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ENVISAGING NATURAL VEGETATION IN CONTRASTING ENVIRONMENTS (PIEDMONT AND ALLUVIAL) OF DERA GHAZI KHAN, PAKISTAN

AYAZ AHMAD[1], DR ASMA SAEED[2], DR ALLAH BAKHSH GULSHAN[3], WAQAS YOUSAF[4] AND IMRAN ZAFAR[5*]

[1]*Department of Biological Sciences, Gomal University Dera Ismail Khan, K.P.K. Pakistan*
[2]*Institute of Biological Sciences, Gomal University, D.I. Khan, K.P.K. Pakistan*
[3]*Department of Botany, Ghazi University, D.G. Khan, Punjab. Pakistan*
[4]*Institute of Molecular Biology and Biotechnology, Department of Botany, The University of Lahore, Punjab Pakistan*
[5]*Department of Bioinformatics and Computational Biology, Virtual University of Pakistan*
**Corresponding author's email: Bioinfo.pk@gmail.com*

Abstract

Climate change and *anthropogenic activities* have an impact on vegetation patterns and spatial arrangement. Dera Ghazi Khan Rangelands and its environs are home to a diverse array of plant species that flourish in a variety of habitats. There are two types of habitats in the research area: piedmont and alluvial. The present study predicted the interaction between surrounds and vegetation at the land use and land cover (LULC), Broad vegetation groups (BVGs), vegetation type, formation and sub-formation levels redundancy analysis (RDA). We've identified 76 species, 62 genera, and 28 families, most of which were Solanaceae (20 species) and Asteraceae (20 species). The Qualitative data were also used to analyse the variety & floral species richness of every random selection in which Shannon diversity (H) values varied from 2.93 to 2.49, and the estimated species richness (S.R.) range was 19.70 to 9.30, with high values indicating high variety in the unit area. The normal cluster analysis was applied on the Mesic zone found at a low elevation of 114.3 m, Sandy alluvial plains located at a height of 147.21 m and the Piedmont environment at an altitude of 809.85 metres above sea level. The DCA is being used to analyse the entire data set, and the Eigenvalues of the recoded first four DCA axes, are 0.785, 0.377, 0.137, and 0.088. DCA-Ordination revealed the major curve to an amalgam of elevation (p<0.05) and slope (p<0.01) as elevation considerations associated with species distribution. Soil factors were key ecosystem elements along the DCA axis. Mg2+, K+, and N2+ contributed no more than 0.054%, 0.20%, and 0.073% of variation along each ordination axis, respectively. We observed that lower elevations (riparian) have more plant species richness and variety than higher elevations (piedmont). Furthermore, there was a substantial positive link between length and vegetation pattern, demonstrating that numerous environmental conditions impact the overall vegetation pattern in the study area.

Key words: Vegetation, Contrasting Environments, Alluvial, Piedmont, Floral Species, Dera Ghazi Khan.

Introduction

Plants and soil contribute to incorporating the urban green spaces to determine the environment's capacity to promote biodiversity (Farinha-Marques *et al*., 2011). One of the fundamental objectives of plant evolutionary biologists is to analyse the relationship between vegetative types and the ecosystem (Grime, 2006). Identifying the vegetation–environment interaction is crucial for a better understanding of the consequences of climate change on landscapes and the ecological response to global climate change (Miebach, 2017). Assessing vegetation's climate change adaptations may aid in forecasting the future consequences of global warming on ecosystems, diversity, and our own nutritional security and welfare (Brooks *et al*., 2006). The interaction of vegetation and environment may also quantitatively demonstrate connections between driving variables and natural ecological patterns, assisting in the discovery of the fundamental causes of environmental changes. The Spatial and chronological patterns of biodiversity have received less consideration (Beever *et al*., 2006). In contrast, temporal and spatial variation in the distribution and abundance are crucial ecological techniques for assessing phyto-climatic diversity at point levels and gradients to manage the montane ecosystem (Khan *et al*., 2013). Sustainable use and conservation of plant biodiversity are important for geo-climatic gradients to drive plant species composition, which plays an important role in how plant species assemble locally into communities (Benito *et al*., 2018; Zhou *et al*., 2020).

Plant scientists worldwide show a common interest in native plant species to predict new inclusive research investigations, ethnopharmacological, ecological, and phytoplankton studies skewed toward charismatic contributions (Kandel *et al*., 2016; Brodeur *et al*., 2018). The phenotypic variation and systematic importance of flowering plants are investigated in different geographical regions of Pakistan to measure the functional diversity in restored ecosystems (Hanif *et al*., 2019; Guiden *et al*., 2021). Research towards a collaborative, global infrastructure for biodiversity assessment at each location, building a global observing system among vegetation and consumer in the community (Guralnick *et al*., 2007). As a result, the Sources of floral scent variation and floristic diversity provide phylogenetic patterns as per the investigation of earlier researcher (Zafar *et al*., 2020; Zafar *et al*., 2022), for different evolution of plant sexual diversity in the context of intra-floral integration in metameric organisms (Jaramillo & Manos, 2001; Diggle, 2014). The classification and anthropogenic disturbance of alluvial plant communities of the Piedmont region are historical sites with various life patterns of different plant varieties (Matthews *et al*., 2011).

Topography and vegetation types morphology are frequently utilised as habitat surrogates, and they contribute to the spatial variability of soil respiration in subtropical plant species, which is connected with meteorological factors such as soil moisture (Chen *et al*., 1997; Vetter *et al*., 2006). Plant ecology studies the interactions of plants with their physical and biological environments (Lambers *et al*., 2008). Plant community types are determined by topographic elements such as soil physical and chemical qualities (Yimer *et al*., 2006). Vegetation patterns changed dramatically across topographies, suggesting distinct environmental conditions and determining habitats for various plant species (Miller *et al*., 2010). Diversity in leaf characteristics at different altitudes indicates the adaptive structure of different types of natural flora in different environments and displays the compositional response to variability in biochemical and anatomical elements of different plants (Naskar & Palit, 2015). Ecosystems are influenced by both biotic and abiotic factors, which can affect natural interpretations and lead to predictions about species proliferation (Lewis *et al*., 2017). Variables influencing species diversity include not just abiotic and environmental characteristics, but also climatic gradients impacted by biotic factors (Li *et al*., 2020).

Diverse climatic parameters and anthropogenic effects influence vegetation patterns and spatial layouts (Oliver and Morecroft, 2014). As a result, the impact of the environment on plants at floristic classification levels remains unclear (Ninkovic *et al*., 2021). Some studies on the relationship between soil and vegetation (Trudgill, 1977), moisture and vegetation (Chang and Wetzel, 1991), topography and greenery (Ng *et al*., 2009), and environment and vegetation (Roderick *et al*., 2000), were calculated using a few defined criteria, such as selecting annual mean precipitation to indicate the characteristic "water" that may affect native plants. However, the relationship between average rainfall and vegetation may never be significant (Overpeck *et al*., 1990); instead, total monthly rainfall throughout the growing season or quarterly rainfall may be a significantly better strategy to studying the effect of water on plants. It is appropriate to take into account as many ecological parameters as necessary, especially in extremely different locations and plants (Levin, 1971).

One of the most productive tropical regions of Punjab is Dera Ghazi Khan (Malana & Khosa, 2011). The temperature is extremely high in the region. The two main languages spoken in the district are Urdu and Punjabi. Infant mortality rate (IMR) and maternal mortality rate (MMR) are high due to the lack of adequate health care facilities (Shafiq *et al*., 2021). Almost all ethnic groups use herbal medicines to cure many diseases, and these cultures have a great deal of traditional knowledge about medicinal plants (Gulshan *et al*., 2012). Plants are used for many things, including food, shelter, and medicinal ingredients. Inadequate management of these plants, on the other hand, is caused by a lack of precise knowledge of the exploitable components, insufficient collection time, and inefficient sampling techniques. New research in the Dera Ghazi Khan area adopts a quantitative method for therapeutic herbs and ethnopharmacological study document the traditional use of local medicinal vegetation even before understanding fades (Shafiq *et al*., 2021).

The main objective of this research is to arrive at a hypothesis to quantify the Impact of ecological parameters on individual species using various statistical approaches. The topographic profiles of the transect were determined using an altimeter (Suunto, Vantaa, Finland). The elevation of the transect varies from 110 to 2657 meters (s.n.m.). Transects can also be georeferenced more easily than stand-alone plots. The transect was georeferenced using GPS technology. The exploration and prediction of Phyto-diversity in the foothills and alluvial habitats and the prediction of the affinities of aerial vegetation over a steep gradient landscape from the highlands (piedmont) to lowland habitats are the main objectives of this study (alluvial). This research also set new trends for botanical scholars in managing and representing natural flora for future studies in various fields of botany to record indigenous plant-based medicinal knowledge and establish a profile of therapeutic plants using quantitative indicators.

Material and Methods

Site of study: We chose the Piedmont and Riparian Zone of Dera Ghazi Khan for our research; the geographical map is shown in (Fig. 1). The piedmont of this region is an arid zone that gets water from rainfall. The Geographic coordinates of Dera Ghazi Khan, Pakistan are 30°03′22″ N latitude, 70°38′05″ E longitude and 129 m = 423 ft elevation above sea level. This district's overall environment is dry, with little rain falling each year. Winters are comparatively chilly, but the rest of the year is warm, with the exception of summers, which are extremely scorching. In during wintertime, temperatures typically vary between 40- and 70-degrees Fahrenheit (4 and 15 degrees Celsius), whereas during the summer, the climatic condition of this zone may reach 115 degrees Fahrenheit (46 degrees Celsius). The annual and seasonal rainfall in this area is 142 mm, with the rainy season lasting from June to August as mentioned in Table 1.

Data collection: Spring (February-March, 2018-2019) is the optimum time for study since most plant species are actively growing and their reproductive organs are clearly identifiable (Ahmad *et al*., 2021). Mid-March was the month with the highest coverage of most plant species. A series of test sites along a single continuous transect stretching over the floodplains was used to study the flora and its environment. The sampling locations were discovered along an uplift transect in floodplains that led to a gravel plateau above. To collect vegetation data, the distance between locations was roughly one kilometre, and 10*10 m squares were planted at each site.

A composite sample was created by combining soil samples from three separate locations in each batch. The gravel was filtered using a 2mm wide mesh. This composite sample was broken down into three subtests. The sieved soil samples were maintained until they could be inspected. The physical and chemical characteristics of the sieved soil sample, including soil texture, pH, E.C., and total soluble salts, were determined using standard techniques.

Table 1. Climate Data: Tornadic activity is widespread in the season due to the barren mountains of Koh-Suleman (Sulaiman Mountains) and the sandy soil of the area. Summertime in Pakistan has some of the country's greatest temperatures. Fort Munro, on the outskirts of the Province of Punjab, has a more temperate climate. Snowfall has indeed been recorded in the wintertime.

Month	Climate data for Dera Ghazi Khan												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Record high °C (°F)	25.0 (77.0)	30.0 (86.0)	35.0 (95.0)	38.0 (100.4)	42.0 (107.6)	46.0 (114.8)	44.0 (111.2)	42.0 (107.6)	40.0 (104.0)	38.0 (100.4)	32.0 (89.6)	22.0 (71.6)	46.0 (114.8)
Average high °C (°F)	20.3 (68.5)	22.1 (71.8)	26.9 (80.4)	33.5 (92.3)	38.7 (101.7)	41.5 (106.7)	38.5 (101.3)	37.4 (99.3)	36.7 (98.1)	33.4 (92.1)	27.7 (81.9)	21.9 (71.4)	31.5 (88.8)
Daily mean °C (°F)	12.2 (54.0)	14.7 (58.5)	19.9 (67.8)	26.0 (78.8)	30.9 (87.6)	34.2 (93.6)	32.7 (90.9)	31.9 (89.4)	30.2 (86.4)	25.3 (77.5)	19.1 (66.4)	13.6 (56.5)	24.2 (75.6)
Average low °C (°F)	4.2 (39.6)	7.3 (45.1)	12.9 (55.2)	18.5 (65.3)	23.1 (73.6)	26.8 (80.2)	26.9 (80.4)	26.4 (79.5)	23.8 (74.8)	17.3 (63.1)	10.5 (50.9)	5.3 (41.5)	16.9 (62.4)
Record low °C (°F)	−2.2 (28.0)	−2.0 (28.4)	4.0 (39.2)	9.5 (49.1)	14.4 (57.9)	17.5 (63.5)	18.6 (65.5)	19.5 (67.1)	15.8 (60.4)	8.0 (46.4)	2.2 (36.0)	−2.8 (27.0)	−2.8 (27.0)
Average rainfall mm (inches)	10.0 (0.39)	17.5 (0.69)	34.8 (1.37)	21.7 (0.85)	17.2 (0.68)	14.4 (0.57)	60.8 (2.39)	57.5 (2.26)	17.6 (0.69)	4.8 (0.19)	2.1 (0.08)	10.4 (0.41)	268.8 (10.57)
Mean monthly sunshine hours	222.2	206.8	234.3	259.2	290.1	247.7	241.3	261.1	271.1	283.2	249.7	220.4	2,987.1

Table 2. Nomination of gender and individualities.

Gender:					
		Frequency	Percent	Valid percent	Cumulative percent
Valid	Male	18	60.0	60.0	60.0
	Female	12	40.0	40.0	100.0
	Total	30	100.0	100.0	

The demographic distribution of the participants on the basis of gender as mentioned in Table 2, shows that of the 30 participants, 18 are males (60%) while 12 are females (40%)

Table 3. Respondents age.

Age					
		Frequency	Percent	Valid percent	Cumulative percent
Valid	20-29	15	50.0	50.0	50.0
	30-39	5	16.7	16.7	66.7
	40-49	7	23.3	23.3	90.0
	Above 50	3	10.0	10.0	100.0
	Total	30	100.0	100.0	

According to the study of the data supplied on the age group of the 30 participants as mentioned in Table 3, the four age groups are evenly distributed. 15 of the participants (50 percent) were under the age of 25; 5 (16.7 %) were between the ages of 30 and 40; 7 (23.3 %) were between the ages of 40 and 50; and 3 (10 percent) were 50 and over

Table 4. Respondents educational details.

Educational qualification					
		Frequency	Percent	Valid percent	Cumulative percent
Valid	Diploma	6	20.0	20.0	20.0
	First degree	8	26.7	26.7	46.7
	Master ‘s degree	8	26.7	26.7	73.3
	Ph.D.	8	26.7	26.7	100.0
	Total	30	100.0	100.0	

According to the degree of education of the participants utilised in the study as mentioned in Table 4, where 8 (24.7%) have a high school diploma, and 8 (20 %) have a diploma. 8 individuals (26.7%) have a master's degree; 8 participants (26.7%) have a first degree; and 8 participants (26.7%) have a Ph.D.’

Table 5. Respondents work experience.

Work experience in your current organization in years					
		Frequency	Percent	Valid percent	Cumulative percent
Valid	0-1	6	20.0	20.0	20.0
	2-5	8	26.7	26.7	46.7
	6-10	7	23.3	23.3	70.0
	11-20	6	20.0	20.0	90.0
	Above 20	3	10.0	10.0	100.0
	Total	30	100.0	100.0	

According to the study's participants' years of experience as mentioned in Table 5, the majority (8, or 26.7 %), have 2.5 years of experience, and 7 (23.3 %) have 6-to-10-year experience. Six participants (20 %) have 11 to 20 years of experience, six participants (20 %) have 0 to one year of experience, and three responses (10 %) have 20 or more years of experience

Table 6. Respondents material status.

Marital status					
		Frequency	Percent	Valid percent	Cumulative percent
Valid	Single	11	36.7	36.7	36.7
	Married	18	60.0	60.0	96.7
	Divorced	1	3.3	3.3	100.0
	Total	30	100.0	100.0	

The demographic distribution of the participants on the basis of material status as mentioned in Table 6, shows that of the 30 participants, 11 are single (36.7%), 18 (60%) are married and 1 (3.35) are divorced

Vegetation analysis: The vegetation data from the studied area were evaluated using classification and ordering methods as per Wang & Kerre (1996). The classification and order criteria were utilised to assess whether the classification findings were accurately reflected in the floristically categorised main data set and to discover correlations between environmental variables, composition, and plant structure. Finally the two classification methods were utilised for study purpose, one used hierarchical subdivision (Wang & Kerre, 1996), based on statistical data and we used Two-way indicator species analysis (Twinspan) as researcher (Kooch *et al*., 2008), already used for hierarchical divisive population classification based on successive refinement of a single observation axis produced by correspondence analysis (CA) or detrended correspondence analysis (DCA) of a community composition. Twinspan calculates an indicator values index (I) for each split of the site's hierarchical categorization as per generic formula $I_j=(n_j^+)/(n^+) - (n_j^-)/(n^-)$, where n+ and n are the number of places on the (arbitrary) positive and negative ends of the break, correspondingly, and n_j^+ and n_j^- are the number of places on the positively and negatively sides that include pseudo species j, in both.

We also used DECORANA program (ter Braak, 1989), for ordinating multivariate species data and perform correspondence analysis to rank data on the presence or absence of species and detrended correspondence analysis where order axes I and II were used for data interpretation. The compatibility between the two approaches with simplification data was evaluated by overlapping separate categorization groups created by each process on the order of overlays. The Shannon diversity index (H) as per formula $\mathbf{E_H = H / \ln(S)}$, and uniformity index (J) were used to evaluate the species richness of all samples maintained for each species. Taxonomic affluence (S) refers to the total number of species in stock or one place.

Nearly 30 people, including men and women, were questioned to obtain ethnobotanical information. A statistical method was used to calculate the sample size. Data was gathered through semi-structured interviews, group discussions, questionnaires, and study visits. The direct participation of the local population and Hakims in the region was used to conduct the research. This information was later crossed with current literature. For documents and other essential information, the City Council and various authorities were contacted.

Demographic details of respondents in study area: Demographic information includes gender, age 3), education, employment work experience and marital status are explored in this report.

Quantitative analyses of ethnobotanical data: Ethnobotanical data will be used to describe plant sections and processing techniques. Different quantitative indices were utilized as performance indicators as per earlier research (Ashfaq *et al*., 2019), such as Use Value (U.V.), Relative Frequency of Citation (RFC), Informant Consensus Factor (ICF), and Fidelity Level (F.L.).

Statistical Analyses

All acquired data were logarithmically converted to match the ANOVA assumptions, except for the percentage values. The inverse transformation of the sine (arcsine) function was used as per earlier research (Green & Suchey, 1976). Pearson's correlation was used with the MINITAB software package. The matrix also included landscape factors such as plot height and soil properties. Data related to DG Khan's main plants were evaluated using various quantitative indices such as Relative Frequency of Citation (RFC), Use Value (U.V.), Informant Consent Factor (ICF), and Level of Fidelity (F.L.).

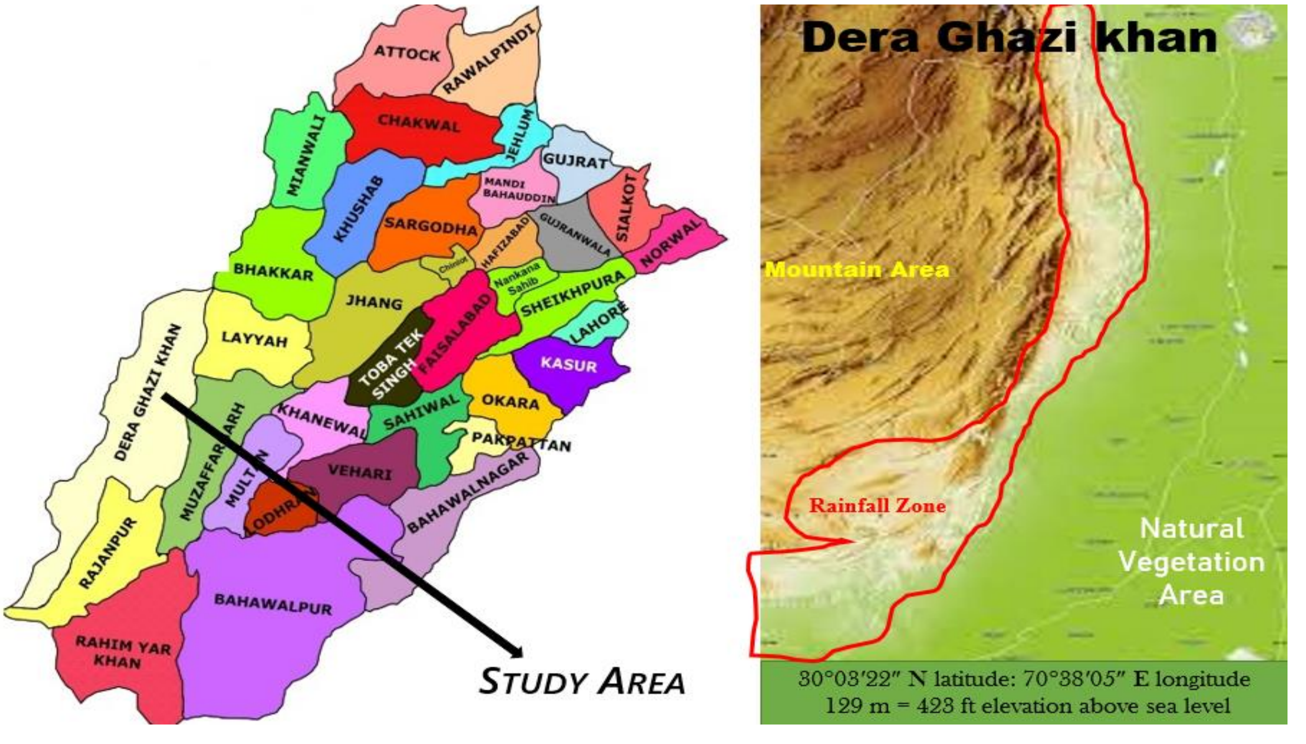

Fig. 1. Study area DG Khan.

Results

Floristic composition: During the field research, 76 species, 62 genera, and 28 families were discovered in the study area. Out of the total families, 61.7% were represented by one species, and the most significant contributing flora was identified as angiosperms dicot and identification of dicot were compared with earlier research of Zafar *et al*., (2021). In contrast, angiosperms monocot contributed less to the floristic richness of the research area as showen (Fig. 2). The Apocynaceae, Asteraceae, Fabaceae and Amaranthaceae families each supplied three species, while Rhamnaceae, Solanaceae and Capparaceae each gave three species were found to be the least species-rich families. In terms of life forms, herbs contributed more than shrubs and trees. *Alhagi maurorum, Rhayzia stricta*, *Nerium oleander*, *Acacia jacquemontii* and *Calotropis procera* are among the significant shrubs.

Vegetation ecology

Floristic richness and diversity of species: Qualitative data were also used to analyse the variety & floral species richness of every random selection. Inside the area of research, Shannon diversity (H) values varied from 2.93 to 2.49, with a high value suggesting high diversity. The estimated species richness (S.R.) range was 19.70 to 9.30, with high values indicating high variety in the unit area. Because DCA axis-1 had a significant negative relationship with species abundance and diversity, the results revealed that species richness decreased as elevation increased throughout the transect. The highest efficiency was obtained at the lowest end of the transect (19.70), while the lowest value was found at the top end (10 species per unit area). The H, B, and D diversity indexes revealed similar elevation patterns, falling as the transect gradient progressed. It was discovered that there is a negative correlation between altitude and diversity parameters.

Classification: The flora roughly follows the topographic pattern. Piedmonts, including high-altitude rocky terrain, mountain Suleman slopes, dunes, and a mesic riparian ecosystem along the Indus River, make up the study area (Alluvial Environment). As the topographical variables vary, the floristic composition progressively transforms. The number of distinct species identified in the study area ranges.

Normal cluster analysis: Three plant correlations have been detected inside the study areas employing conventional hierarchical clustering. The cluster analysis' closest links were blended with the interconnections with very few stands. These linkages are influenced by the kind of soils, geographical strata, and altitude of the location where plant samples were obtained. The quantity and substance of plant relationships were measured at three different levels inside every association.

The separation of *Chlorisbarbata, Chenopodium album, Launaea procumbens, Eragrostis minor, Typha elephantine, Nelumbo nucifera, Eragrostis barrelieri, Enneapogon desvauxii, Phalaris minor, Capparis, Saccharum munja, Euphorbia prostrate, Pongamia pinnata, Saccharum officinarum* and *Aerva persica*. Along the elevation gradients, the clusters identified three types of flora. Three hierarchical groupings emerged as a consequence such as Mesic zone (Association A), Sandy alluvial plains (Association B) and Piedmont zone (Association C). These associations are described as individually.

Association A-mesic zone: *Chenopodium album, Chloris barbata, Eragrostis minor, Euphorbia prostrata, Nelumbo nucifera, Launaea procumbens, Eragrostis barrelieri, Enneapogon desvauxii, Saccharum officinarum, Phalaris minor, Aerva persica, Saccharum munja, Pongamia pinnat* and *Pongamia pinnata*. These species were not found in the other clusters identified by standard cluster analysis. The majority of the species in this group can be found in and around planted or abandoned crop fields. More common species included *Chloris barbata, Nelumbo nucifera, Enneapogon desvauxii, Euphorbia prostrata, Chenopodium album, Launaea procumbens, Eragrostis minor, Acacia nilotica, Typha elephantine* whereas *Eragrostis barrelieri, Phalaris minor, and Saccharum officinarum* were rare. Rare species included *Aerva persica, Saccharum munja, Capparis ducidua* and *Saccharum munja,, Cymbopogon jawarancusa, Demostachya bipinnata, Calotropis procera, Cyanodon dactylon, Ziziphus mauritiana, Alhagi maurorum, Pagnum harmala, Rhayzia stricta, Haloxylon salicornium, Sueda fruticosa, Demostachya bipinnata, Calligonum polygonoides, Leptadenia pyrotechnica, Demostachya bipinn, Techomella undulate, Tamarix aphylla, Cenchrus setigerus* and *Withiana coagulans,* were also found in all three associations, as were *Sacchrum spontaneum, Prosopis juliflora, Capparis cartilagnea, Salsola foetida, Ebenus stellata, Daphne mucronata, Euphor* and *Eclipta prostrate,*. Furthermore, in association A and C, Haloxylon recurvum, Dipterygium glaucum, Ziziphus budhensis, Ziziphus nummuclaria and Prosopis species *specigera* were found.

Soil: The association "A" was determined as being located at a low elevation of 114.3 m utilizing conventional hierarchical clustering (a. s. l.). Because it gets the most drain water from hill torrents, rainwater, and runoff, the soil of this association is rich in micro-and macronutrients. The soil in this relationship has a high amount of soil chemical changes. The soil exhibited the greatest mean E.C. and inorganic material levels from the summit. The soil in this relationship contains the highest concentrations of cations and anions.

Association B-Sandy alluvial plains.

The inclusion of Nerium oleander and Phragmites occidental is absent from all other relationships found by traditional hierarchical clustering and are identified as bioindicators for this species, which distinguishes this relationship. While species such as *Cymbopogon jawarncusa, Demostachya bipinnata, Calotropis procera, Cyanodon dactylon, Zicziphus mausritiana, Alhagi maurorum, Padgnum harmasla, Rhayzia stricta, Haloxyelon salicoranium, Sueda fruticosa, Leptadenia pyrotechnica, Tamari*, *Calligonum polygonoides,* In all associations A and B, *Sacchrum spontaneum, Prosopis juliflora, Capparis cartilagnea, Salsola foetida, Ebenus stellata, Daphne mucronata, Euphorbia granulate, Eclipta prostrate, Farsetia hamiltonii, Panicum hemitonon, Fagonia bruguieri, , salvad Bracharia reptans, Cirsium arvense, Panicum repens, Hertia intermedia, Phyllanthus, Periploca aphylla, Trianthem aportulacastrum, Sophora mollis, Olea cuspidate, Datura stramonium, Tribulus terrestris* and *Cenchrus ciliaris,* were also found in both associations B and C, according to standard cluster analysis.

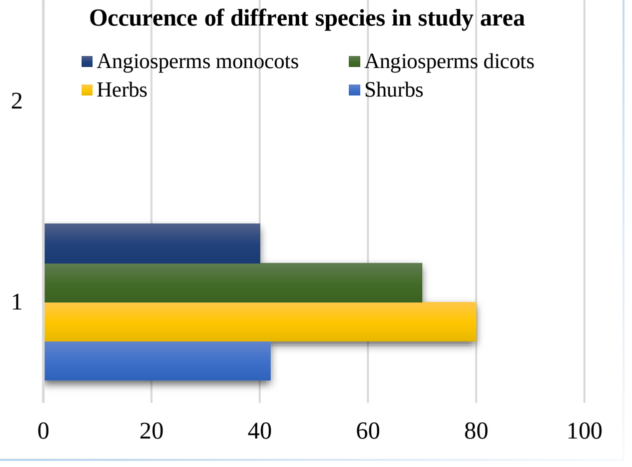

Fig. 2. The figure represents the total counting of angiosperms, monocot and dicot plants as well as the indication of shrubs and herbs found in the study area.

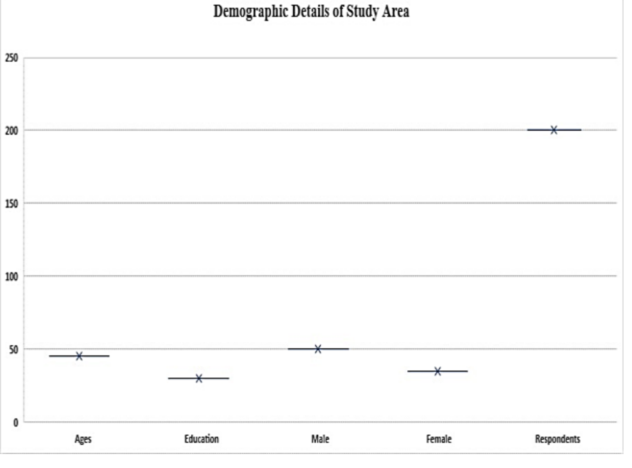

Fig. 3. A total of 200 individuals were interrogated. The original inhabitants made up the overwhelming majority of the 200 respondents. The large majority of people were between the ages of 20 and 50 above. Due to a lack of educational infrastructure in that region, a significant proportion of informants have completed their ten-year education (69.5%). The majority of the informants preferred to communicate in Punjabi and Urdu regularly. A sizable proportion of participants (55%) were male rather than female (45%).

Soil: Association "B" was discovered at an elevation of 147.21 m (a.s.l.) via normal cluster analysis, which was somewhat higher than association A. The soil in this relationship had moderate soil chemical reaction values. The E.C. and organic matter levels in the soil were both averages. Compared to Association A and Association C, this association's soil contains intermediate cation and anion values.

Association C-piedmont environment: *Heliotropium eichwaldi, Bothriosperum tenellum, Dichanthium annulatum, Scirpus maritimus, Gymnosporia royleana, Citrulus colocynthis, Acacia modesta, Piper longum*, and *Acacia jacquemontii*, that were not present from all other associations demonstrated by normal cluster analysis, characterized this association. Common species included *Heliotropium eichwaldi, Bothriosperum, Dichanthium annulatum, Scirpus maritimus, Gymnosporia royleana*, and *Acacia jacquemontii*, while rare species included *Acacia modesta. Haloxylon recurvum, Depterygium glaucum, Ziziphus budhensis, Ziziphus nummuclaria*, and *Prosopis specigera* were also found in association A and C, as indicated using standard cluster analysis. Similarly, *Hertia intermedia, Bracharia reptans, Periploca aphylla, Panicum repens, Sophora mollis, Phyllanthus niruri, Datura stramonium, Trianthema portulacastrum, Cenchrus ciliaris, Tribulus terrestris*, and *Olea cuspidate* were found in both associations B and C using conventional cluster analysis.

Soil: This association is situated at an altitude of 809.85 metres above sea level, has a lot of topographic diversity, and was isolated using standard cluster analysis. Soil has less edaphic qualities in terms of structure and chemicals. The bulk of the sampling stands was in the stony desert zone, and the plant type exhibiting lithospheric site preferences was validated. Compared to the remainder of the associations A and B, the soil had the lowest mean levels of E.C. and organic matter. Cations and anions soluble in soil were at their lowest levels. The species in this interaction favoured a low pH and fewer cations and anions.

Ordination: Informally describing the repercussions of ordination in broad generalities is difficult. The ratings appear to be more akin to the non-continuous nature of vegetation and the classification-based grouping. As a result, it's simple and profitable to use ordination to characterize the essential properties of the stands and species connected with ordination.

DCA was used to analyze the entire data set. The first four DCA axes have Eigenvalues of 0.785, 0.377, 0.137, and 0.088, respectively. In the current situation, species that dwell on sandy substrates have low axis-1 scores, while species that reside in rocky environments have high scores, and species that live in alluvial plains are in the centre.

The significant positive relationship between DCA axis-1 and elevation implies that as the axis value score increased, the altitude likewise increased. As the height increased, the significant stigma between DCA axis-1 scores and soil conductivity suggested that E.C. decreased. As the score along DCA axis-1 rises, the E.C. of the substrate falls. According to the results, species such as *Chenopodium album, Chloris barbata, Eragrostis minor, Euphorbia prostrate, Typha elephantine, Launaea procumbens, Nelumbo nucifera, Eragrostis barrelieri, Acacia nilotica, Enneapogon desvauxii, Saccharum officinarum, Phalaris minor, Aerva persica, Saccharum munja* It's possible that *Pongamia pinnata* increased as soil cations and anions decreased.

A huge number of species emerged as a result of the area's specialization. Component species with a low land relationship (A) *Chenopodium album, Chloris barbata, Eragrostis minor, Euphorbia prostrate, Nelumbo nucifera, Launaea procumbens, Acacia nilotica, Typha elephantine, Eragrostis barrelieri, Enneapogon desvauxii, Saccharum officinarum, Phalaris minor, Aerua persica, Saccharum mun*, On alluvial plains, *Rhayzia stricta, Haloxylon salicornium, Sueda fruticosa, Leptadenia pyrotechnica, Calligonum polygonoides, Techomella undulate, Tamarix aphlla, Cenchrus setigerus, and Withiana coagulans ran*, and *Heliotropium eichwaldi, Bothriosperum tenellum, Dichanthium annulatum.*

Table 7. The detail of identified species and their families with accumulated percentage of existence.

Sr. No.	Identified family name	Number of identified species	Percentage
1.	*Acanthaceae*	3	1.65
2.	*Asteraceae*	20	11
3.	*Papilionaceae*	9	4.95
4.	*Cactaceae*	3	1.65
5.	*Poaceae*	4	2.2
6.	*Lamiaceae*	5	2.75
7.	*Amaranthaceae*	6	3.3
8.	*Rosaceae*	4	2.2
9.	*Apiaceae*	6	3.3
10.	*Solanaceae*	11	6.06
11.	*Chenopodiaceae*	8	4.4
12.	Euphorbiaceae	5	2.75
13.	Malvaceae	3	1.65
14.	Asclepiadaceae	7	3.85
15.	Portulaceae	2	1.1
16.	Zygophyllaceae	4	2.2
17.	*Mimosaceae*	11	6.06
18.	*Polygonaceae*	4	2.2
19.	*Geraniaceae*	2	1.1
20.	*Nyctaginaceae*	2	1.1
21.	*Salvadoraceae*	2	1.1
22.	*Boraginaceae*	6	3.3
23.	*Convolvulaceae*	2	1.1
24.	*Caesalpiniaceae*	9	4.95
25.	*Meliaceae*	2	1.1
26.	*Liliaceae*	6	3.3
27.	*Moraceae*	4	2.2
28.	*Tamaricaceae*	2	1.1
29.	*Apocynaceae*	3	1.65
30.	*Myrtaceae*	2	1.1
31.	*Cactaceae*	2	1.1
32.	*Capparidaceae*	4	2.2
33.	*Tamaricaceae*	2	1.1
34.	*Palmaceae*	3	1.65
35.	*Rubiaceae*	1	0.55
36.	*Brassicaceae*	1	0.55
37.	*Violaceae*	1	0.55
38.	*Sapindaceae*	1	0.55
39.	*Pedaliaceae*	1	0.55
40.	*Zingiberaceae*	1	0.55
41.	*Rhamnaceae*	1	0.55
42.	*Lauraceae*	1	0.55
43.	*Fumariaceae*	1	0.55
44.	*Resedaceae*	1	0.55
45.	*Ficoidaceae*	1	0.55
46.	*Oxalidaceae*	1	0.55
47.	*Aizoaceae*	1	0.55
48.	*Sapindaceae*	1	0.55
49.	*Cannabinaceae*	1	0.55
50.	*Bignoniaceae*	1	0.55
51.	*Frankeniaceae*	1	0.55
52.	*Oleaceae*	1	0.55
53.	*Berberidaceae*	1	0.55
54.	*Cucurbitaceae*	1	0.55
55.	*Verbenacea*	1	0.55

Despite growing substrate, water accessibility had a substantial influence on the DCA-axis I. The aridity increased as one proceeded from the right to the left side of the canyon. The spatial distribution of species along the DCA-axis I is influenced by soil chemistry. As the score along the ordination axis-I grows, the concentration of bivalent cations such as Ca+2 and Mg+2 decreases. The rocky zone of the transect has lower cations and anions than the stony and partially sandy alluvial plains. The discrepancy is most likely due to geological distribution, sufficient to prevent species dispersal. *Heliotropium eichwaldii, Bothxriosperum tenellum, Dichanthium annulatum, Scirpus masritimus, Gymnosporia royleana, Citrulus coloecynthis, Accacia modesta, Pipper lonegum,* and *Acacia jacquemontii* were all rocky-area species that were not found on the alluvial plains. Elevation, pH, and organic matter all impacted the ordination axis-II. Organic matter rises when scores on the ordination axis-II drop. There was a lot of biological detritus in the persistently coarse water towards the bottom. The association "C" was found to sustain site-specific species that can survive at high altitudes with restricted nutrient sources, and these species were completely missing from the alluvial plains. In addition, when one goes from the bottom to the top, the pH drops, which is highly connected to axis 1. As a result of the dilution, the pH value of the water stream was the lowest, as were the readings at high elevation.

Identifications of important plants: Over 185 plants were identified, which were split into 52 families. The most usually cited families were Solanaceae (20 species) and Asteraceae (20 species). The most frequent life form was herbs (51%). The leaves (68 %) were the most extensively employed plant part, followed by the whole plant (65%), and extraction was the most common form of administration (50%). Fresh plant material was used to make herbal medicines in the past. According to the literature, several species have been identified, each with its unique medicinal qualities.

Demographic data of this study: Five field visits to collect ethnomedical knowledge on = plants were conducted (to account for seasonal fluctuations). A field study is undertaken from June 2019 through March 2020. A total of 200 participants were questioned and exploratory details is shown (Fig. 3).

Discussion

Dera Ghazi Khan, Pakistan is a study area which is notable for its alluvial plains and practically fertile soil (Ahmad & Qadir, 2011). Furthermore, cultivated plant species such as fruits, vegetables, and staple crops are regularly grown in this environment. This region is usually supplied with water through tube-well from subterranean water, as subsurface water is suitable for vegetative development across this sector. Soil nutrient content was found to be almost comparable between streams and along lateral gradients of water flow canals. A total of 76 species were anticipated in the current study, which was done in the piedmont and riparian habitats of Dera Ghazi Khan District, Punjab, from March-April 2018-2019. *Brachiaria reptans* (L.), *Aristida adscensionis* (L.), *Cenchrus setiger*

(Vahl.), *Cenchrus ciliaris* (L.), *Cymbopogon jawarancusa* (Schult.), *Chloris barbata* (Sw.), *Cynodon glabratus* (Steud.), *Cynodon dactylon* (L.), *Stapf. Dichanthium* (Hochst.), *Stapf., Enneapogon persicus* (Boiss.), *Panicum hemitomon* (Schult.), *Eragrostis barrelieri* (Wolf.), *Phalaris minor* (Retz.), *Panicum repens* (L.), *Saccharum munja* (Roxb.), *Phragmites australis* (Cav.), *Saccharum spontaneum* (L.), *Saccharum* except for specific areas where the soil composition was not suitbale, the plant families and species listed in *Amaranthaceae, Fabaceae, Asteraceae, Poaceae,* and *Apocynaceae* were the dominant and important families contributing to the native flora, result as per mthced with Fongod *et al*., (2014), while *Boragenaceae, Polygonaceae, Chenopodiaceae,* and *Cucrbitaceae* were negligible and had a smaller number of species result matched with earlier research (Hussain *et al*., 2016). It was also discovered that the distribution patterns of these plant groupings matched those previously determined by several studies (Jan *et al*., 2017; Ahmad *et al*., 2021) in the surrounding area, Pakistan's piedmont and alluvial plains are also investigated as per earlier research (Pourrut *et al*., 2011). As per our results the climatic changes and interactions with biotic variables, vegetation diversity has resulted in a diverse range of plants and occupants inhabiting comparable habitats and communities as per same investigation our results are highly comparable with earlier research (Montoya & Raffaelli, 2010; Pugnaire *et al*., 2019; Vandvik *et al*., 2020). Based on habit type, herbaceous plant growth firms make up more than half of all species (55.26%). Our findings are also consistent with previous research (Tao *et al*., 2021) undertaken by several plant ecologists across Pakistan's diverse geographical zones. Herbaceous plants (55.26%) were the most prevalent living form in the alluvial environment of the research region.

This study showed a comprehensive link between two height zones. The relationships were proved via quantitative analysis, demonstrating that these vegetation species groups are not formed at randomly and our result match with earlier research (Lundholm, 2015). Our results also demonstrated that all little variations in climatic conditions and altitude have a significant impact on the creation of community composition boundaries, which are determined by soil cations and anions exchange capacity, height, soil chemical characteristics, and chemical reactions (pH). According to DCA research analysis, altitude, soil chemical reactions (pH), electrical conductivity, and bicarbonates all have a substantial influence on species distribution and community composition. The previous study (Moffett *et al*., 2010; Nottingham *et al*., 2018), discovered a consistent pattern of vegetation zones influenced by edaphic variables, implying that the two locations are identical. Naturally, ordination along environmental gradients from the bottom to the top of the longitudinal effects neighbourhood diversity (Usseglio-Polatera & Beisel, 2002); it has the strongest positive association with elevations and is associated with the three floristic categories of communities revealed by cluster analysis and detail of enlivenment gradient and short ecological gradient are mentioned in (Fig. 4). While it is apparent that high heights have poor nutrition levels, they are also associated with nutrient loss and downhill slope torrents.

An integrated framework of plant structure and function is dependent on the amount of above-ground vegetation (Weigelt *et al*., 2021), which is more constant owing to some psychological processes, and this is fully dependent on regional climatic and edaphic conditions. The competitive impacts and responses of a guild of temperate plant species, as well as the productivity of temperate broad-leaved forest stands with varying tree species variety, were investigated. *Peganum hermala, Fagonia indica, Suaeda fructicosa, Rhazya stricta, Withania coagulens* and *Tribulus terristris,* were the most abundant perennial life span species in the soil in Dera Ghazi Khan's upland (arid) area. However, the soil of the flat alluvial plains (mesic) area has the greatest diversity of annual life span plants such as *Fumaria indica, Chenopodium album, Melilotus albus,* and *Medicago denticulata.* The xeric type of vegetation's Dera Ghazi Khan's soil is plentiful in the piedmont (upland area) as per earlier research (Gulshan *et al*., 2012), but the mesic type of Dera Ghazi Khan's soil were largely retrieved from the alluvial plain (low land area). As per our results we also explored that Dera Ghazi Khan's soil demonstrates the occurrence of distinct species in rare, frequent, abundant, and variable abundance (Hussain, 2009). The beatifical species known Acacia Modesta was much in the piedmont region, whereas Acacia nilotica was discovered in the alluvial plains of Dera Ghazi Khan. Mesic environment species include *Fumaria indica, Euphorbia helioscopia, Vicia sativa* and *Melilotus albus* are also investigated in study area. Due to its topographic variety, Dera Ghazi Khan is rich in flora, notably medicinal herbs, which the local people use for herbal tea, applications, and decoctions. This region has never had ethnomedicinal plant research before; therefore, it was chosen for this one. Plants were identified based on information supplied by the local people and Hakims who practise ethnomedicine.

In (Fig. 5), the individuals species and their families are indicated with different colour coded range and details of all families are presented with percentage of occurrence like *Acanthaceae* (03), *Asteraceae* (20), *Papilionaceae* (09), *Cactaceae* (03), *Poaceae* (04), *Lamiaceae* (05), *Amaranthaceae* (06), *Rosaceae* (04), *Apiaceae* (06), *Solanaceae* (11), *Chenopodiaceae* (08), Euphorbiaceae (05), Malvaceae (03), Asclepiadaceae (07), Portulaceae (02), Zygophyllaceae (04), *Mimosaceae* (11), *Polygonaceae* (04), *Geraniaceae* (02), *Nyctaginaceae* (02), *Salvadoraceae* (02), *Boraginaceae* (06), *Convolvulaceae* (02), *Caesalpiniaceae* (09), *Meliaceae* (02), *Liliaceae* (06), *Moraceae* (04), *Tamaricaceae* (02), *Apocynaceae* (03), *Myrtaceae* (02), *Cactaceae* (02), *Capparidaceae* (04), *Tamaricaceae* (02), *Palmaceae* (03), *Rubiaceae, Brassicaceae, Violaceae, Sapindaceae, Pedaliaceae, Zingiberaceae, Rhamnaceae, Lauraceae, Fumariaceae, Resedaceae, Ficoidaceae, Oxalidaceae, Aizoaceae, Sapindaceae, Cannabinaceae, Bignoniaceae, Frankeniaceae, Oleaceae, Berberidaceae* , *Cucurbitaceae* and *Verbenaceae*, are most commonly found in study area. The detail of identified individual species and their families are mentioned in (Table 7).

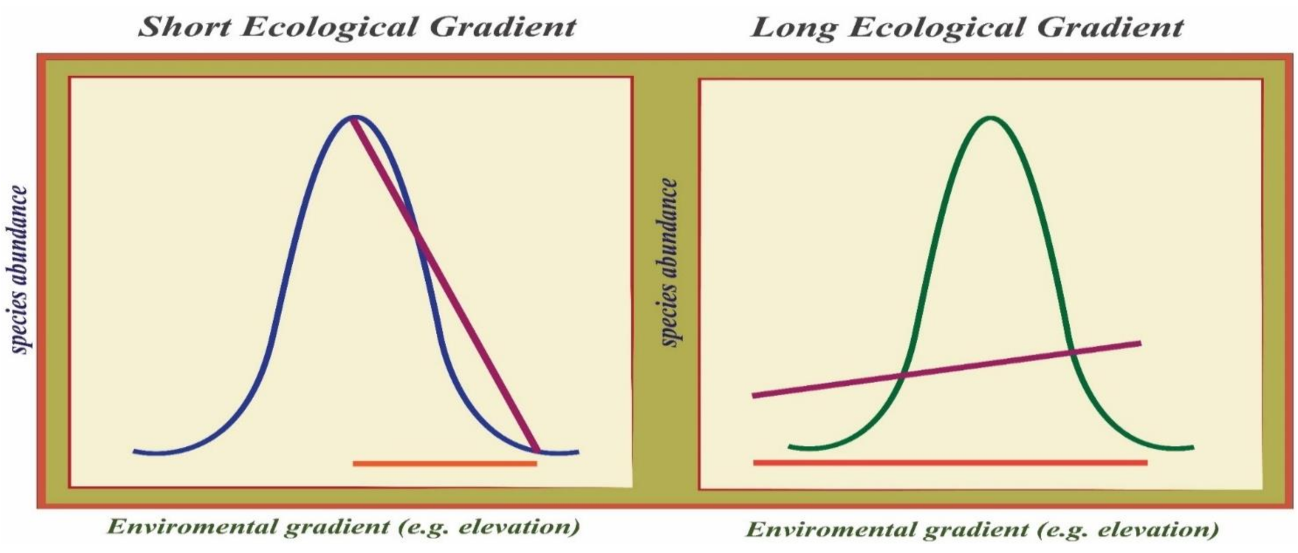

Fig. 4. Ecological gradient: The negative relationships between pH support this theory, E.C., N, Ca, Na, and Mg. This statement also lends credence to the notion that each species has its own features. Plants and their responses to ecological adaptation in a region with dramatic climatic changes were impacted by environmental factors, resulting in the floristic makeup of all three groups. The research area's edaphic variation is little known, and Pakistan's detailed species composition reacts to elevation gradients.

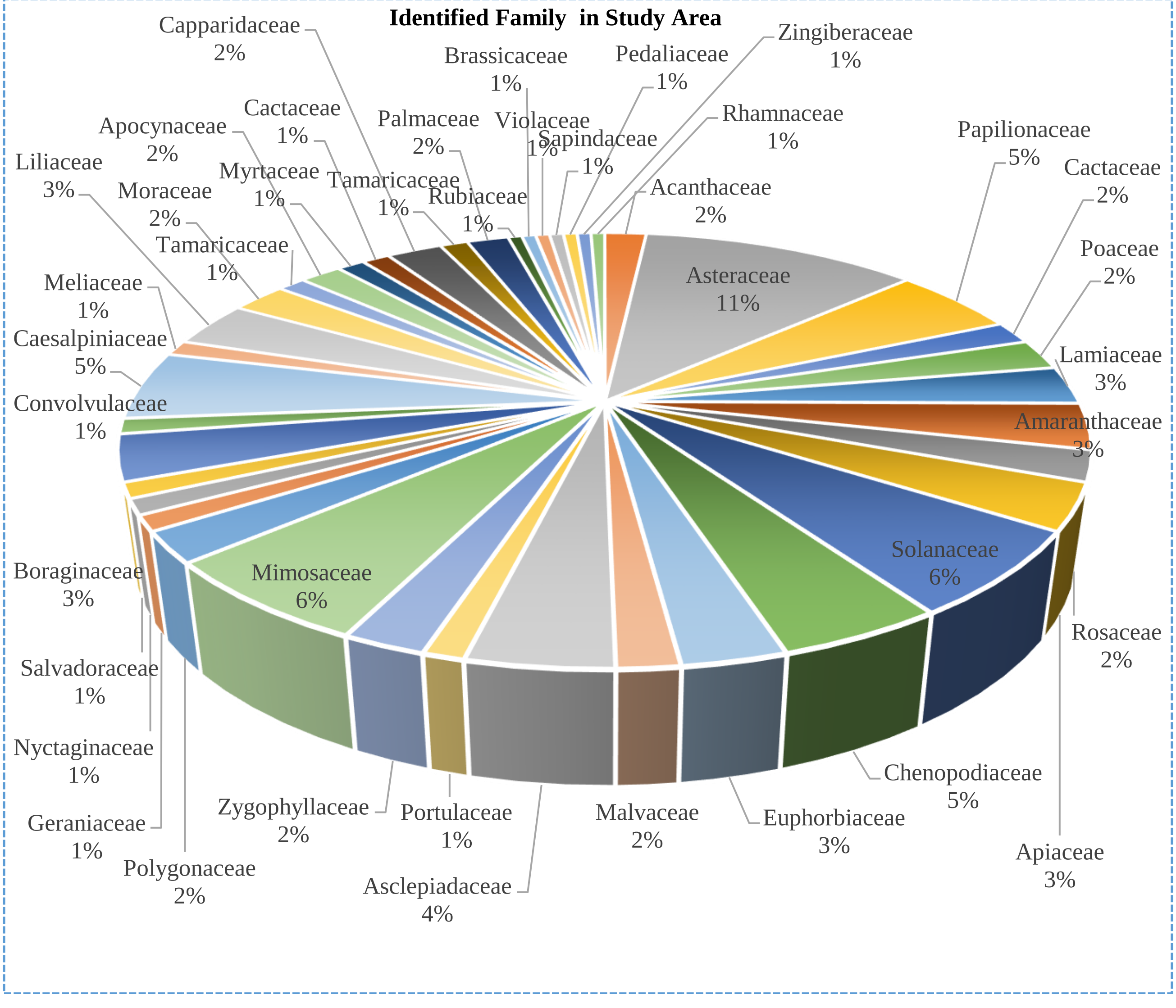

Fig. 5. The family identified in D.G khan area; The ethnomedicinal research was based on 189 plant species from 52 families collected from various parts of DG Khan. The Monocots were represented by three families, while the remaining 49 represented the Dicots.

Conclusion

The current study effort in District D.G. Khan has identified the quantity and composition of communities in two historical locations, Piedmont and Riparian habitats, at various altitudinal inclines. The most significant source of habitat for floral variation is topographically diversified landscapes. According to our data, species diversity is also dramatically reduced at high altitudes compared to low altitudes. According to an ethnobotanical study, rural communities still employ plants in everyday life. This study sets the foundation for the long-term preservation of native flora. Phytochemical and medical research can benefit from plants with high ICF, U.V., and F.L. This insight might open the door for new plant-based commercial medications to be developed.

Recommendations and suggestions

According to the present study, District D.G. Khan is located in the Suleman mountain range and is extremely rich in floral variety. Plants provide food, fuel, lumber, fodder, and medicines to the population of this region daily. Based on the findings and conclusions, we may offer the following recommendations and suggestions:

1. Local and native species should be managed to improve this area's ecology and nutrient cycle.
2. For the first time in Pakistan, extensive ecological and morphological examinations of plant species.
3. For the first time in Pakistan, extensive ecological and morphological examinations of plant species.
4. Tree species in the research area with little or poor regeneration require immediate 5. care to ensure survival.
5. Give natural species, particularly woody plants, more time to thrive.
6. Alternative fuelwood choices should be made accessible, such as natural gas and liquefied petroleum gas.
7. Because they are the genuine owners of natural resources and residents of the area, local people should be actively involved in increasing awareness about wild vegetation protection through social, print, and electronic media.
8. Through electronic or print media, natives should be aware of the importance of local biodiversity, habitat conservation, and the consequences of natural resource depletion.
9. By supporting and encouraging indigenous populations to preserve endangered species through various extensions Based on our findings, future biodiversity conservation and management efforts should aid taxonomists, ethnobotanists, ecologists, and conservationists in their research initiatives worldwide. Much work connected to flora documentation, Phyto diversity, and seed banks were published from time to time

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