



Research Article

Floristic Diversity and Life Form Spectrum of Vegetation in Swabi District, Khyber Pakhtunkhwa, Pakistan

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Abstract | The current study was conducted to investigate floral structure, life form and leaf size spectrum and habitat status of plants of Swabi District, Pakistan. Regular visits were organized between the years of 2022 to 2023 to collect plant samples of the region and prepare a flora inventory. The life form of the plant and the size of its leaves were determined. Plant species were also classified according to their habitats. In the current study, we collected and identified about 140 species belonging to 102 genera and 53 families. The largest family was Poaceae (15 spp.), followed by Rosaceae (11 spp.) and Solanaceae (7 spp.). Herbaceous vegetation predominates, followed by trees, shrubs and climbing plants. In this study the area was found to be dominated by therophytes with (48 spp., 34%), followed by phanerophytes (39 spp., 28%) and Hemicryptophytes (33 spp., 24%). Examination of leaf shape spectra revealed that Microphyll (43 spp., 31%), followed by Nanophyll (38 spp., 27%), and Mesophyll (34., 24%). In the current study we also classified plants species based on their habitat. The results showed that the largest number of species were found in dry places (31 spp., 22%), followed by moist places (29 spp., 21%), cultivated areas (26 spp., 18%), wasteland areas (23 spp., 16%). This study provides basic information on the flora of Swabi, because the flora of the study area is very diverse therefore further studies will be required to assess the conservation status of the wild flora and obtain quantitative information on the vegetation.

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Keywords | Ethnobotany, Floristic diversity, Habitat, Life form, Leaf form, Swabi



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Introduction

Vegetation refers to a comprehensive list of plant species found in a given geographic area (Amjad *et al.*, 2017). Understanding vegetation structure

provides insight into biodiversity and helps assess current climate conditions (Thakur *et al.*, 2012). It provides an important resource for systematic research on plant life (Khan *et al.*, 2017). Floristic inventory provides a taxonomic perspective on flora,

further classifying and analyzing plant species in a given region (Panda *et al.*, 2014). Floristic diversity encompasses both morphological characteristics and ecological interactions across various environments (Catarino *et al.*, 2002). The life form of a plant refers to the shape of its vegetative body which is affected by climate, while the biological spectrum represents the distribution of different classes of life forms (Sharma *et al.*, 2018). Such traits reflect adaptive strategies of plant species to prevailing ecological conditions (Khalid *et al.*, 2017). Life forms and leaf size spectra are important indicators of micro and macro-climatic conditions and of anthropogenic effects in a region (Cain *et al.*, 1959). These studies help to understand local vegetation cover and major climate changes (Oosting, 1948), and provide information about plant physiology and interactions (Rashid *et al.*, 2011). Plant physiognomy traits, such as life form and leaf size spectrum, are often used in vegetation studies (Khalid, 2017), which indicate climate and adaptability to existing climatic conditions. However, biotic factors such as overgrazing and deforestation can alter the distribution of life forms. Although research has been done on the floral spectrum and biology in several regions, these are lacking in the District Swabi, Khyber Pakhtunkhwa, Pakistan. This study aims to address the gap by examining the

region's biological features and flora inventory, as well as by offering the fundamental information required for studies in forestry, taxonomy, ecology, ethnobotany, and conservation.

Materials and Methods

Study area

Swabi District, Khyber, Pakhtunkhwa, Pakistan is located between the Indus and Kabul rivers (Maqsood *et al.*, 2015). It is the fourth largest populated district. Swabi is located between 34.70 °N and 72.280 °E, with a total area of 1,543 km². Approximately 78% of the district is mountainous, while the remaining 22% comprise flat, and terrain. The district is mainly mountainous (78.0%), while the remaining part (21.0%) is flat, dry land. May and June show significant temperature increases, while July, August and September show almost constant temperatures. June was the month with the highest recorded temperature of 41.5°C. January had the lowest temperature ever recorded, namely 2°C. The woody vegetation includes *Quercus* sp. *Acacia nilotica*, *Pinus roxburgii*, *Tamarix aphylla* and *Acacia modesta*. Dominant shrubs include *Dodonaea viscosa*, *Justicia adhatoda*. While *Saccharum spontaneum*, etc. are common (Figure 1).

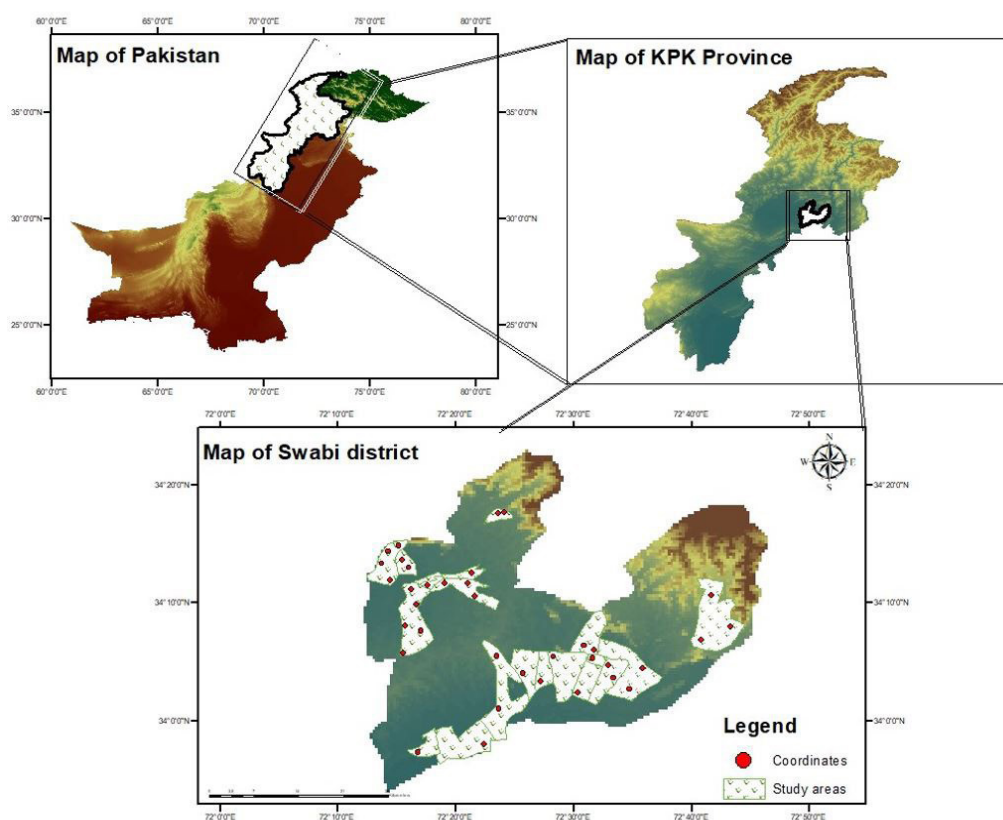


Figure 1: Map showing the geographical location of the study area District Swabi Khyber Pukhtunkhwa, Pakistan.

Materials and Methods

Field visit and data collection

Regular visits were conducted from 2022-2024 to collect and identify the plant specimens and other ecological field data.

Specimen preservation

Collected plants were dried, preserved, and placed on herbarium sheets.

Plant identification

Plant identification was done using the Flora of Pakistan by (Ali et al., 1989-1993).

Floral inventory

A comprehensive floral inventory, alphabetized by plant families, has been compiled.

Classification by leaf size and habitat type

Plant species were classified according to leaf size and habitat type following (Hussain, 1989).

Biological spectrum analysis

Biological spectrum was analyzed using the methodology used by (Raunkiaer, 1934).

Results

Floristic diversity

Floral diversity refers to all plants, both wild and cultivated, present in any geographic area. The floristic composition of each region is influenced by several factors such as prevailing climatic conditions, soil properties, anthropogenic pressures and natural stresses. The total number of plant species present in a given geographical area is called its floral composition. The flora of the Swabi region includes 53 families, 102 genera and 140 species. The largest families were Poaceae (15 spp.), Rosaceae (11 spp.), Dryopteridaceae and Solanaceae (7 spp.), each Polygonaceae (6 spp.), Pteridaceae, Fabaceae, Moraceae and Cucurbitaceae (5 spp.), Euphorbiaceae, Chenopodiaceae, Aspleniaceae, Brassicaceae. and Salicaceae (4 spp.), Fagaceae, Lamiaceae, Cupressaceae and Adiantaceae (3 spp.), Simaroubaceae, Equisetaceae, Amaranthaceae, Urticaceae, Geraniaceae, Verbenaceae and Betulaceae (2 spp.). The remaining families had only one species (Figure 2; Table 1).

Legends: Key to abbreviations: Tables 1 and 2

Habit: T-Tree; S-Shrub; H-Herb; C-Climber.

Life form: G-Geophytes; Th-Therophytes; H-Hemicrptophytes; Ch-Chamaephytes; P-phanerophytes; Mic-Microphanerophytes; Mesp-Mesophanerophytes; Megp-Megaphanerophytes. Leaf form: Ap- Aphyllous; L-Leptophyll; N-Nanophyll; Mic-Microphyll; Mes-Mesophyll; Meg-Megaphyll, Mac-Macrophyll. Habitat: A-agricultural fields; D-dry slopes; W-moist places; CU-cultivated; GY-Graveyards; F-forest; M-moist; S-shady places; R-rock crevices; Wp-waste places. Specimen (Herbarium) voucher number: HG-Huma Gul; ISL-Abbreviation of Herbarium of Quaid-i-Azam University Islamabad, Pakistan; QAU-Quaid-i-Azam University, Islamabad, Pakistan.

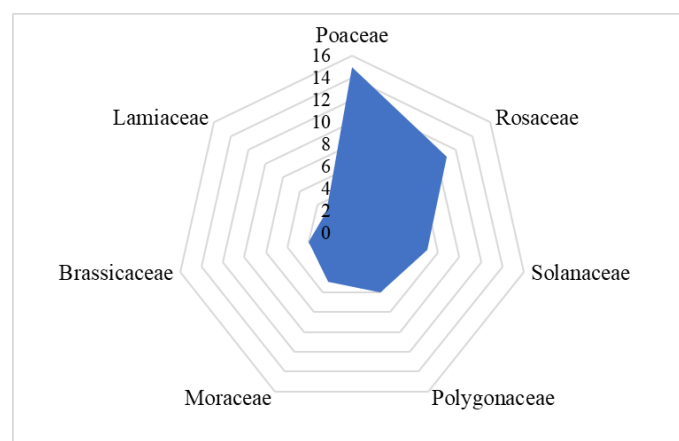


Figure 2: Top seven plant families and their contribution to species in the study areas.

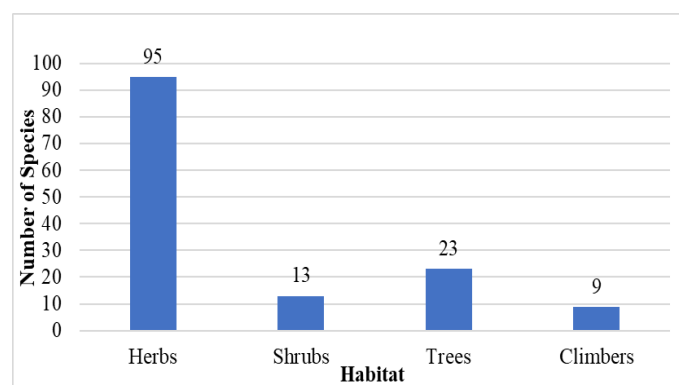


Figure 3: Habitat wise distribution of plant species in the study area.

Herbaceous vegetation was dominant (95 species, 68%), followed by shrubs (13 species, 9%), trees (23 species, 16%) and climbing plants (9 species, 7%) (Figure 3, Table 2). Herbaceous vegetation dominates the study area, followed by trees, shrubs and climbing plants. This predominance of herbaceous vegetation is attributed to the overuse of trees and shrubs by the valley's inhabitants, which has led to the decline of their population.

Table 1: Ecological characteristics and floristic diversity of the plants of the study area district Swabi.

S. No	Plant Species	Family	Habit	Life form	Leaf form	Habitat	Life cycle	Voucher numbers
1	<i>Adiantum capillus-veneris</i> L. HG-1, ISL, QAU, Pakistan	Adiantaceae	Herb	Hem	Nan	Mp	Perennial	HG-ISL-110
2	<i>Asiantum venustum</i> D. Don HG-2, ISL, QAU, Pakistan	Adiantaceae	Herb	Hem	Nan	Mp	Perennial	HG-ISL-111
3	<i>Polystichum wilsonii</i> Christ. HG-3, ISL, QAU, Pakistan	Dryopteridaceae	Herb	Hem	Nan	Wap	Perennial	HG-ISL-112
4	<i>Cystopteris fragilis</i> (L.) Bernh. HG-4, ISL, QAU, Pakistan	Cystopteridaceae	Herb	Geo	Mic	Wap	Perennial	HG-ISL-113
5	<i>Dryopteris odontoloma</i> (Moore.). HG-5, ISL, QAU, Pakistan	Dryopteridaceae	Herb	Hem	Lep	Mp	Perennial	HG-ISL-114
6	<i>Asplenium septentrionale</i> (L.) HG-6, ISL, QAU, Pakistan	Aspleniaceae	Herb	Hem	Lep	Wap	Perennial	HG-ISL-115
7	<i>Polystichum discretum</i> (D. Don) J. Sm HG-7, ISL, QAU, Pakistan	Dryopteridaceae	Herb	Hem	Nan	Mp	Perennial	HG-ISL-116
8	<i>Hypodematum crenatum</i> (Forssk.) Kuhn. HG- 8, ISL, QAU, Pakistan	Dryopteridaceae	Herb	Hem	Lep	Mp	Perennial	HG-ISL-117
9	<i>Asplenium adiantum-nigrum</i> L. HG-9, ISL, QAU, Pakistan	Aspleniaceae	Herb	Hem	Nan	Mp	Perennial	HG-ISL-118
10	<i>Dryopteris sieboldii</i> L. HG-10, ISL, QAU, Pakistan	Dryopteridaceae	Herb	Hem	Lep	Wap	Perennial	HG-ISL-119
11	<i>Dryopteris serrato-dentata</i> (Bedd.) Hayata. HG-11, ISL, QAU, Pakistan	Dryopteridaceae	Herb	Hem	Lep	Mp	Perennial	HG-ISL-120
12	<i>Adiantum incisum</i> L. HG-12, ISL, QAU, Pakistan	Adiantaceae	Herb	Hem	Lep	Mp	Perennial	HG-ISL-121
13	<i>Asplenium trichomanes</i> L. HG-13, ISL, QAU, Pakistan	Aspleniaceae	Herb	Hem	Lep	Mp	Perennial	HG-ISL-122
14	<i>Polystichum lonchitis</i> (L.) Roth. HG-14, ISL, QAU, Pakistan	Dryopteridaceae	Herb	Hem	Nan	Mp	Perennial	HG-ISL-123
15	<i>Ceterach dalhousiae</i> (Hk.) C. Chr HG-15, ISL, QAU, Pakistan	Aspleniaceae	Herb	Hem	Nan	Mp	Perennial	HG-ISL-124
16	<i>Equisetum arvense</i> L. HG-16, ISL, QAU, Pakistan	Equisetaceae	Herb	Hem	Lep	Wap	Perennial	HG-ISL-125
17	<i>Equisetum ramossimum</i> Desf. HG-17, ISL, QAU, Pakistan	Equisetaceae	Herb	Geo	Aph	Mp	Perennial	HG-ISL-126
18	<i>Pteridium aquilinum</i> (L.) Kuhn. HG-18, ISL, QAU, Pakistan	Pteridaceae	Herb	Geo	Mic	Wap	Perennial	HG-ISL-127
19	<i>Pteris cretica</i> L. HG-19, ISL, QAU, Pakistan	Pteridaceae	Herb	Hem	Mic	Mp	Perennial	HG-ISL-128
20	<i>Pteris vitata</i> L. HG-20, ISL, QAU, Pakistan	Pteridaceae	Herb	Hem	Mic	Mp	Perennial	HG-ISL-129
21	<i>Onychium contiguum</i> Wall ex. Hope HG-21, ISL, QAU, Pakistan	Pteridaceae	Herb	Geo	Mic	Wap	Perennial	HG-ISL-130
22	<i>Cheilanthes pteridioides</i> (Reichard.) C. Chr. HG-22, ISL, QAU, Pakistan	Pteridaceae	Herb	Hem	Nan	Wap	Perennial	HG-ISL-131
23	<i>Juniperus communis</i> L. HG-23, ISL, QAU, Pakistan	Cupressaceae	Shrub	Phan	Lep	F	Perennial	HG-ISL-132
24	<i>Picea simithiana</i> (Wall.) Bioss. HG-24, ISL, QAU, Pakistan	Pinnaceae	Tree	Phan	Nan	F	Perennial	HG-ISL-133
25	<i>Allium cepa</i> L. HG-25, ISL, QAU, Pakistan	Alliaceae	Herb	Geo	Mes	CU	Annual	HG-ISL-134

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S. No	Plant Species	Family	Habit	Life form	Leaf form	Habitat	Life cycle	Voucher numbers
26	<i>Cyperus rotundus</i> L. HG-26, ISL, QAU, Pakistan	Cyperaceae	Herb	Ther	Nan	Mp	Perennial	HG-ISL-135
27	<i>Oryza sativa</i> L. HG-27, ISL, QAU, Pakistan	Poaceae	Herb	Ther	Mic	CU	Perennial	HG-ISL-136
28	<i>Hordium vulgare</i> L. HG-28, ISL, QAU, Pakistan	Poaceae	Herb	Hem	Mic	Af	Annual	HG-ISL-137
29	<i>Dicanthium annulatum</i> (Forssk.) Stapf. HG-29, ISL, QAU, Pakistan	Poaceae	Herb	Hem	Nan	Af	Perennial	HG-ISL-138
30	<i>Cynodon dactylon</i> L. HG-30, ISL, QAU, Pakistan	Poaceae	Herb	Hem	Lep	Drp	Perennial	HG-ISL-139
31	<i>Apluda mutica</i> L. HG-31, ISL, QAU, Pakistan	Poaceae	Herb	Hem	Nan	Af	Annual	HG-ISL-140
32	<i>Avena fatula</i> L. HG-32, ISL, QAU, Pakistan	Poaceae	Herb	Ther	Mic	Af	Annual	HG-ISL-141
33	<i>Zea maize</i> L. HG-33, ISL, QAU, Pakistan	Poaceae	Herb	Ther	Mes	Drp	Annual	HG-ISL-142
34	<i>Amanathus spinosus</i> L. HG-34, ISL, QAU, Pakistan	Amaranthaceae	Herb	Ther	Mic	Wap	Annual	HG-ISL-143
35	<i>Amaranthus viridis</i> L. HG-35, ISL, QAU, Pakistan	Amaranthaceae	Herb	Ther	Mic	Drp	Annual	HG-ISL-144
36	<i>Nerium oleander</i> L. HG-36, ISL, QAU, Pakistan	Apocynaceae	Shrub	Phan	Mes	Mp	Perennial	HG-ISL-145
37	<i>Hedra neplensiis</i> K. Koch. HG-37, ISL, QAU, Pakistan	Araliaceae	Climber	Phan	Mes	F	Perennial	HG-ISL-146
38	<i>Calotropis procera</i> (Willd.) R. Brown HG-38, ISL, QAU, Pakistan	Asclepediaceae	Shrub	Cham	Mes	Drp	Perennial	HG-ISL-147
39	<i>Berberis Lycium</i> L. HG-39, ISL, QAU, Pakistan	Berberidaceae	Shrub	Phan	Nan	Rp	Annual	HG-ISL-148
40	<i>Betula utilis</i> D. Don HG-40, ISL, QAU, Pakistan	Betulaceae	Tree	Phan	Mes	F	Perennial	HG-ISL-149
41	<i>Alnus nitida</i> (spach). Endl. HG-41, ISL, QAU, Pakistan	Betulaceae	Tree	Phan	Mes	Wap	Annual	HG-ISL-150
42	<i>Raphanus sativus</i> L. HG-42, ISL, QAU, Pakistan	Brassicaceae	Herb	Ther	Mac	CU	Annual	HG-ISL-151
43	<i>Verbasaccum thapsus</i> L. HG-43, ISL, QAU, Pakistan	Brassicaceae	Herb	Ther	Meg	Drp	Perennial	HG-ISL-152
44	<i>Thlaspi arvense</i> L. HG-44, ISL, QAU, Pakistan	Brassicaceae	Herb	Ther	Nan	Wap	Annual	HG-ISL-153
45	<i>Thlaspi griffthianum</i> Boiss HG-45, ISL, QAU, Pakistan	Brassicaceae	Herb	Ther	Nan	Wap	Annual	HG-ISL-154
46	<i>Cannabis sativa</i> L. HG-46, ISL, QAU, Pakistan	Cannabaceae	Herb	Ther	Mic	Wap	Annual	HG-ISL-155
47	<i>Chenopodium album</i> L. HG-47, ISL, QAU, Pakistan	Chenopodiaceae	Herb	Ther	Nan	Drp	Annual	HG-ISL-156
48	<i>Chenopodium botrys</i> L. HG-48, ISL, QAU, Pakistan	Chenopodiaceae	Herb	Ther	Mic	Wap	Annual	HG-ISL-157
49	<i>Chenopodium foliosum</i> Aschers. HG-49, ISL, QAU, Pakistan	Chenopodiaceae	Herb	Ther	Nan	Wap	Annual	HG-ISL-158
50	<i>Chenopodium ambrosioides</i> L. HG-50, ISL, QAU, Pakistan	Chenopodiaceae	Herb	Ther	Mes	Wap	Annual	HG-ISL-159

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S. No	Plant Species	Family	Habit	Life form	Leaf form	Habitat	Life cycle	Voucher numbers
51	<i>Sedum hispanicum</i> L. HG-51, ISL, QAU, Pakistan	Crassulaceae	Climber	Hem	Nan	Mp	Perennial	HG-ISL-160
52	<i>Cucumis melo</i> L. HG-52, ISL, QAU, Pakistan	Cucurbitaceae	Climber	Ther	Mes	Drp	Annual	HG-ISL-161
53	<i>Luffa cylindrica</i> L. HG-53, ISL, QAU, Pakistan	Cucurbitaceae	Climber	Ther	Mic	CU	Annual	HG-ISL-162
54	<i>Cucumis sativus</i> L. HG-54, ISL, QAU, Pakistan	Cucurbitaceae	Climber	Ther	Mac	CU	Annual	HG-ISL-163
55	<i>Cucurbita maxima</i> Duch. Ex Lam. HG-55, ISL, QAU, Pakistan	Cucurbitaceae	Climber	Ther	Meg	CU	Annual	HG-ISL-164
56	<i>Cucurbita Pepo</i> L. HG-56, ISL, QAU, Pakistan	Cucurbitaceae	Climber	Ther	Meg	CU	Annual	HG-ISL-165
57	<i>Euphorbia helioscopia</i> L. HG-57, ISL, QAU, Pakistan	Euphorbiaceae	Herb	Ther	Nan	Drp	Annual	HG-ISL-166
58	<i>Euphorbia timctoria</i> L. HG-58, ISL, QAU, Pakistan	Euphorbiaceae	Herb	Ther	Mic	Drp	Annual	HG-ISL-167
59	<i>Euphorbia Peplus</i> L. HG-59, ISL, QAU, Pakistan	Euphorbiaceae	Herb	Ther	Lep	Af	Annual	HG-ISL-168
60	<i>Ricinus communis</i> L. HG-60, ISL, QAU, Pakistan	Euphorbiaceae	Shrub	Phan	Mic	Drp	Perennial	HG-ISL-169
61	<i>Quercus Baloot</i> Griffith. HG-61, ISL, QAU, Pakistan	Fagaceae	Tree	Phan	Mic	Drp	Perennial	HG-ISL-170
62	<i>Fummaria indica</i> L. HG-62, ISL, QAU, Pakistan	Fumariaceae	Herb	Ther	Lep	Drp	Annual	HG-ISL-171
63	<i>Erodium cicutarium</i> L. HG-63, ISL, QAU, Pakistan	Geraniaceae	Herb	Ther	Mes	Wap	Annual	HG-ISL-172
64	<i>Quercus incana</i> Roxb. HG-64, ISL, QAU, Pakistan	Fagaceae	Tree	Phan	Mic	Drp	Perennial	HG-ISL-173
65	<i>Geranium colinum</i> Sweet. HG-65, ISL, QAU, Pakistan	Geraniaceae	Herb	Hem	Mic	F	Perennial	HG-ISL-174
66	<i>Swertia cordata</i> (G. Don) Clarke HG-66, ISL, QAU, Pakistan	Gentianaceae	Herb	Ther	Lep	Drp	Annual	HG-ISL-175
67	<i>Mentha longifolia</i> (L.) Huds. HG-67, ISL, QAU, Pakistan	Lamiaceae	Herb	Hem	Nan	Mp	Perennial	HG-ISL-176
68	<i>Quercus dilatata</i> Royle. HG-68, ISL, QAU, Pakistan	Fagaceae	Tree	Phan	Mic	Drp	Perennial	HG-ISL-177
69	<i>Mirabilis jalapa</i> L. HG-69, ISL, QAU, Pakistan	Nyctaginaceae	Herb	Ther	Mes	Drp	Perennial	HG-ISL-178
70	<i>Ajuga bracteosa</i> Wall. ex Benth. HG-70, ISL, QAU, Pakistan	Lamiaceae	Herb	Hem	Mic	Drp	Perennial	HG-ISL-179
71	<i>Ocimum basilicum</i> L. HG-71, ISL, QAU, Pakistan	Lamiaceae	Herb	Cham	Nan	Drp	Perennial	HG-ISL-180
72	<i>Morus nigra</i> L. HG-72, ISL, QAU, Pakistan	Moraceae	Herb	Phan	Mes	Drp	Perennial	HG-ISL-181
73	<i>Juglans regia</i> L. HG-73, ISL, QAU, Pakistan	Juglandaceae	Tree	Phan	Mic	Drp	Perennial	HG-ISL-182
74	<i>Morus macroura</i> Miq. HG-74, ISL, QAU, Pakistan	Moraceae	Herb	Phan	Mes	Drp	Perennial	HG-ISL-183
75	<i>Myrtus communis</i> L. HG-75, ISL, QAU, Pakistan	Myrtaceae	Shrub	Phan	Mic	Mp	Perennial	HG-ISL-184

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S. No	Plant Species	Family	Habit	Life form	Leaf form	Habitat	Life cycle	Voucher numbers
76	<i>Ficus johannis</i> Boiss. HG-76, ISL, QAU, Pakistan	Moraceae	Herb	Phan	Mes	Drp	Perennial	HG-ISL-185
77	<i>Morus alba</i> L. HG-77, ISL, QAU, Pakistan	Moraceae	Herb	Phan	Mes	Drp	Perennial	HG-ISL-186
78	<i>Ficus palmata</i> Forssk. HG-78, ISL, QAU, Pakistan	Moraceae	Herb	Phan	Mes	Drp	Perennial	HG-ISL-187
79	<i>Jasminum officinale</i> L. HG-79, ISL, QAU, Pakistan	Oleaceae	Shrub	Phan	Nan	Drp	Annual	HG-ISL-188
80	<i>Oxalis corniculata</i> L. HG-80, ISL, QAU, Pakistan	Oxalidaceae	Herb	Ther	Nan	Sp	Annual	HG-ISL-189
81	<i>Medicago minima</i> (L.) Grufb. HG-81, ISL, QAU, Pakistan	Fabaceae	Herb	Ther	Nan	Af	Annual	HG-ISL-190
82	<i>Melilotus officinalis</i> (Linn.) Desr. HG-82, ISL, QAU, Pakistan	Fabaceae	Herb	Ther	Nan	Mp	Annual	HG-ISL-191
83	<i>Vicia sativa</i> L. HG-83, ISL, QAU, Pakistan	Fabaceae	Climber	Ther	Nan	Af	Annual	HG-ISL-192
84	<i>Trifolium repens</i> L. HG-84, ISL, QAU, Pakistan	Fabaceae	Herb	Ther	Nan	F	Perennial	HG-ISL-193
85	<i>Trigonella gracilis</i> Benth. HG-85, ISL, QAU, Pakistan	Fabaceae	Herb	Ther	Nan	Mp	Perennial	HG-ISL-194
86	<i>Platanus orientalis</i> L. HG-86, ISL, QAU, Pakistan	Platanaceae	Tree	Phan	Mes	F	Perennial	HG-ISL-195
87	<i>Rumex dentatus</i> L. HG-87, ISL, QAU, Pakistan	Polygonaceae	Herb	Hem	Mes	Mp	Annual	HG-ISL-196
88	<i>Rumex hastatus</i> D. Don HG-88, ISL, QAU, Pakistan	Polygonaceae	Herb	Cham	Nan	Drp	Perennial	HG-ISL-197
89	<i>Bistorta amplexicaulis</i> (D. Don) HG-89, ISL, QAU, Pakistan	Polygonaceae	Herb	Hem	Mes	F	Perennial	HG-ISL-198
90	<i>Polygonum barbatum</i> L. HG-90, ISL, QAU, Pakistan	Polygonaceae	Herb	Ther	Nan	Mp	Perennial	HG-ISL-199
91	<i>Punica grantaum</i> L. HG-91, ISL, QAU, Pakistan	Polygonaceae	Tree	Phan	Mic	Drp	Perennial	HG-ISL-200
92	<i>Ranunculus muricatus</i> L. HG-92, ISL, QAU, Pakistan	Polygonaceae	Herb	Geo	Mic	Wap	Annual	HG-ISL-201
93	<i>Ziziphus mauritiana</i> Lam. HG-93, ISL, QAU, Pakistan	Rosaceae	Tree	Phan	Nan	Drp	Perennial	HG-ISL-202
94	<i>Potentilla nepalensis</i> Hook. HG-94, ISL, QAU, Pakistan	Rosaceae	Herb	Hem	Mic	F	Perennial	HG-ISL-203
95	<i>Rosa alba</i> L. HG-95, ISL, QAU, Pakistan	Rosaceae	Shrub	Phan	Nan	CU	Perennial	HG-ISL-204
96	<i>Rubus ulmifolius</i> Schott HG-96, ISL, QAU, Pakistan	Rosaceae	Shrub	Phan	Mic	Mp	Perennial	HG-ISL-205
97	<i>Rubus sanctus</i> Schreber HG-97, ISL, QAU, Pakistan	Rosaceae	Shrub	Phan	Mic	Mp	Perennial	HG-ISL-206
98	<i>Prunus domestica</i> L. HG-98, ISL, QAU, Pakistan	Rosaceae	Tree	Phan	Mes	CU	Perennial	HG-ISL-207
99	<i>Prunus persica</i> L. Batsch. HG-99, ISL, QAU, Pakistan	Rosaceae	Tree	Phan	Mes	CU	Perennial	HG-ISL-208
100	<i>Prunus cornuta</i> (Wall. Ex. Royle.) HG-100, ISL, QAU, Pakistan	Rosaceae	Tree	Phan	Mes	F	Perennial	HG-ISL-209

Table continues on next page.....

S. No	Plant Species	Family	Habit	Life form	Leaf form	Habitat	Life cycle	Voucher numbers
101	<i>Salix babylonica</i> L. HG-101, ISL, QAU, Pakistan	Salicaceae	Tree	Phan	Mic	Wap	Perennial	HG-ISL-210
102	<i>Prunus armeniaca</i> L. HG-102, ISL, QAU, Pakistan	Rosaceae	Tree	Phan	Mes	CU	Perennial	HG-ISL-211
103	<i>Pyrus pashia</i> Ham. Ex. D. Don. HG-103, ISL, QAU, Pakistan	Rosaceae	Tree	Phan	Mic	CU	Annual	HG-ISL-212
104	<i>Salix tetrasperma</i> Roxb. HG-104, ISL, QAU, Pakistan	Salicaceae	Tree	Phan	Mes	Wap	Perennial	HG-ISL-213
105	<i>Populus alba</i> Wall. HG-105, ISL, QAU, Pakistan	Salicaceae	Tree	Phan	Mes	CU	Perennial	HG-ISL-214
106	<i>Populus nigra</i> L. HG-106, ISL, QAU, Pakistan	Salicaceae	Tree	Phan	Mac	CU	Perennial	HG-ISL-215
107	<i>Pyrus communis</i> L. HG-107, ISL, QAU, Pakistan	Rosaceae	Tree	Phan	Mic	CU	Perennial	HG-ISL-216
108	<i>Dodonaea viscosa</i> (L.) Jacq. HG-108, ISL, QAU, Pakistan	Sapindaceae	Shrub	Phan	Mic	Drp	Perennial	HG-ISL-217
109	<i>Veronica polita</i> Fries. HG-109, ISL, QAU, Pakistan	Scrophulariaceae	Herb	Ther	Nan	Mp	Annual	HG-ISL-218
110	<i>Datura innoxia</i> Mill HG-110, ISL, QAU, Pakistan	Solanaceae	Herb	Ther	Mes	Wap	Annual	HG-ISL-219
111	<i>Datura stramonium</i> L. HG-111, ISL, QAU, Pakistan	Solanaceae	Herb	Ther	Mes	Wap	Annual	HG-ISL-220
112	<i>Lycopersicon esculentum</i> Miller HG-112, ISL, QAU, Pakistan	Solanaceae	Herb	Ther	Mes	CU	Annual	HG-ISL-221
113	<i>Solanum nigrum</i> L. HG-113, ISL, QAU, Pakistan	Solanaceae	Herb	Ther	Mic	Drp	Annual	HG-ISL-222
114	<i>Solanum pseudo-capsicum</i> L. HG-114, ISL, QAU, Pakistan	Solanaceae	Herb	Ther	Mic	G	Perennial	HG-ISL-223
115	<i>Solanum tuberosum</i> L. HG-115, ISL, QAU, Pakistan	Solanaceae	Herb	Geo	Mes	CU	Perennial	HG-ISL-224
116	<i>Urtica dioica</i> L. HG-116, ISL, QAU, Pakistan	Urticaceae	Herb	Ther	Mic	Mp	Perennial	HG-ISL-225
117	<i>Debregeesia salcifolia</i> (D. Don) Rendle. HG-117, ISL, QAU, Pakistan	Urticaceae	Shrub	Phan	Mic	Mp	Perennial	HG-ISL-226
118	<i>Vitis vinifera</i> L. HG-118, ISL, QAU, Pakistan	Vitaceae	Climber	Phan	Mes	CU	Perennial	HG-ISL-227
119	<i>Tribulus terrestris</i> L. HG-119, ISL, QAU, Pakistan	Zygophyllaceae	Herb	Hem	Lep	Wap	Annual	HG-ISL-228
120	<i>Triticum aestivum</i> (L.) HG-120, ISL, QAU, Pakistan	Poaceae	Herb	Ther	Mic	CU	Annual	HG-ISL-229
121	<i>Avena sativa</i> HG-121, ISL, QAU, Pakistan	Poaceae	Herb	Ther	Nan	W	Annual	HG-ISL-230
122	<i>Dichanthium annulatum</i> L. HG-122, ISL, QAU, Pakistan	Poaceae	Herb	Hem	Nan	W	Perennial	HG-ISL-231
123	<i>Physalis minima</i> L. HG-123, ISL, QAU, Pakistan	Solanaceae	Herb	Cham	Mic	W	Annual	HG-ISL-232
124	<i>Cupressus sempervirens</i> L. HG-124, ISL, QAU, Pakistan	Cupressaceae	Tree	Meg	Mes	CU	Perennial	HG-ISL-333
125	<i>Verbena officinalis</i> L. HG-125, ISL, QAU, Pakistan	Verbenaceae	Herb	Ther	Nan	W	Perennial	HG-ISL-334

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S. No	Plant Species	Family	Habit	Life form	Leaf form	Habitat	Life cycle	Voucher numbers
126	<i>Lantana camara</i> L. HG-126, ISL, QAU, Pakistan	Verbenaceae	Shrub	Ther	Mic	W	Perennial	HG-ISL-335
127	<i>Datura alba</i> L. HG-127, ISL, QAU, Pakistan	Simaroubaceae	Herb	Cham	Mes	W	Annual	HG-ISL-336
128	<i>Verbascum thapsus</i> L. HG-128, ISL, QAU, Pakistan	Simaroubaceae	Herb	Nan	Mic	W	Perennial	HG-ISL-337
129	<i>Arundo donax</i> L. HG-129, ISL, QAU, Pakistan	Poaceae	Herb	Phan	Mac	W	Perennial	HG-ISL-338
130	<i>Cymbopogon citratus</i> Spreng. HG-130, ISL, QAU, Pakistan	Poaceae	Herb	Hem	Nan	CU	Perennial	HG-ISL-339
131	<i>Desmostachya bipinnata</i> (L.) Stapf. HG-131, ISL, QAU, Pakistan	Poaceae	Herb	Hem	Mac	W	Perennial	HG-ISL-340
132	<i>Phalaris minor</i> L. HG-132, ISL, QAU, Pakistan	Poaceae	Herb	Ther	Mic	W	Annual	HG-ISL-341
133	<i>Sorghum halepense</i> (L.) Pers. HG-133, ISL, QAU, Pakistan	Poaceae	Herb	Geo	Mic	W	Perennial	HG-ISL-342
134	<i>Colocasia esculentus</i> L. HG-134, ISL, QAU, Pakistan	Araceae	Herb	Geo	Meg	CU	Perennial	HG-ISL-343
135	<i>Phoenix dactylifera</i> L. HG-2, ISL, QAU, Pakistan	Arecaceae	Tree	Meg	Mic	CU	Perennial	HG-ISL-344
136	<i>Asparagus officinalis</i> L. HG-136, ISL, QAU, Pakistan	Asparagaceae	Herb	Nan	Lep	CU	Perennial	HG-ISL-345
137	<i>Narcissus poeticus</i> L. HG-137, ISL, QAU, Pakistan	Amaryllidaceae	Herb	Meg	Mes	CU	Perennial	HG-ISL-346
138	<i>Thuja orientalis</i> L. HG-138, ISL, QAU, Pakistan	Cupressaceae	Tree	Meg	Nan	CU	Perennial	HG-ISL-347
139	<i>Cynoglossum glochidiatum</i> Wall. Ex HG-139, ISL, QAU, Pakistan	Boraginaceae	Herb	Ther	Mic	Drp	Perennial	HG-ISL-348
140	<i>Impatiens bicolor</i> Royle. HG-140, ISL, QAU, Pakistan	Balsaminaceae	Herb	Ther	Mes	Mp	Annual	HG-ISL-349

Legends: Key to abbreviations: [Tables 1, 2.](#)

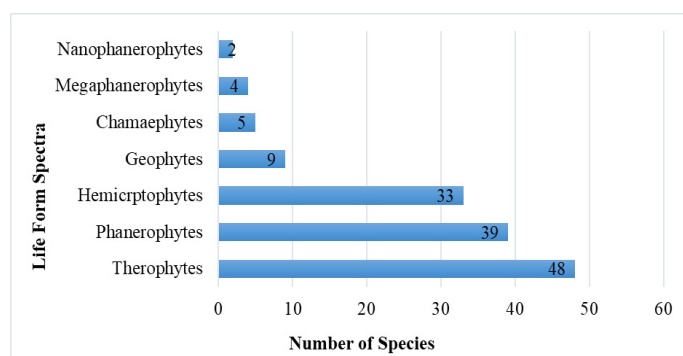


Figure 4: This figure represents life form spectra of vegetation of study area.

Biological spectrum of vegetation

In the present study, a Raunkiaerean classification is applied, study reveals that therophytes are the most abundant life form with (48 spp., 30%), followed by phanerophytes (39 spp., 25%), Hemipterophytes (33 spp., 21%), Nanophanerophytes (2 spp., 1%), Megaphanerophytes (4 spp., 3%), Geophytes (9

spp., 6%), Mesophanerophytes (18 spp., 11%), and Chamaephytes (5 spp., 3%), were the second most common life forms ([Figure 4](#)).

Plant parts used and mode of preparation

Examination of leaf size spectra ([Figure 5](#)), Microphyll (43 spp., 31%), followed by Nanophyll (38 spp., 27%), Mesophylls (34 spp., 24%), Leptophyll with (15 spp., 11%), Macrophyll with (5 spp., 3%), Megaphyll with (4 spp., 3%) and Aphyllous has only (1 species) ([Figure 5](#)). Plant species are also classified based on their habitat. The results showed that the largest number of species were found in Dry places (31 species., 22%), followed by Moist places (29 species., 21%), Cultivated areas (26 species., 18%), Wasteland areas (23 species., 16%), Wet places (11 spp., 8%), forests places (10 spp., 7%), Agricultural areas (7 spp., 5%). While the rest of all Rocky, Shady and Graveyards places have only (1 spp., 1%) ([Figure 6](#)).

Table 2: Summary of ecological characteristics of plants of the study area.

S.No	Characteristics	Number	Percentage %
1	Vegetation		
	Families	53	--
	Genera	102	--
	Species	140	--
2	Habit		
	Herbs	95	68%
	Shrubs	13	9%
	Trees	23	16%
	Climbers	9	7%
3	Life form (Spectrum)		
	Therophytes	48	30%
	Phanerophytes	39	25%
	Geophytes	9	6%
	Hemicrptophytes	33	21%
	Chamaephytes	5	3%
	Megaphanerophytes	4	3%
	Nanophanerophytes	2	1%
	Mesophanerophytes	18	11%
4	Leaf form		
	Microphyll	43	31%
	Nanophyll	38	27%
	Mesophyll	34	24%
	Leptophyll	15	11%
	Macrophyll	5	3%
	Megaphyll	4	3%
	Aphyllous	1	1%
5	Habitat		
	Dry places	31	22%
	Cultivated	26	18%
	Forest	10	7%
	Agricultural fields	7	5%
	Rocky place	1	1%
	Shady places	1	1%
	Waste places	23	16%
	Moist places	29	21%
	Wet places	11	8%
	Graveyards	1	1%
6	Life cycle		
	Annual	48	34%
	Perennial	92	66%

Discussion

The flora of the Swabi region includes 53 families, 102 genera and 140 species. The largest families were

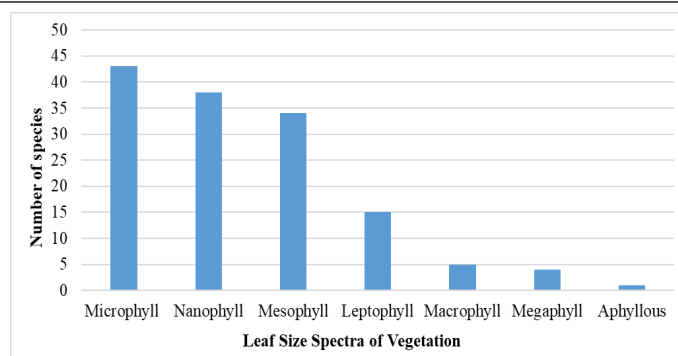


Figure 5: This figure represents leaf size spectra of vegetation of study area.

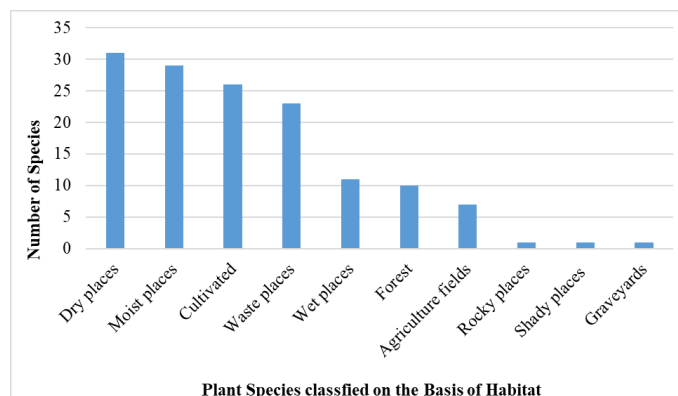


Figure 6: Classification of plants species of study area based on their habitat.

Poaceae (15 spp.), Rosaceae (11 spp.), Dryopteridaceae and Solanaceae (7 spp.), each Polygonaceae (6 spp.), Pteridaceae, Fabaceae, Moraceae and Cucurbitaceae (5 spp.), Euphorbiaceae, Chenopodiaceae, Aspleniaceae, Brassicaceae. and Salicaceae (4 species), Fagaceae, Lamiaceae, Cupressaceae and Adiantaceae (3 species), Simaroubaceae, Equisetaceae, Amaranthaceae, Urticaceae, Geraniaceae, Verbenaceae and Betulaceae (2 species). The remaining families had only one species. Research in floriculture provides basic information for further investigation of taxonomic and ecological information and for planning sustainable management and conservation of plant resources (Amjad *et al.*, 2017). Many studies, including those by (Durrani *et al.*, 2005) have shown that some families are dominant. The existence of these families was confirmed in the Flora of Pakistan by (Ali *et al.*, 1989-1993) and it was emphasized that they have a wide distribution. Additionally, (Ullah and Badshah, 2017) reported in their study in Lajbouk that the dominant family was Poaceae, followed by Lamiaceae, Asteraceae and Solanaceae. Ullah *et al.* (2020), described 250 species in 77 families; Asteraceae and Lamiaceae are the main dominant families. These results are in close agreement with those from

Jammu and Kashmir ([Sharma et al., 2018](#)), in which Asteraceae was identified as the dominant family, followed by Rosaceae, Lamiaceae and Poaceae.

Herbaceous vegetation was dominant (95 spp., 68%), followed by shrubs (13 spp., 9%), trees (23 spp., 16%) and climbing plants (9 spp., 7%). Herbaceous vegetation dominates the study area, followed by trees, shrubs and climbing plants. Similar patterns were observed at different intervals ([Khan et al., 2017](#)) in Ranizai, Swat ([Ali et al., 2019](#)) in Nowshera region; Swat, ([Naveed et al., 2012](#)) Karak, ([Anjum et al., 2020](#)) in Baluchistan, ([Ullah and Badshah, 2017](#)) in the Jelar Valley; Akhtar in Miandam, Swat ([Khalid, 2017](#)) and ([Khan et al., 2017](#)) in Darra Adam Khel. The prevalence of herbaceous vegetation and the excessive consumption of trees and shrubs by the inhabitants of the valley lead to a decrease in the decomposition of trees and shrubs. These findings highlighted the urgent need for numerous improvements and conservation efforts. In the present study, therophytes are the most abundant life form therophytes with (48 spp., 34%), followed by phanerophytes (39 spp., 28%), Hemicryptophytes (33 spp., 24%), Nanophanerophytes (2 spp., 1%), Megaphanerophytes (4 spp., 3%), Geophytes (9 spp., 6%), Mesophanerophytes (18 spp., 11%), and Chamaephytes (5 spp., 4%), were the second most common life forms. The physiognomy of flora and vegetation is influenced by life forms and environmental factors. [Raunkiaer \(1934\)](#) proposed a classification of life forms based on the placement of permanent structures in adverse conditions that affect the physiognomy of flora and vegetation. Our results are consistent with those of ([Cain and Castro, 1959](#)). Similar findings have been documented in studies conducted in Gadoon and Swabi ([Sher et al., 2014](#)). The finding of our results is strongly coincides with that of ([Haq et al., 2019](#)), who reported the prevalence of therophytes in the region. Similarly, ([Kar et al., 2010](#)) obtained similar spectra of life forms during their survey in the grasslands of Odisha, India. Examination of leaf size spectra, Microphyll (43 spp., 31%), followed by Nanophyll (38 spp., 27%), Mesophylls (34 spp., 24%), Leptophyll with (15 spp., 11%), Macrophyll with (5 spp., 3%), Megaphyll with (4 spp., 3%) and Aphyllous has only (1 spp.). Leaf size plays a crucial role in determining various plant functions, such as photosynthesis and transpiration. Understanding the leaf size spectrum of plant species can provide information about their physiological

processes and community dynamics ([Oosting, 1948](#)). These results are consistent with those reported by ([Malik et al., 2007](#)), who showed that similar leaf size classes predominate in Kashmir and Quetta. The results showed that the largest number of species were found in dry places (31 species., 22%), followed by moist places (29 spp., 21%), cultivated areas (26 spp., 18%), wasteland areas (23 spp., 16%), Wet places (11 spp., 8%), forests places (10 spp., 7%), agricultural areas (7 spp., 5%). While the rest of all rocky, shady and Graveyards places have only (1 spp., 1%). The habitat conditions in the region are predominantly dry as the maximum number of species are found in dry habitats, followed by forests. In the present study, we are also classified the Plant species based on their habitat. Various researchers such as ([Samreen et al., 2016](#)) have also conducted similar studies. They classified plant species based on their habitat type. Therefore, our findings are relevant in this regard. The biological spectrum (life forms and leaf size spectra) is the most important feature and is widely used in studying vegetation. The life forms of plant species in a region determine the macro and micro climatic conditions of the region ([Shimwell, 1971](#)) while determination of leaf size classes is useful for understanding the physiological processes of plant species and their communities ([Oosting, 1956](#)). Several works have been published on the floristic lists and ecological characteristics of different Pakistani and foreign locations, such as ([Batalha et al., 2002](#); [Kar et al., 2010](#); [Amjad et al., 2012](#)).

Conclusion

This study concludes that the flora of the Swabi region presents a diversity dominated by arid habitats, as evidenced by the maximum number of species found in this area. Although this study provides basic information on the flora of district Swabi, further studies are needed to assess the conservation status of the wild flora and collect quantitative data on the vegetation. Restoration of degraded forests is recommended, prioritizing on-site efforts to facilitate the natural flowering of plants in their natural habitat, rather than resorting to practices elsewhere.

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during data collection.

Novelty Statement

This study provides the first comprehensive analysis of the floristic composition and biological spectrum of District Swabi, Khyber Pakhtunkhwa. It highlights unique ecological patterns and adaptive plant strategies in an underexplored region of Pakistan.

Author's Contribution

Anwar Hussain Khan, Nasira Bibi: Collected and analyzed the data.

Rayyan Komal and Shabir Ahmad: Wrote the text.

Huma Gul: Wrote the final version of the text.

All authors approved the final version of the manuscript.

List of abbreviations

HG, Huma Gul; ISL, Herbarium of Quaid-i-Azam University Islamabad, Pakistan; QAU, Quaid-i-Azam University, Islamabad, Pakistan.

Conflict of interest

The authors have declared no conflict of interest.

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