me
241	<i>Robinia pseudoacacia</i> L.	Leguminosae	First reported from area	T	MP	Mi
242	<i>Rosa moschata</i> Herrm.	Rosaceae	First reported from area	S	NP	Me
243	<i>Rosa webbiana</i> Wall. ex. Royle	Rosaceae	First reported from area	S	NP	Me
244	<i>Rubia himalayensis</i> Klotzsch	Rubiaceae	First reported from area	H	TH	Na
245	<i>Rubus ellipticus</i> Sm.	Rosaceae	First reported from area	S	NP	Me
246	<i>Rubus fruticosus</i> Agg.	Rosaceae	First reported from area	S	NP	Me
247	<i>Rubus niveus</i> Thunb.	Rosaceae	First reported from area	S	NP	Me
248	<i>Rubus ulmifolius</i> Schott	Rosaceae	First reported from area	S	NP	Me
249	<i>Rumex dentatus</i> L.	Polygonaceae	First reported from area	H	TH	Me
250	<i>Rumex hastatus</i> D. Don	Polygonaceae	First reported from area	H	TH	Me
251	<i>Rydingia limbata</i> (Benth.) Scheen & V.A. Albert	Lamiaceae	First reported from area	S	NP	Mi
252	<i>Saccharum bengalense</i> Retz.	Poaceae	First reported from area	H	H	Me
253	<i>Saccharum spontaneum</i> L.	Poaceae	First reported from area	H	H	Me
254	<i>Sageretia thea</i> (Osbeck) M.C. Johnston.	Rhamnaceae	First reported from area	S	NP	Mi
255	<i>Salix babylonica</i> L.	Salicaceae	First reported from area	T	MP	Mi
256	<i>Salix tetrasperma</i> Roxb.	Salicaceae	First reported from area	T	MP	Mi
257	<i>Salvia moorcroftiana</i> Wall. ex. Benth.	Lamiaceae	First reported from area	H	TH	Mi
258	<i>Sapindus marginatus</i> Willd.	Sapindaceae	First reported from area	T	MP	Me
259	<i>Sarcococca pruniformis</i> Lindl.	Buxaceae	First reported from area	S	NP	Mi
260	<i>Sauromatum venosum</i> (Dryand. ex Aiton) Kunth	Araceae	First reported from area	H	TH	Mi
261	<i>Saxifraga oppositifolia</i> L.	Saxifragaceae	First reported from area	H	TH	Mi
262	<i>Scandix pecten-veneris</i> L.	Apiaceae	First reported from area	H	TH	Mi
263	<i>Scutellaria linearis</i> Benth	Lamiaceae	First reported from area	H	TH	Mi
264	<i>Senecio chrysanthemoides</i> DC.	Asteraceae	First reported from area	H	TH	Mi
265	<i>Seseli mucronatum</i> (Schrenk) Pimenov & SdobniNa	Apiaceae	First reported from area	H	TH	Mi
267	<i>Silene conoidea</i> L.	Caryophyllaceae	First reported from area	H	TH	Mi
268	<i>Silybum marianum</i> (L.) Gaertn.	Asteraceae	First reported from area	H	TH	Me
269	<i>Sisymbrium irio</i> L.	Brassicaceae	First reported from area	H	TH	Mi
270	<i>Sisymbrium officinale</i> (L.) Scop.	Brassicaceae	First reported from area	H	TH	Mi
271	<i>Solanum nigrum</i> L.	Solanaceae	First reported from area	H	TH	Mi
272	<i>Solanum pseudocapsicum</i> L.	Solanaceae	First reported from area	H	TH	Mi
273	<i>Solanum virginianum</i> L.	Solanaceae	First reported from area	H	TH	Mi
274	<i>Sonchus asper</i> (L.) Hill	Asteraceae	First reported from area	H	TH	Me

Sl. No.	Species	Family	Repot status	Habit	Biological Spectrum	
					Life Form	Leaf spectrum
275	<i>Sorghum halepense</i> (L.) Pers.	Poaceae	First reported from area	H	H	Me
276	<i>Stellaria media</i> (L.) Vill.	Caryophyllaceae	First reported from area	H	TH	Mi
277	<i>Strobilanthes urticifolia</i> Wall. ex Kuntze	Acanthaceae	First reported from area	H	TH	Mi
278	<i>Tagetes Minuta</i> L.	Asteraceae	First reported from area	H	TH	Mi
279	<i>Taraxacum campyloides</i> G.E.Haglund	Asteraceae	First reported from area	H	TH	Mi
280	<i>Taxus baccata</i> L.	Taxaceae	First reported from area	T	MP	Mi
281	<i>Tecomella undulata</i> (Sm.) Seem.	Bignoniaceae	First reported from area	T	MP	Mi
282	<i>Themeda anathera</i> (Nees ex Steud.) Hack.	Poaceae	First reported from area	H	H	Mi
283	<i>Tinospora sinensis</i> (Lour.) Merr.	Menispermaceae	First reported from area	H	TH	Mi
284	<i>Torilis nodosa</i> (L.) Gaertn.	Apiaceae	First reported from area	H	TH	Mi
285	<i>Tribulus terrestris</i> L.	Zygophyllaceae	First reported from area	H	TH	Mi
286	<i>Trichodesma indicum</i> (L.) Lehm	BorragiNaceae	First reported from area	H	TH	Mi
287	<i>Trifolium pratense</i> L.	Leguminosae	First reported from area	H	TH	Mi
288	<i>Trifolium repens</i> L.	Leguminosae	First reported from area	H	TH	Mi
289	<i>Tulipa clusiana</i> DC.	Liliaceae	First reported from area	H	GE	Mi
290	<i>Typha latifolia</i> L.	Typhaceae	First reported from area	H	GE	Me
291	<i>Ulmus villosa</i> Brandis ex Gamble	Ulmaceae	First reported from area	T	MP	Mi
292	<i>Urtica dioica</i> L.	Urticaceae	First reported from area	H	TH	Mi
293	<i>ValeriaNa jatamansi</i> Jones	Caprifoliaceae	First reported from area	H	TH	Me
294	<i>Verbascum thapsus</i> L.	Scrophulariaceae	First reported from area	H	TH	Me
295	<i>VerbeNa officinalis</i> L.	Verbenaceae	First reported from area	H	TH	Mi
296	<i>Veronica persica</i> Poir.	PlantagiNaceae	First reported from area	H	TH	Mi
297	<i>Viburnum gradiflorum</i> Wall. ex DC.	Adoxaceae	First reported from area	S	NP	Me
298	<i>Vicia hirsuta</i> (L.) Gray	Leguminosae	First reported from area	H	TH	Mi
299	<i>Vicia sativa</i> L.	Leguminosae	First reported from area	H	TH	Mi
300	<i>Viola odorata</i> L.	Violaceae	First reported from area	H	TH	Mi
301	<i>Vitex negundo</i> L.	Lamiaceae	First reported from area	S	NP	Mi
302	<i>Withania somnifera</i> (L.) DuNal	Solanaceae	First reported from area	S	TH	Me
303	<i>Woodfordia fruticosa</i> (L.) Kurz	Lythraceae	First reported from area	S	NP	Mi
304	<i>Xanthium strumarium</i> L.	Asteraceae	First reported from area	H	TH	Me
305	<i>Zanthoxylum arantum</i> DC.	Rutaceae	First reported from area	S	NP	Mi
306	<i>Ziziphus jujuba</i> Mill.	Rhamnaceae	First reported from area	T	MP	Mi
307	<i>Ziziphus nummularia</i> (Burm.f.) Wight & Arn	Rhamnaceae	First reported from area	S	NP	Mi
308	<i>Ziziphus oxyphylla</i> Edgew.	Rhamnaceae	First reported from area	S	NP	Mi

T=Tee, S=Shrub, H= Herb, NP= Nanophanerophytes=Megaphanerophytes, TH= therophytes, Ge= geophytes, H= hemicryptophytes, Mi =Microphylls, Me= Mesophylls, Na= Nanophylls, L= Lyptophylls.

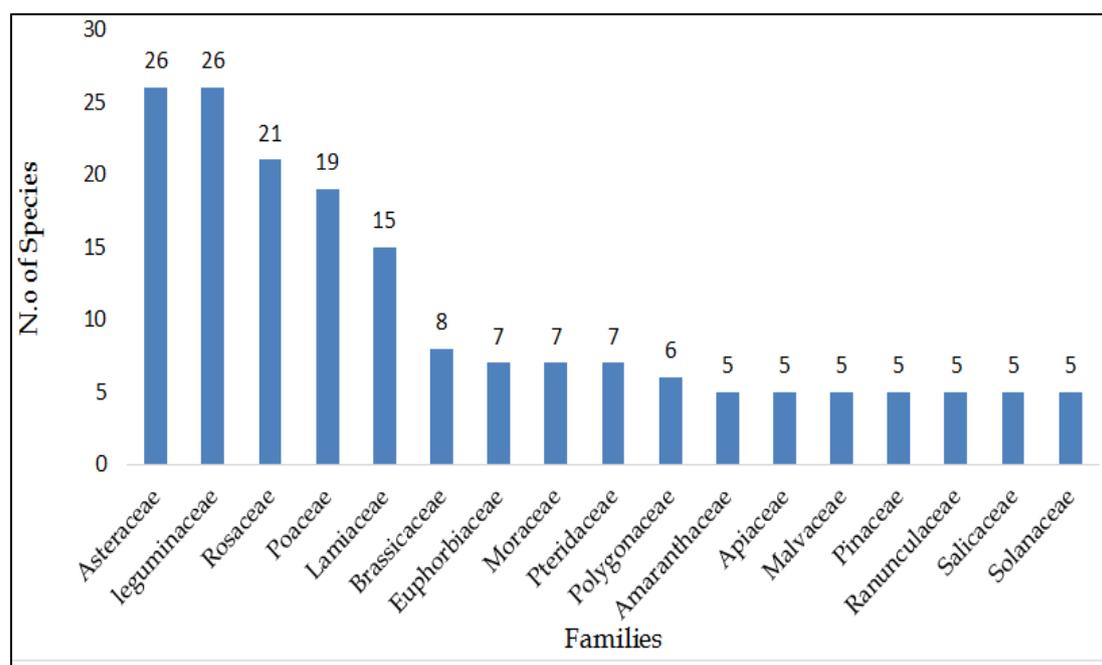


Fig. 1. Families with high specific diversity.

As far as generic diversity is concerned a total of 243 genera were recorded belonging to 92 tracheophyte families. Asteraceae was found to be the richest family represented by 22 genera followed by Leguminosae with 18, Poaceae with 17, and Lamiaceae and Rosaceae with 14 genera each. (Fig. 2)

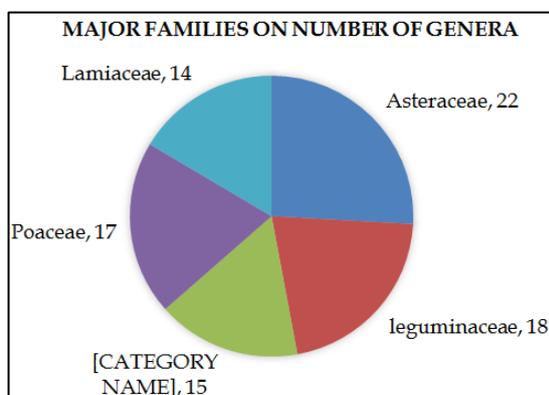


Fig. 2. Families with high generic diversity.

On the bases of habit plants of the study area were divided into three classes i.e. Herbs, shrubs and trees. Fig. 3 Shows habit statistics of plants of study area. The vegetation was dominated by herbs as 202(66%) species showed herbaceous habit. Trees habit was shown by 59(19 %) species.as far as shrubs are concerned 47(15%) species were shrubby. High percentage of herbs shows extreme environments of summer and winter which force the plants to shorten their life cycle. High tree diversity is an indicator of middle altitude ecosystem of Western Himalaya.

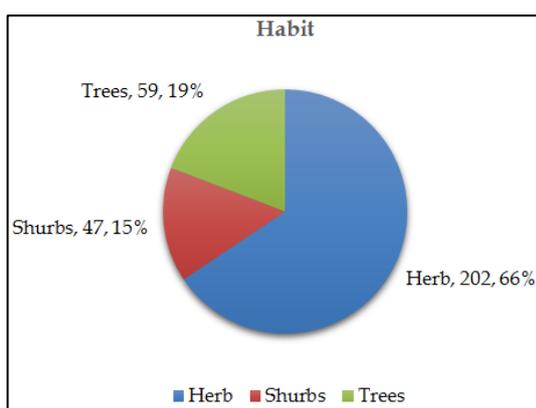


Fig. 3. Habit wise share of vegetation.

Life form

life form classification of tracheophytes of the area on reflects that therophyte was dominant life form class represented by 135(44 %) species.

The high number of therophytes in the area shows that most part of the study area reside subtropical dry habitat. Megaphanerophytes were represented by 58 species (18 %). Hemicryptophytes were represented by 49 species, which makes 16 percent of the total plant species. Nanophanerophytes contributed by 45(14%) while geophytes by 21(7%) species. (Fig. 4).

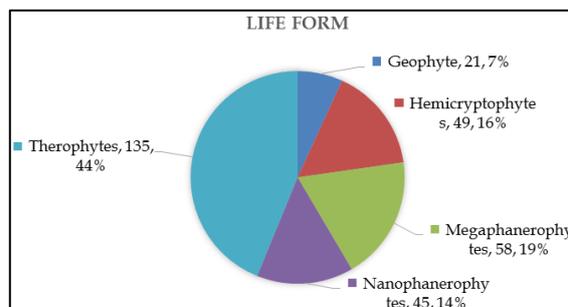


Fig. 4. Life form classification.

Leaf spectrum

As far as leaf size spectrum is concerned the study area was dominated by Microphylls represented by 158species, followed by mesophylls represented by 116 plant species. These numbers show that the study area has moderate but uneven distribution of annual rain fall and severe summers. Nanophylls, megaphylls and Leptophylls were represented by 22, 10 and 16 species respectively.

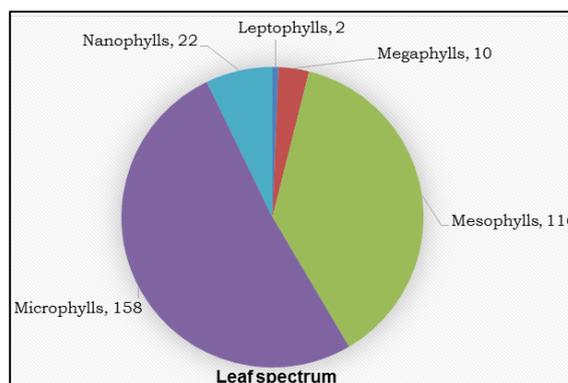


Fig. 5. Leaf size spectra.

Discussion

During the decades long, tiresome and tedious job of compiling flora of Pakistan the pioneer exploratory work was contributed in terms of “flora of British India” Hooker *et al.*, 1872-1997. That document served as the baseline for scaffolding the flora of Pakistan.

Other notable and mention worthy mass contribution was added by Stewart, 1972 who collected more than 6000 plant species for the compilation of "catalogue to the flora of west Pakistan". A number of plant scientists across Pakistan contributed towards the exploration of plant resources of Pakistan. Shah & Khan (2006) documented 80 Species of embryophytes related to 49 families from Siran Valley area Mansehra with their ethnomedicinal uses.

Fazal *et al.*, (2010) recognized 211 species of 170 genera and 66 families from Haripur area of Mansehra. Haq *et al.*, (2010) recognized 402 plants species from 110 families of vascular plants from Nandiar Valley of Battagram, Pakistan. Khan *et al.*, (2013) revealed 101 plant species belonging to 52 families. Haq *et al.*, (2015) described 157 species of plants from Nandiar Khuwar catchment area of Himalaya and documented that Nanophyte was leading life form followed by Therophyte.

Urooj *et al.*, (2015) documented herbaceous vegetation about the area of Mangla dam. They recognized 37 species related to 17 families of plants. Mehmood *et al.*, 2015 recorded 331 species of vascular plants belonging to 246 genera and 101 families. Farooq *et al.*, 2017a recorded 246 plant species from this study area but the list was not complete, and the recent work will be a useful addendum to the floristic check list of the area.

It is expected that current work about check list of vascular plant of Upper Tanawal District Mansehra will offer a comprehensive information of the floristic diversity of the area and could be used as baseline for supplementary scientific study. Such agendas for unexplored areas have also been published earlier by numerous researchers and could be perceived in the literature. Such checklists include Zaheer & Sardar, (2008), Fazal *et al.*, (2010), Ilyas *et al.*, (2013 and Waris *et al.*, (2013), Khan *et al.*, 2015, Khan *et al.*, 2016 and Mehmood *et al.*, 2015.

Badshah *et al.*, (2013) described that Poaceae, Papilionaceae and Asteraceae are the dominant

families in the district Tank, Pakistan. Comparable outcomes were attained by many other botanists like Marwat & Qureshi (2000) and Durrani *et al.*, (2005) in their corresponding study area. Many Other researches have specified the domination of Asteraceae and Poaceae e.g. Fazal *et al.*, (2010), Saima *et al.*, (2010), Khan *et al.*, (2014) and Khan *et al.*, (2015). Our findings also promote that Asteraceae, Leguminosae and Poaceae are larger families in the study area. Future studies will be helpful to discover the potential of these plant species for different uses.

Conclusion

The is rich in biodiversity with large number of species and genera. Moreover, 53 tree species with thick canopy reflects that still the area has rich forests and can be conserved and used for ecological services as well as ecotourism and forest regeneration site.

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