

**Assessment of floristic diversity, biological spectrum and conservation prioritization of plant communities in Urban and Peri-urban areas of Ganderbal, Kashmir**

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(MSF-2021-139)



**Division of Natural Resources Management**

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**Sher-e-Kashmir University of Agricultural Sciences &  
Technology of Kashmir**

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**Assessment of floristic diversity, biological spectrum and conservation prioritization of plant communities in Urban and Peri-urban areas of Ganderbal, Kashmir**

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Forest Resource Management**

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*Dedicated*

*To my  
Beloved  
Mother*



**Sher-e-Kashmir**  
**University of Agricultural Sciences and Technology of Kashmir**  
**Division of Natural Resources Management,**  
**Faculty of Forestry, Benhama, Ganderbal**

**Certificate – I**

This is to certify that the thesis entitled, “**Assessment of floristic diversity, biological spectrum and conservation prioritization of plant communities in Urban and Peri-urban areas of Ganderbal, Kashmir**” submitted in partial fulfilment of the requirements for the award of the degree of **Master of Science (Forestry) Forest Resource Management**, to the **Faculty of Forestry, Sher-e-Kashmir University of Agricultural Sciences and Technology of Kashmir** is a record of bonafide research work carried out by **Ms. Baria Ashraf (Regd. No. MSF-2021-139)** under my supervision and guidance. No part of the thesis has been submitted for any other degree or diploma.

It is further certified that information received during the course of investigation has duly been acknowledged.

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**ABSTRACT**

The present investigation entitled “Assessment of floristic diversity, biological spectrum and conservation prioritization of plant communities in Urban and Peri-urban areas of Ganderbal, Kashmir” was carried out during the Year 2022 and 2023. The study was conducted to explore tree diversity, life form, leaf spectrum. The vegetation analysis was conducted in nine wards of Municipal Committee of Ganderbal and in nine different peri-urban areas which were within the 1-2 km vicinity of wards. Trees, shrubs and herbs were sampled randomly by 10 m x10 m, 5 m x 5m and 1m x1 m quadrants respectively. This study revealed that the floristic diversity consisted of 115 species belonging to 50 families including 101 dicots, 8 monocots and 6 gymnosperms. Asteraceae (11.304 %), Rosaceae (9.565 %), Leguminosae (6.087 %) and Amaranthaceae (5.217 %) were the leading families. Moreover, it's important to highlight that Prunus and Rosa stood out as the two most diverse genera in terms of the number of species, each consisting of three species. In the course of this study, two species were

recognized as endemic, with an additional 12 species classified as native to the study area. In conclusion, the comparative analysis of plant biodiversity between urban and peri-urban regions revealed a greater diversity of tree, shrub, herb, sub-shrub and climber species in urban settings, highlighting the impact of urbanization on the richness and composition of plant life.

The findings indicate that among the 115 plant species surveyed, trees constituted 25.22 %, shrubs accounted for 19.13 %, sub-shrubs and climbers each comprised 1.74 %, palm species constituted 0.87 %, while herbs dominated with 51.30 %, emphasizing the substantial prevalence of herbaceous vegetation in the studied area. The species when compared to Raunkiaer's life form system (1934) revealed the preponderance of therophytes (34.78 %) followed by nanophanerophytes (17.39 %) thus indicating thero-phanerophytic type of phytoclimate. Microphylls (34.78 %) and simple (66.09 %) were found to be high in the leaf size spectrum and leaf lamina type. It was concluded that the dominance for therophytes over other life-forms is due to response to the harsh climate and anthropogenic pressure on the flora of urban and peri-urban areas.

The degradation of habitats and excessive exploitation has led to biodiversity loss, underscoring the urgency of prioritizing communities and habitats for conservation. Prioritizing communities and habitats are essential for initiating effective conservation and management programs, requiring both quantitative and qualitative evaluations of vegetation. Therefore, an attempt has been made to; (i) identify the communities and habitats; (ii) evaluate them for species richness, native, endemic, economically important and threatened species; (iii) prioritize communities and habitats for conservation. Seven (07) distinct plant communities and Six (06) distinct habitats were recorded. Within the diverse array of communities, those involving *Juglans regia* - *Ailanthus altissima*, *Aesculus indica* - *Juglans regia*, *Platanus orientalis* and *Populus deltoides* exhibited the most elevated Conservation Priority Index (CPI), attaining a score of 46 each. Among the habitats, the Garden Area habitat demonstrated the greatest Conservation Priority Index (CPI) at 40, closely trailed by the Shady Moist and Riverine habitats, both registering a CPI of 38. Hence, consistent monitoring of communities and habitats possessing elevated Conservation Priority Index (CPI) values is essential for their efficient and successful management.

**Key words:** Floristic Diversity, Biological Spectrum, Urban, Peri-urban, Conservation Priority Index.

Signature of Student

Dated \_\_\_\_\_

Signature of Major Advisor

Dated \_\_\_\_\_

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*Place: Benhama, Ganderbal*

***Baria Ashraf***

*Dated: \_\_\_\_\_*

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## Chapter-1

### INTRODUCTION

The term "biodiversity," initially coined as the full expression "biological diversity" by Lovejoy (1980), is commonly employed to refer to the variety of species, a usage that gained prominence around 1980 when Norse and Mc Manus provided its first definition. The abbreviation 'biodiversity' was later introduced by Walter G. Rosen in 1985 during the inaugural planning meeting of the 'National Forum on Biodiversity' held in Washington D.C. in September 1986, as documented by UNEP in 1995. According to its definition, it is "the variability among living organisms from all sources, including, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are a part; that includes diversity within species, between species and among ecosystems" (CBD, 1992). Recognizing that traditional methods of classifying and separating, species were insufficient, others expanded the definition by including the diversity and variability of living organisms.

DeLong (1996) provided a more thorough definition, saying that "biodiversity" is an attribute of a place that specifically refers to the variety within and among living organisms, assemblages of living organisms, biotic communities and biotic processes, whether they are present naturally or have been influenced by humans. Biodiversity can be quantified in terms of genetic diversity, identity and number of distinct types of species, assemblages of species, biotic communities, biotic processes and the amount (such as abundance, biomass, cover and rate) and structure of each. It can be observed and measured at any spatial scale, from individual microsites and habitat patches to the entire biosphere. Forest ecosystem biodiversity includes the variability of life present in all its form i.e., from bacteria to higher plants and animals and at all levels of organisation from genes to ecosystems as well as the structure, functioning and ecological processes present at each of these levels of organisation (Norberg *et al.*, 2001). Thus, biodiversity has multidimensional aspect, for instance, compositional,

structural and functional diversity (Roy *et al.*, 2004; Norse *et al.*, 1986; Roy and Srivastava, 2012). Furthermore, biodiversity is the natural capital and ecological infrastructure that fosters economic growth, social development and human well-being.

Over 3.5 billion years, speciation, extinction, migration and more recently human influences which can be explained at many hierarchical levels—have changed the distribution and size of the biodiversity that exists today. For a long time, ecologists have been interested in a wide range of topics, including the diversity of species, quantifying the diversity of species and analysing the theories about its formation. The most conventional and often used indicator of biodiversity is the number of species, also known as species richness (Purvis and Hector, 2000). Species richness is just one element of biodiversity, which is simply the number of species present in a given ecosystem, region or location. Although species richness and species diversity are commonly confused, the technical definition of species diversity considers both species richness and species evenness. When evaluating the relative conservation values of habitats or landscapes, the presence of numerous species is frequently employed as a criterion. However, species richness is blind to the identity of the species (Fiedler and Jain, 1992).

Species diversity is one of the most crucial indicators for assessing and evaluating the sustainability and stability of forest communities. Knowledge of the forest species composition is vital for its sensible management in terms of economic value, regeneration capacity (Wyatt and Smith, 1987) which could eventually result in preservation and proper maintenance of biological diversity (Verma *et al.*, 1999). Understanding the composition, organisation, change and growth of communities is aided by the study of species diversity (Li *et al.*, 2002). Moreover, species diversity is influenced by several environmental factors (Gaston, 2000; Lan, 2003; Tang *et al.*, 2004) especially by the altitudinal gradient which affects species composition and structure (Whittaker, 1972).

Floristic diversity refers to the variety of plants that are present in a certain region at a particular period of time. In order to assess the diversity status and ensure biodiversity conservation, a floristic inventory and diversity assessment are required. Understanding species diversity and distribution patterns is essential for assessing the structural complexity and resources of that region (Kumar *et al.*, 2002) which is important for human survival, economic prosperity and for the function and stability of ecosystem (Singh, 2002). Biodiversity is assessed on both a spatial and temporal level. Without a thorough evaluation of floristic diversity at all three levels, including genetic, species and ecosystem (community and habitat) diversity, it is difficult to formulate or adopt any conservation policies and legislations (Pitchairamu *et al.*, 2008). Thus, plant diversity studies are needed to evaluate the composition and richness of the vegetation at a given site.

According to Warming (1909), a life-form is a representation of the harmony between a plant and its environment since it represents the total of a specie's adaptive characteristics. Depending on where the bud is in respect to overwintering strategies, life forms are defined (Blasi *et al.*, 1990). Following Raunkiaer's method, Mueller-Dombois and Ellenberg (1974) divided the species into life forms. The woody plant species were categorised into phanerophyte life-form, while the herbaceous plant species to the non-phanerophyte life-form (Abusaief and Dakhil, 2013). There are five broader groups in the classification proposed by Raunkiaer: phanerophytes, chamaephytes, hemicryptophytes, cryptophytes and therophytes, which are organized according to higher protection of the renewing buds. Mueller-Dombois and Ellenberg (1974) adjusted Raunkiaer's classification to include plant traits in the favourable season (Tanvir *et al.*, 2014).

The biological spectrum is used to compare plant communities that are widely separated geographically and express the percentage of life-forms present in a specific flora (Raina and Sharma, 2010). Raunkiaer (1934) developed the phrase "biological spectrum," which also determine stratification patterns, type of

phytoclimate and stratification of biotic communities (Gazal and Raina, 2015). In different regions of the world, occurrence of similar biological spectra indicates similar environmental condition as well as the micro and macro climate that dominate the area (Hussain *et al.*, 2015). Plants are divided into life-forms, which are the result of adaptations to the predominate climatic circumstances, based on similarities in structure, function and ecological requirements. After floristic composition, life forms are significant physiognomic characteristics that indicate the harmony between plants and their surroundings and are employed in vegetation research (Shimwell, 1971; Warming, 1909). Similarly, leaf size spectra of a region are useful, for studying the plant associations in response to numerous prevailing environmental conditions. Therefore, leaf size can be useful in assessing vegetation at the regional level since it gives a sense of floristic adaptation (Rashid *et al.*, 2011).

India is one of the world's known megadiverse nations, harbouring almost 7-8 % of the worlds recorded species on just 2.5 percent of the planet's territory and holding 4 of the 34 internationally recognised biodiversity hotspots (Himalaya, Indo-Burma, Western Ghats and Sri Lanka, Sundaland). India is also home to a large repository of traditional knowledge about biological resources. By conducting ongoing surveys and exploration, inventories of floral and faunal diversities are being gradually updated with a number of new findings. In addition to its species richness, India also has a high proportion of endemic species. Additionally, India is regarded as one of the eight Vavilovian centres of origin and diversity of agricultural plants, with more than 300 wild species serving as near relatives and ancestors to domesticated plants that are still evolving in their natural habitat. India is one in every of the world's most biologically and culturally numerous countries additionally well-endowed, with 10 distinct bio geographic zones. India has tremendous diversity, genetic furthermore as of species and ecosystems. This diversity may be seen in the wide range of landforms and climatic conditions that are present in ecosystems from the

tropical to the temperate and from the alpine to the desert. India also features a variety of wetland environments, from hot, humid coastal regions to high altitude, cold deserts, with a variety of flora and fauna (MoEF, 2014). However, the adverse effects of human impacts on biodiversity are increasing dramatically and threatening the foundation of sustainable development. Habitat fragmentation brought on by human activity is the main issue causing biodiversity loss, followed by climate change, nitrogen loading and biotic exchanges (Sala *et al.*, 2000).

Urban forestry is the systematic study, observation and management of urban forests, or tree populations in urban areas, with the goal of enhancing urban environments. The term "urban forest" refers to all publicly and privately owned trees that are situated within an urban area, including individual trees along streets and in backyards as well as stands of remnant forest (Nowak *et al.*, 2001). Numerous advantages of trees in urban areas include public aesthetic appeal, root erosion prevention, improved air quality, wind break, shelter belt, protection of water flow, carbon sequestration, amelioration of harsh weather conditions, provision of raw materials to the wood industries, preservation watershed, provision of leisure facilities and home garden as food. Urban forest provides multiple tangible environmental advantages that are frequently unrecognised as reported by McPherson and Simpson, 1999.

Urbanisation is a dynamic and complicated process that occurs at several spatial and temporal scales (Grimm *et al.*, 2008). Cities had often been compacted and had concentrated populations. Today's modern cities are getting bigger and bigger. Urban regions around the world are growing on average twice as quickly as urban populations (Angel *et al.*, 2011). In addition to growing physical expansiveness, peri-urbanisation characterises urban land change. In this process, rural areas that are close to or far from urban centres are engulfed by or changed into extended metropolitan regions (Simon *et al.*, 2004). As a result, contemporary and industrial land uses and governance systems sharply contradict traditional and agricultural land uses. As a physical phenomenon, peri-

urbanisation is the process of transforming agricultural land, pastures and forests into urban areas. In developing nations, notably in Asia and Africa, peri-urbanisation is the most common kind of urban growth and development, with varying characteristics between nations and regions. As a result, rapidly urbanising places have one of the most intricate mosaics of different land uses and land covers of any landscape.

The forests of Himalayas, especially the forests of J&K, are currently under a number of threats and are ranked among the most threatened in the world (Shaheen *et al.*, 2012). Although the forests of this region are of great ecological and economic importance, they are increasingly facing threats such as land-use change, urbanization, habitat loss and fragmentation, introduction of invasive alien species, overgrazing, deforestation, fire, overexploitation of forest resources. The need for the economically significant biodiversity is rising quickly along with the human population. One of the ongoing issues contributing to the degradation of forests is the removal of plants used for fuel and fodder (Singh, 1998). Such practices are disseminating the moisture loving species and encourage the hardy species that are least valuable for the society. Continuing threats make it important to identify and prioritize biodiversity components at local, regional and global levels (Sharma *et al.*, 2014).

Keeping in view the importance of biodiversity in urban areas, present study entitled “**Assessment of floristic diversity, biological spectrum and conservation prioritization of plant communities in Urban and Peri-urban areas of Ganderbal, Kashmir**” was conducted with the following objectives:

1. Assessment of floristic diversity and biological spectrum in Urban and Peri-urban areas of Ganderbal.
2. To study the conservation prioritization of forest communities and habitats in Urban and Peri-urban areas of Ganderbal.

## Chapter-2

### REVIEW OF LITERATURE

The chapter review of literature essentially identifies the strengths and limitations of the current text, wherein previous research is analysed, explored and thereby offering comprehensive and critical overview of the existing studies in the support of the present topic. Keeping in view the multiple perspective of the study entitled **“Assessment of floristic diversity, biological spectrum and conservation prioritization of plant communities in Urban and Peri-urban areas of Ganderbal, Kashmir”** efforts have been made to review the literature under the following three headings:

- 2.1 Studies on Floristic diversity
- 2.2 Studies on Biological Spectrum
- 2.3 Studies on conservation prioritization of plant communities and habitats

#### 2.1 Studies on Floristic diversity

Wani and Pant (2023) examined the floristic diversity and community characteristics of Gulmarg Wildlife sanctuary Kashmir Himalaya. A total of 364 species of vascular plants belonging to 74 families were identified. Of the total species, 22 were trees, 34 shrubs, 290 herbs and 14 ferns. A total of 18 communities (10 within forest and 8 within alpine zone) were identified. Within the identified forest communities, species richness ranged from 44 to 198; tree density and total basal area ranged from 185-810 Ind ha<sup>-1</sup> and 20.28-159.8 m<sup>2</sup> ha<sup>-1</sup>, respectively.

Pulicherla *et al.* (2023) conducted a study on floristic exploration of East Sikkim district of Sikkim. The investigation encompassed an examination of 165 plant species, originating from 140 genera within 71 families. Notably, the family Asteraceae stood out with the highest representation, featuring 15 plants. The

study also highlighted that herb constituted the majority, with a substantial count of 87 plants, surpassing other plant habits in terms of abundance.

Haq *et al.* (2023) conducted a comprehensive examination of the vegetation composition in the Shawilks Mountain Range Forest, uncovering the presence of 116 plant species distributed across 99 genera and 46 families. The predominant family was Asteraceae, contributing 11 % of the total species, closely followed by Fabaceae at 10 %. The study also revealed that the herbaceous growth form dominated, constituting 53 % of the overall vegetation.

Gatoo *et al.* (2022) conducted a comprehensive examination floristic diversity in Pahalgam range. Floristically, seventy plant species belonging to thirty-eight families were recorded. Among which 16, 10 and 10 were tree, shrub and herb species respectively. The dominant family represented by seven species was Poaceae followed by Asteraceae and Rosaceae families with six species each.

Tasveer (2022) studied the phytosociology status of different conifer stands of Gulmarg Forest Range of Kashmir Himalayas. According to the study, there were fifty-four plant species belonging to twenty-five families. Asteraceae the dominant family was represented by eight species. The phytosociology of different sites revealed that among trees *Abies pindrow* was the dominant species while the *Viburnum grandiflora* was dominant among shrub species.

Mugloo *et al.* (2022) studied floristic diversity in the Shopian Forest Range in Kashmir Valley of Jammu and Kashmir. A total of 53 plant species from 35 families, including 36 herbs, 9 trees and 8 shrubs, were documented. With seven families, Poaceae was the dominant, followed by Pinaceae, Rosaceae and Fabaceae, each of which had four species. *Pinus wallichiana* was found to be the dominant tree species.

Wani and Pant (2022) conducted a study to understand tree diversity in Gulmarg Wildlife Sanctuary, Kashmir Himalaya. Six sampling sites covering six different forest ecosystems yielded a total of 18 species, 18 genera and 14

families. With four species, Pinaceae was the most numerous families, followed by Sapindaceae with two species. The *Pinus-Taxus-Aesculus* community had the highest stem density, whereas, the *Betula utilis* community had the lowest. The *Abies pindrow* community had the largest total basal area, whereas, the *Pinus-Cedrus* community had the smallest.

Surmal *et al.* (2022) conducted a study on species diversity in coniferous forests from Bhallesa Hills of Pir Panjal Mountain, Western Himalaya. In aggregate, the investigation encompassed the identification of 328 plant species across diverse localities, representing 228 genera and 78 families with varying growth forms. A significant majority, approximately 68.51 %, were classified as native species, while the remaining 31.49 % were characterized as non-native. Within the angiosperms, dicotyledon species emerged as the predominant category, constituting 83.23 % of the total plant species. Among the identified families, Asteraceae was particularly prevalent, featuring 38 species.

Koptseva *et al.* (2021) studied the plant species diversity in urban areas of Northwest Siberia. In the northern taiga and woodland tundra of Northwest Siberia (Russia), two towns and two settlements were taken into consideration for their flora. There were 138 species of vascular plants from 29 different families in the four towns and settlements that were observed. Seventy percent of the whole list is made up primarily of perennial herbs. The Poaceae family among them had a total of 27 species, which was the most in all categories of urban functional zones. The residential neighbourhoods were found to be dominated by planted alien woody species.

Rahman *et al.* (2021) studied the floristic composition of the vascular flora of Zaini pass, District Chitral, Pakistan. Floristically, 280 species of 195 genera and 67 families were recorded from the study area. Three pteridophytes, 2 gymnosperms, 40 monocots and 233 dicots were reported. Asteraceae was the dominant family with 38 species (13.66 %) followed by Papilionaceae with 21 species. (7.55 %), Lamiaceae 18 species (6.47 %), Rosaceae 16 species (5.75 %),

etc. Herbs predominated with a contribution of 84.23 %, followed by trees with 8.46 % and shrubs with 7.30 %.

Tantray (2018) investigated the Sindh Forest Division's diversity. In total, it was revealed that there were 133 plant species, out of which 15 were shrubs and 89 were herbs. These species belonged to 52 families and it was found that Asteraceae was the most dominant family.

Ali *et al.* (2016) conducted a study on floristic composition and ecological characteristics of plants of Chail Valley, district Swat, Pakistan. There were 463 species total, divided into 104 families. The major families were Asteraceae (42 Species), followed by Poaceae (35 Species), Rosaceae and Lamiaceae (each with 26 Species).

Abebe *et al.* (2016) studied the floristic composition and structure of Zerat Forest, Central Ethiopia. A total of 156 plants were found, distributed across 133 genera and 67 families. The most prevalent family was Asteraceae, followed by Fabaceae and Lamiaceae. Herbs made up 35 % of the plants found at the study site, followed by shrubs (31 %).

Verma (2016) conducted a study to understand the plant diversity along an altitudinal gradient with elevations varying from 2200-2600 m above mean sea level in Dankund beat of Kalatop Khajjiar wildlife sanctuary in district Chamba, Himachal Pradesh and recorded a total of 102 species belonging to 54 families and 95 genera. The Asteraceae, Rosaceae and Fabaceae families were the most prevalent families. For elevation ranges of 2200-2400 m and 2400-2600 m, respectively, the index of diversity for plant species was 3.16 and 3.20.

Verma and Kapoor (2014) conducted a study to understand the plant diversity along an altitudinal gradient with elevations varying from 3700 m to 4700 m above mean sea level in alpine area of Rani Kanda in Rakchham Chitkul wildlife sanctuary in district Kinnaur, Himachal Pradesh. According to the study,

there were 102 distinct plant species across 31 families and 66 genera. Asteraceae, Rosaceae, Polygonaceae and Lamiaceae were the major families.

Kamal *et al.* (2014) studied the floristic diversity in Nadaun Block of Hamirpur District, Himachal Pradesh. The survey, which was conducted in 11 sample villages, found the presence of 265 commercially significant species from 81 families and 211 genera, including 78 species of trees, 46 species of shrub and 141 species of herbs. The three most common families were Poaceae (20 species), Fabaceae (18 species) and Asteraceae (14 species).

Thakur *et al.* (2012) studied the floristic composition of Darlaghat Wildlife Sanctuary, Solan, Himachal Pradesh. Floristically, 302 plant species belonging to 99 families were recorded from the study area. From the research area, 302 plant species from 99 families have been identified. These comprise 27 % of trees, 24 % of shrubs, 35 % of herbs and 5 % of climbers. Dicots made up the majority of the 302 species, making up 87 % of the total while gymnosperms made up 2 %, with 6 species. The most prevalent family, accounting for 10 %, was Fabaceae. Asteraceae, on the other hand, was the second-highest dominant family with 9 %.

Verma and Kapoor (2011) conducted a study to understand the plant diversity along an altitudinal gradient with elevations varying from 3000 m to 5000 m above mean sea level in Ropa-Giavung valley of district Kinnaur, Himachal Pradesh and recorded a total of 160 species belonging to 51 families and 119 genera. Asteraceae, Polygonaceae and Rosaceae were the dominating families.

Raina and Sharma (2010) studied the floristic composition of district Jammu, North - Western Himalaya. The survey found 395 plant species, distributed across 302 genera and 93 families. 35 families exhibit monotypic representation in the region, with the largest family being Fabaceae (25 genera/42 species), followed by Asteraceae (24/29), Poaceae (21/23) etc. Dicotyledons made up 90.21 percent of the entire flora.

## 2.2 Studies on Biological Spectrum

Haq *et al.* (2023) examined the vegetation composition and ecological characteristics of the forest in the Shawilks Mountain Range from Western Himalayas. Their findings unveiled a rich diversity, identifying 116 plant species spanning 99 genera and 46 families in the study area. Notably, the predominant growth form was herbaceous, constituting 53 % of the overall vegetation. The biological spectrum analysis revealed the prevalence of therophytes, indicative of disturbed vegetation.

Singh *et al.* (2022) studied the floristic composition and species diversity of agricultural fields of Shri Guru Ram Rai University, Dehradun, Uttarakhand, India. Floristic analysis of the study area revealed the occurrence of 203 different plant taxon belonging to 68 families. The herbaceous growth form dominated the study area with 121 species. Therophytes were the dominant life form accounting for 44.55 %.

Rahman *et al.* (2021) studied biological spectrum of the vascular flora of Zaini pass, District Chitral, Pakistan. Floristically, 280 species of 195 genera and 67 families were recorded from the study area. Herbs predominated with a contribution of 84.23 %, followed by trees with 8.46 % and shrubs with 7.30 %. The most predominant life form that constituted 40.28 % was therophytes, followed by hemicryptophytes and phanerophytes with 15.46 % each, geophytes with 14.02 %, chamaephytes with 12.94 %. Nanophylls were the most abundant leaf size with 34.17 %, followed by microphylls 22.30 %, mesophylls 18.34 %, leptophylls 16.18 % and macrophylls 7.55 % and aphyllous with 1.44 %. Simple leaf type led the class with 67.87 %, followed by compound with 19.85 %.

Sen and Bhakat (2020) conducted a study on quantitative analysis of floristic composition, biological spectrum and leaf spectrum of a sacred grove in Jhargram District, West Bengal. According to the findings of floristic investigations, there were 217 angiosperm species, which were divided among

196 genera and 59 families in 27 orders. Phanerophytes [76 (35.02 %)] were most common, followed by therophytes [73 (33.64 %)], chamaephytes [33 (15.21 %)], hemicryptophytes [30 (13.82 %)] and cryptophytes [5 (2.30 %)], according to the biological spectrum. The grove had a "thero-chamaephyte" phytoclimate form.

Haq *et al.* (2018) studied the floristic composition and biological spectrum of Keran - a remote valley of north-western Himalaya. A total of 183 species of plants, 55 of which were exotic species, were counted. The predominant growth form was herbaceous (67 %). Therophytes made up 37 % of all living organisms. Mesophylls (34 %) and nanophylls (29 %) were the two main leaf size categories, followed by microphylls (27 %). The bulk of the species (65 %) had the simple leaf lamina type.

Farooq *et al.* (2018) studied the diversity and biological spectrum of tree flora in upper Tanawal, district Mansehra, Pakistan. To gather field data using the quadrat method, a total of 127 sampling stands (10 m x 10 m) were sampled from various sites throughout the region. The Upper Tanawal region was home to 53 distinct tree species from 39 genera and 25 tree families. With seven (13 %) tree species, the Moraceae family was the most numerous, followed by the Fabaceae and Rosaceae with six (12 %) each. The findings showed that mesophyll and microphyll, which account for 18 (34 %) of the tree species, respectively, were the two leading leaf size spectrum groups.

Khan *et al.* (2017) carried out an assessment of the floristic diversity, life-forms and biological spectrum of vegetation in Swat Ranizai, District Malakand, Khyber Pakhtunkhwa, Pakistan. Floristically, 264 plant species from 90 families and 202 genera were identified, including 42 monocots and 216 dicots, 5 ferns and 1 gymnosperm. The Poaceae family was found to be the most significant, contributing 20 species to the overall floristic composition. Asteraceae (14 species) and Rosaceae (10 species) were the next most significant families, in that order. According to habit, herbs were the most prevalent (123 species). The

findings also showed that in the entire floristics, microphyll had the most dominant leaf size range and phanerophytes were the most common life forms.

Ullah *et al.* (2016) conducted a study on floristic composition, ecological characteristics and biological spectrum of District Bannu, Khyber Pakhtunkhawa, Pakistan. According to the study, District Bannu has a total of 193 plant species, 154 genera and 54 families. Furthermore, 145 plant species, or 75.13 percent, were dicotyledons, whereas, 48 species, or 24.87 percent, were monocotyledons. With 37 species, the Poaceae was the dominant family. According to their floral classification, 60.62 percent of the plants were therophytes, 9.84 percent were geophytes and 9.84 percent were hemi-cryptophytes. The leaf size spectrum revealed that the plants in the area that had nanophyll leaves made up 48.18 percent of the total.

Ali *et al.* (2016) studied the floristic composition and ecological characteristics of plants of Chail Valley, district Swat, Pakistan. There were 463 species total, divided into 104 families. Therophytes was the most prevalent life form (188 Species, 40.60 %) followed by hemicryptophytes (77 species, 16.63 %). Mesophylls (147 Spp; 31.75 %), microphylls (140 Spp; 30.24 %) and nanophylls (136 Spp; 29.37 %) dominated the leaf spectra. There were two aphyllous species. Simple lamina was present in 305 species or 65.87 % of the species.

Thakur (2015) conducted a study on floristic composition, life-forms and biological spectrum in Sagar District, Madhya Pradesh, India. A total of 82 species from 72 genera and 33 angiosperm families were identified in this study. The top families were determined to be Fabaceae, Asteraceae, Rubiaceae and Combretaceae based on species contributions. The significant life forms were phanerophytes (55 %) therophytes (32.5 %) chamaephytes (6.25 %), geophytes (3.75 %), hemicryptophytes and both epiphytes (1.25 %). The area's phytoclimate was identified as phanero-therophytic by the preponderance of phanerophytes and therophytes.

Amjad *et al.* (2015) conducted a study on floristic composition, biological spectrum of the vegetation in Nikyal valley, Azad Jammu and Kashmir. According to the study, the Nikyal valley's flora included 110 species from 51 families and 98 genera. The most numerous families included Poaceae (18 species), Asteraceae (10 species), Lamiaceae (8 species) and Fabaceae (7 species). The findings showed that hemicryptophytes (32.73 %) were the area's most prevalent life form, followed by therophytes (23.64 %) and nanophanerophytes (22.73 %). Similar to this, in the researched area, nanophyllous species (37.27 %) followed by microphyllous species (29.09 %) remained prominent.

Gazal and Raina (2015) studied the life form composition and biological spectrum of Ramnagar Wildlife Sanctuary, J&K. The 259 tracheophytes in total, have been listed and classified into several life-form classes. The predominant lifeform classes present in the area were therophytes (34.36 %), macrophanerophytes (23.16 %), nanophanerophytes (11.58 %) and chamaephytes (10.81 %). According to Raunkiaer's nomenclature, the region's phytoclimate is thermo-phanerophytic, with a predominance of therophytes and phanerophytes.

Hussain *et al.* (2015) conducted a study on diversity and ecological characteristics of flora of Mastuj valley, Hindukush range, Pakistan. There were 571 species in the study, divided into 82 groups, 65 dicots, 13 monocots, 2 gymnosperms and 2 pteridophyte families. The top families included Asteraceae (91 species), Poaceae (58 species), Papilionaceae (38 species), Lamiaceae and Rosaceae (each with 26 species) etc. Therophytes (40.98 %) dominated the biological spectrum, followed by hemicryptophytes (154 species, or 26.97 %), geophytes (14.36 %), chamaephytes (7.71 %), nanophanerophytes (5.43 %) and megaphanerophytes (244.20 %). Nanophylls (40.98 %), leptophylls (24.87 %), mesophylls (18.56 %) and microphylls (9.11 %) dominated the leaf size spectrum.

Jyoti *et al.* (2014) studied the life form classification and biological spectrum of Lamberi Forest Range, Rajouri, J&K. In total, 222 species from 167 genera and 80 families have been identified in the region. Therophytes (27.03 %)

and macrophanerophytes (25.68 %) were found to be predominate, followed by nanophanerophytes, chamaephytes and hemicryptophytes. Biological spectrum on life form was prepared and compared with Raunkiaer's normal biological spectrum. On comparison with Raunkiaer's normal spectrum the area depicts thermo-phanerophytic kind of phytoclimate.

Nazir *et al.* (2014) conducted a study leaf spectra of plant communities recorded at Sarsawa hills Azad Kashmir. According to the survey, there were 40 plant species in total, divided into 24 families. Leptophylls (40 %) predominated in the leaf spectra, followed by nanophylls (22.5 %), microphylls (22.5 %) and mesophylls (15 %).

Thakur *et al.* (2012) studied the biological spectrum of Darlaghat Wildlife Sanctuary, Solan, Himachal Pradesh. Analyses of life form classes and percentage distributions revealed that phanerophytes made up 47 % of the 302 species, therophytes made up 36 %, cryptophytes made up 9 %, hemicryptophytes made up 5 % and chamaephytes made up 3 %.

Raina and Sharma (2010) studied the lifeform classification and biological spectrum of district Jammu, North - Western Himalaya. The survey found 395 plant species, distributed across 302 genera and 93 families. Raunkiaer's life form system (1934) comparison of species reveals that therophytes (38.23 %) outnumber phanerophytes (19.50 %), indicating a thermo-phanerophytic type of phytoclimate.

### **2.3 Studies on conservation prioritization of plant communities and habitats**

Wani and Pant (2023) examined the status of biodiversity in a protected area of Kashmir Himalaya: Gulmarg Wildlife Sanctuary. A sum of 18 distinct communities were recognized, with 10 located within the forest and 8 situated within the alpine zone. In the current research, an evaluation using 'Conservation Priority Index' (CPI) was conducted on the plant species. As a result, 51 plant

species were identified as being under threat within the GWLS area. Moreover, the habitats with the highest CPI values, which included dry and shaded moist environments, along with the mixed communities of *Aesculus indica-Pinus wallichiana* and *Taxus wallichiana-Prunus cornuta-Aesculus indica*, underscored the significance of effectively managing these prioritized habitats and communities.

Farooq (2023) studied the conservation prioritization of plant communities and habitats in urban green spaces of Srinagar city. Floristically the area comprised of 101 plant species from 46 distinct families. Among the six plant communities *Platanus orientalis* community had the highest CPI value. Among the six habitats riverine habitat showed the highest CPI value.

Wani *et al.* (2022) assessed the Conservation Priority Index (CPI) of species, communities and habitats for biodiversity conservation in Gulmarg Wildlife Sanctuary, Kashmir Himalayas. Among the entire count of recorded plant species, six species were classified as critically endangered, while twenty species were considered endangered. Within the forest and alpine communities, the *Abies pindrow* community and the mixed community of *Juniperus squamata-Rhododendron anthopogon* exhibited the highest CPI values. In terms of habitats, it was the dry habitats that displayed the highest CPI values within the sanctuary.

Sheeraz (2020) studied assessment of conservation prioritization of forest communities and habitats in Pahalgam range. It was revealed that the *Betula utilis* community had the highest Conservation Prioritization Index (CPI) value of 62, followed by *Betula utilis-Prunus tomentosa* community and the *Acer ceasium-Prunus tomentosa* community, each of which had a CPI value of 58 and were therefore determined to have the highest priority for conservation.

Tantray (2018) investigated the Sindh Forest Division's conservation priorities for habitats and communities. In total, it was revealed that there were 133 plant species, out of which 15 were shrubs and 89 were herbs. Additionally, 3

species were found to be severely endangered, 3 as endangered, 8 as vulnerable and 12 as least concern.

Sharma (2019) studied the threat categorization of floristic diversity of Murari Devi and surrounding areas in Mandi District of Himachal Pradesh. A total of 80 species from Murari Devi and the adjacent areas including 32 trees, 28 shrubs and 20 herbs had been classified as threatened. The remaining species have been classified as Least Concern, while another 31 species have been classified as Near Threatened. Additionally, 05 species have been classified as Endangered, Vulnerable (05 spp.) and Least Concern (01 sp.) for Himachal Pradesh using the new IUCN criteria. Out of the total of three species, one was listed as Endangered and the other as Vulnerable, while the other two, *Berberis aristata* (Rare) and *Dioscorea deltoidea* (Vulnerable), were listed in the Red Data Book of Indian Plants.

Sharma and Samant (2017) studied the threat categorization and conservation prioritization of medicinal plants in the surroundings of different hydro-electric projects of Kullu District in Himachal Pradesh. The various categories of threatened species were: 16 species were identified as Critically Endangered, 28 species as Endangered; 85 species as Vulnerable; 60 species as Near Threatened and remaining species as Least Concern based on threat categorization score.

Dipika and Masoodi (2016) studied the threat categorization and conservation prioritization of floristic diversity from Shimla Water Catchment Wildlife Sanctuary in the Indian Himalayan Region. Thirty-one species were listed as Near Threatened, ten as Critically Endangered, 48 as Vulnerable and ten as Endangered. The two biggest risks to floristic diversity have been recognised as overexploitation and habitat loss.

Sharma *et al.* (2014) conducted a study on diversity, threat categorization and conservation prioritization of medicinal plants from Himachal Pradesh, India.

From the research region, 357 species of medicinal plants, representing 98 families and 237 genera, were identified. There were 27 trees, 269 herbs, 54 shrubs, 2 climbers and 5 ferns among these therapeutic plants. 193 of the medicinal plants were indigenous, 3 were endemic and 43 were near endemic. These species have also been prioritised for cultivation based on their rarity, endemism and place of nativity.

Kamal *et al.* (2014) studied the conservation prioritization of the economically important floristic diversity in Nadaun Block of Hamirpur District, Himachal Pradesh. Out of the 265 commercially significant species discovered, it was discovered that 26 were indigenous to the Himalayan region, 10 were indigenous to the Himalayan region and neighbouring countries and 243 were non-natives. One species has been designated as severely endangered out of the total number of species recorded, four species were endemic, seven species were near endemic and 14 species were vulnerable.

Singh and Samant (2010) conducted a study on conservation prioritization of habitats and forest communities in the Lahaul valley biosphere reserve, Northwestern Himalaya, India. Fourteen forest communities and fifteen habitats were identified between 2490 and 4000 metres. 57.14 % of communities were coniferous, 35.71 % were broad leaved and 7.14 % were mixed. The communities with the greatest CPI values were *Abies pindrow-Pinus wallichiana* mixed, *Fraxinus xanthoxyloides*, *Picea smithiana-Pinus wallichiana* mixed and *Cedrus deodara-Acer cappadocicum* mixed. The habitat with the highest CPI value in the forest was shady moist.

Rana and Samant (2009) conducted a study on prioritization of habitats and communities for conservation from Manali Wildlife Sanctuary in the Indian Himalayan Region. 13 habitats, 23 forest communities and 24 alpine communities were found by the study. Shady wet forest, rocky, dry forest and moist slope habitats in the mountains all had high CPIs and were therefore given priority for conservation. In the communities, *Betula utilis*, *Abies pindrow*, *Cedrus deodara*

and *Picea smithiana* in the forest zone and *Rhododendron campanulatum*, *Rhododendron anthopogon*, *Cassiope fastigiata*–*Rhododendron anthopogon* mixed, *Carex nubigena*–*Carex setigera* mixed and *Rhododendron campanulatum*–*Rhododendron lepidotum* mixed communities in the alpine zone respectively, showed high CPI and were therefore prioritised for conservation.

Pant and Samant (2007) studied the prioritization of communities for conservation in Mornaula Reserve Forest between 1500-2200 m and sampled 123 sites. From the sites under examination, a total of 289 species were identified, comprising 37 trees, 37 shrubs and 215 herbs, along with the documentation of 31 forest communities. Notably, the *Rhododendron arboretum* community stood out as the most dominant community with diverse species, encompassing native, endemic, economically important and rare-endangered species.

## Chapter-3

### MATERIALS AND METHODS

The present investigation entitled “**Assessment of floristic diversity, biological spectrum and conservation prioritization of plant communities in Urban and Peri-urban areas of Ganderbal, Kashmir**” was carried in district Ganderbal of Jammu and Kashmir UT during 2022-2023. The district Ganderbal is located between 34.23°N Longitude and 74.78°E Latitude at an elevation of 1650 to 3000 meters above mean sea level. The Ganderbal district situated on the left bank of River Sindh has a geographical area of 39304 hectare which is differentiated as forest (27.86 %), non-agricultural use (14.65 %), barren and uncultivable land (8.04 %), permanent pastures / other grazing land (4.55 %), cultivable waste land (2.48 %) and net area sown (42.42 %) (Anonymous, 2011). The Ganderbal has an urban area of 25.40 square kilometres with one municipal committee (Census of India, 2011). The details of the experimental plots, materials used and methodologies adopted for this study may be discussed as:

#### **3.1 Assessment of floristic diversity and biological spectrum in Urban and Peri-urban areas of Ganderbal**

The floristic diversity and other phytosociological characteristics of the vegetation was studied at different urban and peri-urban areas of Ganderbal, through field surveys. Following the method of multistage random sampling a total of 630 quadrants were laid at different sites. The total number of tree, shrub and herbs quadrats per location were 5, 10 and 20 respectively.

##### **3.1.1 Sampling procedure**

##### **The procedure of multistage random sampling was followed:**

The survey was conducted in nine wards of Municipal Committee of Ganderbal and in nine different peri-urban areas which were within the 1-2 km



**Plate 1: Laying out of quadrats in the study area**

vicinity of wards. In each site, trees were sampled by randomly placed quadrats whose size was determined by species area curve.

Shrubs and herbs were sampled randomly by 5 m x 5m and 1 m x1 m quadrants respectively. For the collection of data from these quadrats standard ecological methods were followed (Curtis and McIntosh, 1950; Greig-Smith, 1957; Misra, 1968; Mueller-Dombois and Ellenberge, 1974; Samant *et al.*, 2002; Joshi and Samant, 2004).

### **3.1.2 Floristic Composition**

Following Curtis and McIntosh (1950), the vegetation data were computed for density, frequency and basal area. The relative values of frequency, density and dominance were determined as per Phillips (1959). According to Phillips (1959) the relative values of frequency, density and dominance were calculated. To express a species' dominance and ecological success, these values have been incorporated to generate the Importance Value Index (IVI) of each species (Curtis, 1959).

#### **Observations recorded:**

1. Identification of species.
2. Number of individuals of each species.
3. Diameter (DBH for trees and basal diameter for shrubs and herbs).

The following parameters were studied for determining the floristic diversity of the urban and peri-urban areas of Ganderbal:

- Density
- Frequency
- Basal Area
- IVI

**a) Density:**

It was recorded as the number of plants per unit area. Density is an expression of the numerical strength of a species where the total number of individuals of each species in all the quadrats is divided by the total number of quadrats studied. Density was calculated by the following expression:

$$\text{Density} = \frac{\text{Total number of individuals of a species in all quadrats}}{\text{Total number of quadrats studied}} \times 100$$

**b) Frequency ( %)**

This term refers to the degree of dispersion of individual species in an area and usually expressed in terms of percentage occurrence. It was studied by sampling the study area at several places at random and recording the name of the species that occurred in each sampling unit. It was calculated by the formula:

$$\text{Frequency} = \frac{\text{Number of quadrats in which the species occurred}}{\text{Total number of quadrats studied}} \times 100$$

**c) Basal Area**

Basal area is the term used to describe the average amount of an area occupied by tree stems. It is defined as the total cross-sectional area of all stems in a stand measured at breast height and expressed as per unit of land area. It was calculated as:

$$\text{Basal area} = \frac{\pi D^2}{4}$$

Where 'D' is the diameter for trees at Breast Height and Basal Diameter for shrubs and herbs.

**d) Relative Density (RD)**

Relative density is the study of numerical strength of a species in relation to the total number of individuals of all the species and was calculated as:

$$\text{Relative density} = \frac{\text{Number of individuals of the species}}{\text{Number of individuals of all the species}} \times 100$$

**e) Relative Frequency (RF)**

The degree of dispersion of individual species in an area in relation to the number of all species occurred.

$$\text{Relative frequency} = \frac{\text{Number of occurrences of the species}}{\text{Number of occurrences of all the species}} \times 100$$

**f) Relative basal area (RB)**

Dominance of a species was determined by the value of the basal cover. Relative dominance is the coverage value of a species with respect to the sum of coverage of the rest of the rest of the species in the area.

$$\text{Relative basal area} = \frac{\text{Total basal area of the species}}{\text{Total basal area of all the species}} \times 100$$

**g) Importance value index (IVI)**

This value was used to determine the overall importance of all species in the community structure. In calculating this index, the percentage values of the relative frequency, relative density and relative dominances were summed up together and this value was designated as the Importance Value Index or IVI of the species (Curtis, 1959).

### **3.1.3 Similarity Index**

The similarity index was determined using the Sorenson index. The equation below was used to derive the Sorensen similarity index:

$$\text{Sorenson index is expressed as } Cs = \{2j/ a +b\} \times 100$$

Where,

j = number of species common to both sites being compared.

a = number of species in site A.

b = number of species in site B.



**Acquiring GPS Location**



**Measuring DBH**



**Measuring Basal Diameter**

**Plate 2: Recording observations.**

### 3.1.4 Diversity index (H'):

Diversity index was calculated according to “Shannon- Wiener” diversity function prescribed by Shannon - Wiener (1963).

$$H' = - \sum_{i=1}^s [(ni / N) \text{LN}(ni / N)]$$

Where, ni = importance value of species i N = total importance value of all the species

### 3.1.5 Biological Spectrum

In-depth field observations on aspects like habit (growing form, Raunkiaer's life form), leaf type (size, lamina) and other characteristics of each species was made during field investigations. The growth form was divided into tree, shrub, sub-shrub, herb, palm and climber depending on the direction and size of the growth as well as any branching of the main-shoot axis or axes (Perez-Harguindeguy *et al.*, 2013).

The location of the growing point or perennating bud during the less favourable seasons was used to classify the life form (Raunkiaer, 1934). Geophytes, Therophytes, Hemicryptophytes, Chamaephytes, Nanophanerophytes, Microphanerophytes, Mesophanerophytes and Megaphanerophytes were among the various kinds of recognised living forms (Muzafar *et al.*, 2019).

The size of the leaves is a good predictor of the local edaphic and climatic conditions. For combined with morphoanatomical information, leaf size classes can produce results that are substantially more precise when determining leaf zones or climates (Ali *et al.*, 2016). Leptophyll, Nanophyll, Microphyll, Mesophyll, Macrophyll and Megaphyll were the various leaf size categories.

The leaf's extended blade, or lamina, is a noticeable, green structure. Leaf lamina has variety of shapes such as Simple, Dissected, Compound and Needle each of which can be ultimately viewed as an adaptation to the complex problem of optimising the capture of light for photosynthesis (Malhado *et al.*, 2009).



**Plate 3: Measuring Leaf Area**

Furthermore, ecological traits like habitat were noted in the field. Crop field, Dry slope, Moist Places, Graveyard, Forest, Roadside, Waste Places and Parks were the many types of habitats.

### **3.2 To study the conservation prioritization of forest communities and habitats in Urban and Peri-urban areas of Ganderbal**

#### **3.2.1 Identification of plant communities**

The IVI (Importance Value Index) values of the trees was used to determine the plant communities. The single tree species accounting for more than 50 % of the IVI was referred to as a single species dominated community, whereas, two or more species accounting for 50 % or more of the IVI were referred to as a mixed community (Joshi and Samant, 2004).

#### **3.2.2 Identification of habitats**

Sites with a closed canopy and a high concentration of humus and moisture were regarded as moist habitats, whereas, those with a low concentration as dry habitats. Sites with a majority of stones as the ground cover were referred to as boulder habitats, whereas, sites with strong anthropogenic pressures were referred to as degraded habitats (Joshi and Samant, 2004).

#### **3.2.3 Identification of native, endemic, economically important species and threatened plants.**

##### **Native**

The species with its origin or first record from the Himalayan Region were considered as natives (Samant *et al.*, 1998, Samant, 2002).

##### **Endemic**

The species restricted to Indian Himalayan Region (IHR) were considered as endemic (Samant and Dhar, 1997; Samant *et al.*, 1998).

### **Economically important**

The information on economically important species was generated through structured interview techniques (Samant *et al.*, 2002).

#### **3.2.4 Prioritization of habitats and communities**

Eight criteria, including species richness, economic importance, native, endemic, threatened plants, altitude, site representation and habitat quantity, were used to prioritise habitats and communities following Joshi and Samant (2004); Pant and Samant (2007).

#### **3.2.5 Criterion used for Prioritization of habitats and communities:**

Score	Richness	EIP (%)	Native (%)	Endemic (%)	Threatened (%)	SR	Altitude (m)	Habitats*
10	>50	>45	>45	>40	>40	1	<200	1
8	46-50	41-45	41-45	36-40	36-40	2	200-400	2
6	41-45	36-40	36-40	31-35	31-35	3	400-600	3
4	36-40	31-35	31-35	26-30	26-30	4	600-800	4
2	<36	<31	<31	<26	<26	>4	>800	>4

(Pant and Samant, 2007)

Abbreviations: EIP =Economically Important Plants; SR= Site Representation; and \*= Criteria only applied for the communities.

## Chapter 4

### EXPERIMENTAL FINDINGS

This chapter provides an overview of the outcomes derived from the current study titled “**Assessment of floristic diversity, biological spectrum and conservation prioritization of plant communities in Urban and Peri-urban areas of Ganderbal, Kashmir.**” The research was carried out within the Urban and Peri-urban areas of Ganderbal between 2022 and 2023. The noteworthy discoveries made throughout this investigation are outlined below, categorized into the following sections:

- 4.1 Assessment of floristic diversity and biological spectrum in Urban and Peri-urban areas of Ganderbal.
- 4.2 To study the conservation prioritization of forest communities and habitats in Urban and Peri-urban areas of Ganderbal.

#### **4.1 Assessment of floristic diversity and biological spectrum in Urban and Peri-urban areas of Ganderbal**

Throughout the entire study area, the research involved the placement of quadrats at 18 specific sites. These sites were situated within both urban and peri-urban areas of Ganderbal. The investigation unveiled a total of 115 plant species (Table 1), representing 102 genera and spanning across 29 different plant orders (Fig 3). These species belong to 50 distinct plant families (Table 2). Within this diversity, there were 8 species classified as monocotyledons, 6 species as gymnosperms and 101 species falling under the dicotyledon category (Fig 4). In terms of plant families, Asteraceae emerged as the most diverse family with 13 species, followed by Rosaceae with 11 species (Table 2). Leguminosae and Amaranthaceae were also notable, encompassing 7 and 6 species, respectively (Fig 1). Additionally, it's worth noting that the two most diverse genera in terms of species richness were *Prunus* and *Rosa*, each comprising three species (Fig 2). Within this research, two species were identified as endemic, while an additional

12 species were categorized as native to the study area (Fig 6). When comparing the flora in urban and peri-urban areas, it was observed that there were 27 tree species in urban locations and 17 in peri-urban areas. In urban settings, there were 21 shrub species, whereas, peri-urban areas had 16. Regarding herbs, urban areas exhibited a total of 59 species, while peri-urban areas showed 43 species. Furthermore, urban areas had 2 sub-shrub species in contrast to 1 sub-shrub species in peri-urban locations and urban areas also hosted 2 climber species (Fig 5).

**Table 1: List of plant species recorded in the Urban and Peri-urban areas of Ganderbal with their Families, Common name, Local name**

S. No.	Name	Family	Common Name	Local Name
1	<i>Abelia × grandiflora</i> Rehder	Caprifoliaceae	Glossy Abelia	-
2	<i>Aesculus indica</i> (Wall. ex Comb.) Hk. f.	Sapindaceae	Indian horse Chestnut	Handoon
3	<i>Ailanthus altissima</i> Swingle.	Simoaroubaceae	Tree of Heaven	Alamthar
4	<i>Alcea rosea</i> L.	Malvaceae	Hollyhock	Sazi posh
5	<i>Amaranthus caudatus</i> L.	Amaranthaceae	Velvet flower	Gandar
6	<i>Amaranthus tricolor</i> L.	Amaranthaceae	Edible amaranth	Laal Sagh
7	<i>Anthemis cotula</i> L.	Asteraceae	Sticking Chamomile	Fackgasa
8	<i>Antirrhinum majus</i> L	Plantaginaceae	Dog Flower	Sheer Dahan
9	<i>Arctium lappa</i> L.	Asteraceae	Greater Burdock	Jangli Knuth
10	<i>Avena sativa</i> L.	Poaceae	Oat	Khaseel
11	<i>Berberis lycium</i> Royle	Berberidaceae	Indian Barberry	Kawdach
12	<i>Bothriochloa ischaemum</i> L.	Poaceae	Yellow bluestem	-
13	<i>Brassica rapa</i> L.	Brassicaceae	Field mustard	Til goggul
14	<i>Buddleja davidii</i> Franch.	Scrophulariaceae	Butterfly brush	-
15	<i>Buxus sempervirens</i> L.	Buxaceae	Boxwood	Papri
16	<i>Callistephus chinensis</i> (L.) Nees	Asteraceae	Annual Aster	-
17	<i>Campsis grandiflora</i> (Thunb.) K. Schum.	Bignoniaceae	Trumpet	-
18	<i>Canna indica</i> L.	Cannaceae	Indian shot	Keli
19	<i>Cannabis sativa</i> L.	Cannabaceae	Marijuana	Bhang
20	<i>Carpesium abrotanoides</i> L.	Asteraceae	Carpesium Fruit	-
21	<i>Catalpa bignoniodes</i> Walter	Bignoniaceae	Indian Bean Tree	Drath
22	<i>Cedrus deodara</i> (Roxb.)	Pinaceae	Deodar	Deodour
23	<i>Celosia argentea</i> L.	Amaranthaceae	Plumed Cock's Comb	Mawl
24	<i>Celtis australis</i> L.	Cannabaceae	European nettle tree	Brimij
25	<i>Cercis siliquastrum</i> L.	Leguminosea	Judas Tree	-
26	<i>Chenopodium album</i> L.	Amaranthaceae	White goosefoot	Bathua
27	<i>Cirsium arvense</i> Scop.	Amaranthaceae	Wool bearing Thistle	Kandeh googeh
28	<i>Clarkia pulchella</i> Pursh	Onagraceae	Ragged Robin	-
29	<i>Convolvulus arvense</i> L.	Convolvaceae	Field Bindweed	-
30	<i>Conyza canadensis</i> L.	Asteraceae	Horseweed	Fleabane
31	<i>Crataegus songarica</i> K.Koch	Rosaceae	Hawthorn	Reng Kul
32	<i>Cryptomeria japonica</i> D. Don	Cupressaceae	Japanese Cedar	Suji
33	<i>Cupressus sempervirens</i> L.	Cupressaceae	Mediterranean cypress	Sarva
34	<i>Dahlia pinnata</i> Cav.	Asteraceae	Garden dahlia	Silybum

**Contd....**

**Table 1: contd....**

S. No.	Name	Family	Common Name	Local Name
35	<i>Daucus carota L.</i>	Apiaceae	Wild Carrot	Gazre gasseh
36	<i>Dianthus caryophyllus L.</i>	Caryophyllaceae	Clove pink	-
37	<i>Dianthus chinensis L.</i>	Caryophyllaceae	Rainbow pink	-
38	<i>Eschscholzia californica Cham.</i>	Papaveraceae	California Poppy	-
39	<i>Euonymus japonicus Thunb.</i>	Celastraceae	Japanese spindle	-
40	<i>Euphorbia peplus L.</i>	Euphorbiaceae	Milkweed	-
41	<i>Ficus carica L.</i>	Moraceae	Common Fig	Anjeer
42	<i>Foeniculum vulgare Mill.</i>	Apiaceae	Fennel	Badiyan
43	<i>Forsythia viridissima Lind.</i>	Oleaceae	Chinese golden bell tree	Tahri Posh
44	<i>Fragaria nubicola (Hoof.f) Linn.</i>	Rosaceae	Himalayan Strawberry	Rengresh
45	<i>Galinsoga parviflora Cav.</i>	Asteraceae	Quick weed	Padini-gha
46	<i>Gomphrena globosa L.</i>	Amaranthaceae	Bachelor's Button	Rakta Mallika
47	<i>Helianthus annus L</i>	Asteraceae	Common sunflower	Gul e Aftab
48	<i>Hedera helix L.</i>	Araliaceae	Common ivy	-
49	<i>Hibiscus syriacus L.</i>	Malvaceae	Rose of Sharon	Gul e Khatmi
50	<i>Hydrangea macrophylla (Thunb.) Seringe</i>	Hydrangeaceae	French hydrangea	-
51	<i>Hypericum androsaemum L.</i>	Hypericaceae	St John's Wort	Chai kul
52	<i>Iberis amara L.</i>	Brassicaceae	Rocket Candytuft	-
53	<i>Indigofera heterantha Wall</i>	Leguminosae	Himalayan indigo	Kanhchu
54	<i>Juglans regia L.</i>	Juglandaceae	English Walnut	Doon
55	<i>Juniperus communis L.</i>	Cupressaceae	Common juniper	Bitru
56	<i>Lagerstroemia indica L.</i>	Lythraceae	Crape Myrtle	-
57	<i>Lavandula angustifolia Mill.</i>	Lamiaceae	English lavender	-
58	<i>Lepidium sativum L.</i>	Brassicaceae	Garden cress	Halim
59	<i>Ligustrum lucidum Ait.f.</i>	Oleaceae	Chinese privet	-
60	<i>Lupinus polyphyllus Lindl.</i>	Leguminosae	Garden lupin	Trum
61	<i>Magnolia kobus DC</i>	Magnoliaceae	Mokryeon	-
62	<i>Magnolia liliflora Desr.</i>	Magnoliaceae	Japanese magnolia	-
63	<i>Malva neglecta Wallr.</i>	Malvaceae	Common Mallow	Souchal
64	<i>Marrubium vulgare L.</i>	Lamiaceae	Horehound	-
65	<i>Matricaria aurea (Loefl.) Sch.Bip.</i>	Asteraceae	Golden Chamomille	FackGass
66	<i>Melia azedarach L.</i>	Meliaceae	Chinaberry tree	Drek

**Contd....**

**Table 1: contd....**

S. No.	Name	Family	Common Name	Local Name
67	<i>Mentha arvensis L.</i>	Lamiaceae	Field Mint	Pudnah
68	<i>Morus alba L.</i>	Moraceae	Mulberry	Tul
69	<i>Myosotis arvensis (L.) Hill</i>	Boraginaceae	Field forget-me-not	-
70	<i>Nerium indicum Mill.</i>	Apocynaceae	Nerium	Kara vira
71	<i>Oxalis corniculata L.</i>	Oxalidaceae	Sleeping beauty	Chok chin
72	<i>Papaver dubium L.</i>	Papaveraceae	Long headed Poppy	-
73	<i>Phlox drummondii Hook.</i>	Polemoniaceae	Annual phlox	-
74	<i>Picea smithiana (Wall.) Boiss.</i>	Pinaceae	Western Himalayan Spruce	Royal
75	<i>Plantago major L.</i>	Plantaginaceae	Broad leaf Plantain	Gula
76	<i>Platanus orientalis L.</i>	Platanaceae	Chinar	Boin
77	<i>Polygonum hydropiper L.</i>	Polygonaceae	Water pepper	Machrangan gaseeh
78	<i>Populus nigra L.</i>	Salicaceae	Black poplar	Phrast
79	<i>Populus deltoides W.Bartram ex Marshall</i>	Salicaceae	Eastern cottonwood	Russi Phrast
80	<i>Prunus avium L.</i>	Rosaceae	Wild cherry	Gilaas
81	<i>Prunus cerasifera Ehrh.</i>	Rosaceae	Cherry plum	Aae'rr
82	<i>Prunus persica Batsch</i>	Rosaceae	Peach	Tche'nunn
83	<i>Robinia psuedoacacia L.</i>	Leguminosae	Black Locust	Kiker
84	<i>Rosa × damascena Mill</i>	Rosaceae	Turkish rose	Kashur Gulab
85	<i>Rosa moschata Herrm.</i>	Rosaceae	Musk rose	Ban gulab
86	<i>Rosa multiflora Thunb.</i>	Rosaceae	Baby rose	Kunj
87	<i>Rubus niveus Thunb.</i>	Rosaceae	Mysore Raspberry	Anchu
88	<i>Rubus ulmifolius Schott</i>	Rosaceae	Elm leaf blackberry	Chhanch
89	<i>Rumex dentatus L.</i>	Polygonaceae	Aegean dock	Jangli palak
90	<i>Rumex hastatus D. Don</i>	Polygonaceae	Arrowleaf Dock	Aula / Ambli
91	<i>Salix alba L.</i>	Salicaceae	Willow	Ver kul
92	<i>Salix babylonica L.</i>	Salicaceae	Weeping Willow	Baid e Majnoon
93	<i>Scilla siberica Andrews</i>	Asparagaceae	Siberian squill	-
94	<i>Setaria viridis (L.) P.Beauv.</i>	Poaceae	Green foxtail	-
95	<i>Sophora japonica L.</i>	Leguminosae	Japanese pagoda tree	-
96	<i>Spiraea japonica L.f.</i>	Rosaceae	Japanese spiraea	-
97	<i>Stellaria media L.</i>	Caryophyllaceae	Chickweed	Losdhi
98	<i>Tagetes minuta L.</i>	Asteraceae	Mint marigold	Gainda
99	<i>Tagetes patula L.</i>	Asteraceae	French Marigold	Gainda

**Contd....**

**Table 1: contd....**

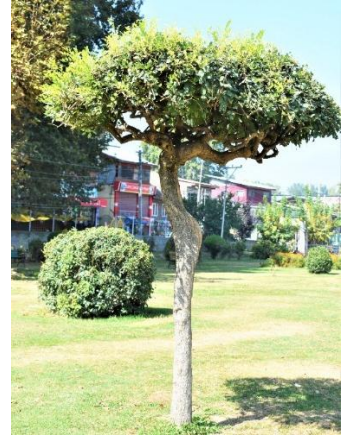
<b>S. No.</b>	<b>Name</b>	<b>Family</b>	<b>Common Name</b>	<b>Local Name</b>
100	<i>Thuja orientalis L.</i>	Cupressaceae	White cedar	Sarva
101	<i>Trachycarpus fortunei (Hook.) H.Wendl.</i>	Arecaceae	Chinese windmill palm	-
102	<i>Trifolium pratense L.</i>	Leguminosea	Red Clover	Bataknur
103	<i>Trifolium repens L.</i>	Leguminosea	White Clover	Bataknur
104	<i>Tropaeolum majus L.</i>	Tropaeolaceae	Garden nasturtium	-
105	<i>Urtica dioica L.</i>	Urticaceae	Stinging nettle	Soi
106	<i>Verbascum thapsus L.</i>	Plantaginaceae	Great mullein	Wan-Tamook
107	<i>Veronica persica Poir.</i>	Plantaginaceae	Persian speedwell	-
108	<i>Viburnum opulus L.</i>	Adoxaceae	Guelder-rose	Kilmish
109	<i>Vinca major L.</i>	Apocynaceae	Large periwinkle	Sadabahar
110	<i>Viola tricolor L.</i>	Violaceae	Wild pansy	Bunafsha
111	<i>Wigelia florida A. DC.</i>	Caprifoliaceae	Rose Weigela	-
112	<i>Xanthium spinosum L.</i>	Asteraceae	Prickly burweed	-
113	<i>Yucca aloiflora L.</i>	Asparagaceae	Dagger plant	-
114	<i>Zantedeschia aethiopica (L.) Spreng.</i>	Araceae	Arum lily	-
115	<i>Zinnia elegans L.</i>	Asteraceae	Common zinnia	-



*Ligustrum lucidum*



*Lagerstroemia indica*



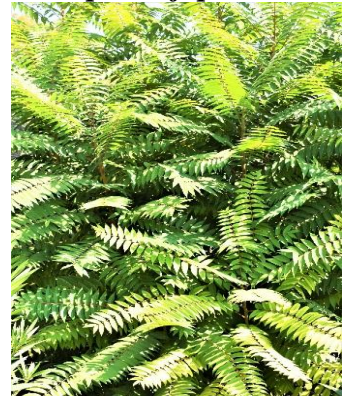
*Sophora japonica*



*Catalpa bignonioides*



*Cupressus sempervirens*



*Ailanthus altissima*



*Cedrus deodara*



*Cercis siliquastrum*



*Cryptomeria japonica*



*Magnolia Kobus*



*Melia azedarach*



*Platanus orientalis*

**Plate 4: Tree Species identified at Urban and Peri-urban areas of Ganderbal**



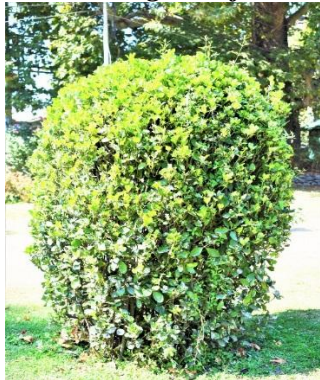
*Abelia × grandiflora*



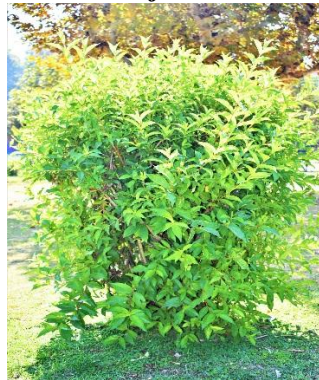
*Buddleja davidii*



*Buxus sempervirens*



*Euonymus japonicus*



*Forsythia viridissima*



*Nerium indicum*



*Rosa × damascena*



*Rosa moschata*



*Spiraea japonica*



*Viburnum opulus*



*Wigelia florida*



*Yucca aloiflora* plate  
4contd

**Plate 5: Shrub Species identified at Urban and Peri-urban areas of Ganderbal**



*Viola tricolor*



*Tagetes minuta*



*Phlox drummondii*



*Gomphrena globosa*



*Iberis amara*



*Myosotis arvensis*



*Dianthus chinensis*



*Eschscholzia californica*



*Convolvulus arvensis*

**Plate 6: Herb Species identified at urban and peri-urban areas of Ganderbal**

contd....

Plate 6: contd...



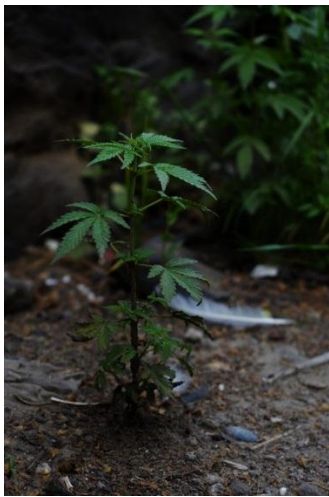
*Clarkia pulchella*



*Cirsium arvense*



*Celosia argentea* plate 5  
contd



*Cannabis sativa*



*Antirrhinum majus*



*Alcea rosea*



*Amaranthus tricolor*



*Arctium lappa*



*Amaranthus caudatus*

**Table 2: Genera, species and species percentage of the entire flora**

S. No.	Family	No. species	No. of genera	Species percentage
1	Adoxaceae	1	1	0.870
2	Amaranthaceae	6	5	5.217
3	Apiaceae	2	2	1.739
4	Apocynaceae	2	2	1.739
5	Araceae	1	1	0.870
6	Araliaceae	1	1	0.870
7	Arecaceae	1	1	0.870
8	Asparagaceae	2	2	1.739
9	Asteraceae	13	12	11.304
10	Berberidaceae	1	1	0.870
11	Bignonaceae	2	2	1.739
12	Boraginaceae	1	1	0.870
13	Brassicaceae	3	3	2.609
14	Buxaceae	1	1	0.870
15	Cannabaceae	2	2	1.739
16	Cannaceae	1	1	0.870
17	Caprifoliaceae	2	2	1.739
18	Caryophyllaceae	3	2	2.609
19	Celastraceae	1	1	0.870
20	Convolvaceae	1	1	0.870
21	Cupressaceae	4	4	3.478
22	Euphorbiaceae	1	1	0.870
23	Hydrangeaceae	1	1	0.870
24	Hypericaceae	1	1	0.870
25	Juglandaceae	1	1	0.870
26	Lamiaceae	3	3	2.609
27	Leguminosae	7	6	6.087

Contd...

**Table 2: contd...**

<b>S. No.</b>	<b>Family</b>	<b>No. species</b>	<b>No. of genera</b>	<b>Species percentage</b>
28	Lythraceae	1	1	0.870
29	Magnoliaceae	2	1	1.739
30	Malvaceae	3	3	2.609
31	Meliaceae	1	1	0.870
32	Moraceae	2	2	1.739
33	Oleaceae	2	2	1.739
34	Onagraceae	1	1	0.870
35	Oxalidaceae	1	1	0.870
36	Papaveraceae	2	2	1.739
37	Pinaceae	2	2	1.739
38	Plantaginaceae	4	4	3.478
39	Platanaceae	1	1	0.870
40	Poaceae	3	3	2.609
41	Polemoniaceae	1	1	0.870
42	Polygonaceae	3	2	2.609
43	Rosaceae	11	6	9.565
44	Salicaceae	4	2	3.478
45	Sapindaceae	1	1	0.870
46	Scrophulariaceae	1	1	0.870
47	Simoaroubaceae	1	1	0.870
48	Tropaeolaceae	1	1	0.870
49	Urticaceae	1	1	0.870
50	Violaceae	1	1	0.870
	<b>Total</b>	115	102	

#### 4.1.1 Floristic diversity at different sites of Urban areas of Ganderbal

Phytosociological parameters, including density, basal area, percentage frequency, relative density, relative basal area, relative frequency and the importance value index (IVI) of various species, have been computed and are presented in Tables 3 to 20.

##### Site 1 (Arampora)

The data presented in Table 3 provides insights into the vegetation composition at site 1. Among the six tree species present, *Platanus orientalis* stands out as the most dominant species, boasting the highest Importance Value Index (IVI) of 47.47. Following closely is *Populus deltoides* with an IVI value of 15.03. On the other hand, *Thuja orientalis* exhibited the lowest IVI value among the trees, standing at 4.94. In the shrub category, *Euonymus japonicus* displayed exceptional dominance, holding the highest values across all phytosociological parameters, with an impressive IVI value of 41.41. Among the herbaceous plants, *Urtica dioica* emerged as the most dominant, with an IVI value of 25.80, followed by *Trifolium pratense* and *Vinca major*, with IVI values of 22.90 and 13.76, respectively. When examining the contribution to basal area, *Platanus orientalis* had the largest share at 40.56 % among the tree species, while *Salix alba* had the highest density share at 0.02 %. For herbs, *Xanthium spinosum* contributed the most to basal area, accounting for 0.0021 %. In contrast, among shrubs, *Euonymus japonicus* had the maximum share in basal area, at 37.79 %. As for density, *Euonymus japonicus* had the highest share among shrubs, with 0.18 % and *Urtica dioica* had the highest density among herbs at 18.90 %.

**Table 3: Floristic composition and phytosociological attributes of plant species at Arampora (1599 m amsl)**

Species	Average Density/ha	Frequency (%)	Average Basal Area cm <sup>2</sup> / ha	Relative Density	Relative Frequency	Relative Basal Area	IVI
<b>TREES</b>							
<i>Cupressus sempervirens</i>	5.00	20.00	3901.67	0.003	3.45	1.59	5.04
<i>Platanus orientalis</i>	10.00	40.00	99773.88	0.01	6.90	40.56	47.47
<i>Populus deltoides</i>	20.00	60.00	11504.78	0.01	10.34	4.68	15.03
<i>Robinia psuedoacacia</i>	15.00	40.00	96.74	0.01	6.90	0.04	6.95
<i>Salix alba</i>	25.00	60.00	2038.22	0.02	10.34	0.83	11.19
<i>Thuja orientalis</i>	5.00	20.00	3668.79	0.003	3.45	1.49	4.94
<b>SHRUBS</b>							
<i>Berberis lycium</i>	80.00	20.00	14371.02	0.05	3.45	5.84	9.34
<i>Euonymus japonicus</i>	280.00	20.00	92949.87	0.18	3.45	37.79	41.41
<i>Hydrangea macrophylla</i>	40.00	10.00	5095.54	0.03	1.72	2.07	3.82
<i>Indigofera heteratha</i>	120.00	30.00	9988.30	0.08	5.17	4.06	9.31
<i>Nerium indicum</i>	120.00	30.00	2580.13	0.08	5.17	1.05	6.30
<b>HERBS</b>							
<i>Cirsium arvense</i>	1000.00	5.00	0.00001	0.63	0.86	0.000000003	1.49
<i>Malva neglecta</i>	5500.00	10.00	0.00034	3.47	1.72	0.0000001	5.19
<i>Plantago major</i>	15000.00	20.00	0.00	9.45	3.45	0.0000003	12.90
<i>Polygonum hydropiper</i>	7500.00	10.00	0.02	4.73	1.72	0.00001	6.45
<i>Scilla siberica</i>	4500.00	10.00	0.00001	2.84	1.72	0.000000004	4.56
<i>Trifolium pratense</i>	29500.00	25.00	0.03	18.59	4.31	0.00001	22.90
<i>Trifolium repens</i>	16500.00	10.00	0.003	10.40	1.72	0.000001	12.12
<i>Tropaeolum majus</i>	12000.00	15.00	0.02	7.56	2.59	0.00001	10.15
<i>Urtica dioica</i>	30000.00	40.00	0.07	18.90	6.90	0.00003	25.80
<i>Verbascum thapsus</i>	2500.00	15.00	0.21	1.58	2.59	0.0001	4.16
<i>Veronica Persica</i>	14500.00	20.00	0.04	9.14	3.45	0.00002	12.58
<i>Vinca major</i>	15000.00	25.00	0.08	9.45	4.31	0.00003	13.76
<i>Xanthium spinosum</i>	4500.00	25.00	5.05	2.84	4.31	0.0021	7.15
<b>TOTAL</b>	<b>158720.00</b>	<b>580.00</b>	<b>245974.48</b>	<b>100.00</b>	<b>100.00</b>	<b>100.00</b>	<b>300.00</b>

Whereas, IVI= Importance Value Index

### Site 2 (Bamloora)

Table 4 presents the data collected from site 2, which revealed the presence of a diverse plant community, including seven tree species, eight shrub species, one sub-shrub species and sixteen herb species. Among the tree species, *Populus deltoides* emerged as the most prominent with an impressive IVI value of 40.62, followed by *Cedrus deodara* with an IVI value of 25.34. In contrast, *Prunus avium* had the lowest IVI value among the tree species at 3.07. *Populus deltoides* also had the highest contribution to basal area, accounting for 32.09 %. It also had the highest density share at 0.08 %, followed by *Morus alba* and *Populus nigra*, both at 0.05 %. Within the shrub category, *Viburnum opulus* and *Buxus sempervirens* were dominant species, with IVI values of 11.31 and 9.60, respectively. Among the herbaceous plants, *Myosotis arvensis* stood out as the most dominant species with an IVI value of 17.49, followed by *Plantago major* and *Oxalis corniculata*, with IVI values of 15.41 and 13.66, respectively. Regarding shrubs, *Buxus sempervirens* contributed the most to basal area at 6.74 %. Both *Rosa moschata* and *Viburnum opulus* had the highest density share among shrubs, both at 0.21 %. Among herbs, *Oxalis corniculata* provided the highest percentage of basal area at 0.002 %, while *Myosotis arvensis* contributed the most to density at 13.26 %.

### Site 3 (Beehama)

The data from site 3 indicates that among the five tree species observed, *Juglans regia* exhibited dominance, both in terms of IVI value (48.30) and the share of basal area (41.57 %). *Ailanthus altissima* followed with IVI values of 22.87 and a basal area share of 12.76 %. In terms of density, *Ailanthus altissima* contributed the most, accounting for 0.03 %, followed by *Celtis australis* at 0.02 %. The shrub category was characterized by *Buddleja davidii*, which had the highest IVI value at 15.65 and contributed 13.93 % to the basal area. *Hydrangea macrophylla* and *Indigofera heterantha* shared the highest density at 0.16 % among the shrub species. Among the herbaceous plants, *Cannabis sativa* emerged

as the most prominent species with an IVI value of 29.96, followed by *Convolvulus arvensis* and *Cirsium arvensis*, with IVI values of 19.71 and 19.53, respectively. In terms of basal area percentage, *Indigofera heterantha* and *Cannabis sativa* both had the highest at 0.005 %. *Cannabis sativa* also recorded the highest density, reaching 24.08 %. Additionally, at this site, two climbers were identified, with *Hedera helix* exhibiting the highest IVI value, which was recorded at 5.52 (Table 5).

#### **Site 4 (Duderhama)**

The phytosociological data presented in Table 6 for site 4 reveals a rich diversity of plant species, including twelve tree species, eight shrub species, one sub-shrub species, one palm species and twenty herb species. Among the tree species, the highest IVI values were observed for *Sophora japonica* (30.70) and *Ligustrum lucidum* (24.56), followed by *Magnolia liliflora* (14.38) and *Magnolia kobus* (12.05). The lowest IVI value (3.17) was recorded for *Prunus cerasifera*. When considering basal area, *Sophora japonica* (25.98 %) and *Ligustrum lucidum* (22.19 %) contributed the most. *Sophora japonica* also had the highest density at 0.04 % among the tree species. In the shrub category, *Abelia × grandiflora* stood out with the highest IVI value (7.01) and accounted for 1.01 % of the basal area. *Rosa × damascena* had the highest density among shrubs at 0.19 %. Among the herbaceous plants, *Antirrhinum majus* displayed the highest IVI value (10.48) and the highest density (8.14 %).

**Table 4: Floristic composition and phytosociological attributes of plant species at Bamloora (1602m amsl)**

Species	Average Density/ha	Frequency (%)	Average Basal Area cm <sup>2</sup> / ha	Relative Density	Relative Frequency	Relative Basal Area	IVI
<b>TREES</b>							
<i>Cedrus deodara</i>	20.00	20.00	79186.31	0.01	2.82	22.52	25.34
<i>Juglans regia</i>	20.00	20.00	50452.23	0.01	2.82	14.35	17.17
<i>Melia azedarach</i>	60.00	20.00	27350.91	0.03	2.82	7.78	10.62
<i>Morus alba</i>	100.00	40.00	3250.66	0.05	5.63	0.92	6.61
<i>Populus nigra</i>	100.00	60.00	26599.04	0.05	8.45	7.56	16.07
<i>Populus deltoides</i>	160.00	60.00	112860.07	0.08	8.45	32.09	40.62
<i>Prunus avium</i>	20.00	20.00	842.36	0.01	2.82	0.24	3.07
<b>SHRUBS</b>							
<i>Berberis lycium</i>	320.00	40.00	3980.89	0.17	5.63	1.13	6.93
<i>Buxus sempervirens</i>	80.00	20.00	23700.64	0.04	2.82	6.74	9.60
<i>Rosa × damascena</i>	360.00	40.00	4438.75	0.19	5.63	1.26	7.08
<i>Rosa moschata</i>	400.00	30.00	2494.35	0.21	4.23	0.71	5.14
<i>Rosa multiflora</i>	120.00	10.00	892.79	0.06	1.41	0.25	1.72
<i>Rubus niveus</i>	160.00	10.00	1273.89	0.08	1.41	0.36	1.85
<i>Rubus ulmifolius</i>	160.00	10.00	815.29	0.08	1.41	0.23	1.72
<i>Viburnum opulus</i>	400.00	60.00	9312.42	0.21	8.45	2.65	11.31
<b>SUB-SHRUB</b>							
<i>Rumex hastatus</i>	320.00	20.00	4223.33	0.17	2.82	1.20	4.18

Contd....

Table 4: contd...

Species	Average Density/ha	Frequency (%)	Average Basal Area cm <sup>2</sup> / ha	Relative Density	Relative Frequency	Relative Basal Area	IVI
<b>HERBS</b>							
<i>Cannabis sativa</i>	17500.00	15.00	0.84	9.10	2.11	0.0002	11.21
<i>Foeniculum vulgare</i>	15000.00	15.00	1.94	7.80	2.11	0.001	9.91
<i>Galinsoga parviflora</i>	5000.00	5.00	0.12	2.60	0.70	0.00003	3.30
<i>Malva neglecta</i>	11500.00	10.00	0.37	5.98	1.41	0.0001	7.39
<i>Marrubium vulgare</i>	6000.00	10.00	0.18	3.12	1.41	0.00005	4.53
<i>Mentha arvensis</i>	2500.00	5.00	0.35	1.30	0.70	0.0001	2.00
<i>Myosotis arvensis</i>	25500.00	30.00	4.46	13.26	4.23	0.001	17.49
<i>Oxalis corniculata</i>	19500.00	25.00	6.23	10.14	3.52	0.002	13.66
<i>Plantago major</i>	21500.00	30.00	0.98	11.18	4.23	0.0003	15.41
<i>Polygonum hydropiper</i>	9500.00	15.00	0.14	4.94	2.11	0.00004	7.05
<i>Rumex dentatus</i>	10000.00	15.00	4.72	5.20	2.11	0.001	7.31
<i>Trifolium pratense</i>	9000.00	10.00	1.15	4.68	1.41	0.000	6.09
<i>Trifolium repens</i>	12500.00	10.00	2.18	6.50	1.41	0.001	7.91
<i>Urtica dioica</i>	13000.00	15.00	0.24	6.76	2.11	0.0001	8.87
<i>Verbascum thapsus</i>	2500.00	5.00	0.87	1.30	0.70	0.0002	2.00
<i>Xanthium spinosum</i>	9000.00	15.00	1.57	4.68	2.11	0.0004	6.79
<b>TOTAL</b>	<b>192300.00</b>	<b>710.00</b>	<b>351700.24</b>	<b>100.00</b>	<b>100.00</b>	<b>100.00</b>	<b>300.00</b>

Whereas, IVI= Importance Value Index

**Table 5: Floristic composition and phytosociological attributes of plant species at Beehama (1590 m amsl)**

Species	Average Density/ha	Frequency (%)	Average Basal Area cm <sup>2</sup> / ha	Relative Density	Relative Frequency	Relative Basal Area	IVI
<b>TREES</b>							
<i>Ailanthus altissima</i>	25.00	60.00	9149.76	0.03	10.08	12.76	22.87
<i>Celtis australis</i>	15.00	40.00	3270.83	0.02	6.72	4.56	11.30
<i>Ficus carica</i>	10.00	40.00	2914.21	0.01	6.72	4.06	10.80
<i>Juglans regia</i>	10.00	40.00	29810.71	0.01	6.72	41.57	48.30
<i>Morus alba</i>	5.00	20.00	3153.26	0.01	3.36	4.40	7.76
<b>SHRUBS</b>							
<i>Berberis lycium</i>	80.00	10.00	407.64	0.08	1.68	0.57	2.33
<i>Buddleja davidii</i>	40.00	10.00	9987.26	0.04	1.68	13.93	15.65
<i>Forsythia viridissima</i>	80.00	20.00	358.28	0.08	3.36	0.50	3.94
<i>Hydrangea macrophylla</i>	160.00	30.00	3363.85	0.16	5.04	4.69	9.90
<i>Indigofera heterantha</i>	160.00	20.00	580.41	0.16	3.36	0.81	4.33
<i>Nerium indicum</i>	120.00	30.00	5503.18	0.12	5.04	7.67	12.84
<b>HERBS</b>							
<i>Anthemis cotula</i>	4500.00	20.00	0.20	4.61	3.36	0.0003	7.97
<i>Indigofera heteratha</i>	9500.00	30.00	3.27	9.73	5.04	0.005	14.78
<i>Avena sativa</i>	10000.00	15.00	2.11	10.25	2.52	0.003	12.77
<i>Brassica rapa</i>	10000.00	25.00	2.11	10.25	4.20	0.003	14.45
<i>Cannabis sativa</i>	23500.00	35.00	3.49	24.08	5.88	0.005	29.96
<i>Cirsium arvense</i>	12500.00	40.00	1.76	12.81	6.72	0.002	19.53
<i>Convolvulus arvense</i>	13500.00	35.00	0.85	13.83	5.88	0.001	19.71
<i>Conyza canadensis</i>	11500.00	40.00	0.56	11.78	6.72	0.001	18.51
<i>Daucus carota</i>	1500.00	15.00	0.01	1.54	2.52	0.0000	4.06
<b>CLIMBERS</b>							
<i>Campsis grandiflora</i>	120.00	10.00	652.91	0.12	1.68	0.91	2.71
<i>Hedera helix</i>	280.00	10.00	2544.84	0.29	1.68	3.55	5.52
<b>TOTAL</b>	<b>97605.00</b>	<b>595.00</b>	<b>71711.53</b>	<b>100.00</b>	<b>100.00</b>	<b>100.00</b>	<b>300.00</b>

Whereas, IVI= Importance Value Index

**Table 6: Floristic composition and phytosociological attributes of plant species at Duderhama (1607 m amsl)**

Species	Average Density/ha	Frequency (%)	Average Basal Area cm <sup>2</sup> / ha	Relative Density	Relative Frequency	Relative Basal Area	IVI
<b>TREES</b>							
<i>Catalpa bignoniodes</i>	20.00	20.00	35828.03	0.01	2.34	3.77	6.12
<i>Cercis siliquastrum</i>	40.00	20.00	31847.13	0.02	2.34	3.36	5.71
<i>Cryptomeria japonica</i>	20.00	20.00	40764.33	0.01	2.34	4.29	6.64
<i>Lagerstroemia indica</i>	40.00	20.00	62420.38	0.02	2.34	6.58	8.93
<i>Ligustrum lucidum</i>	60.00	20.00	210668.79	0.03	2.34	22.19	24.56
<i>Magnolia kobus</i>	40.00	20.00	92038.22	0.02	2.34	9.70	12.05
<i>Magnolia liliflora</i>	80.00	40.00	91719.75	0.03	4.68	9.66	14.38
<i>Platanus orientalis</i>	20.00	20.00	84235.67	0.01	2.34	8.01	10.36
<i>Prunus cerasifera</i>	20.00	20.00	7802.55	0.01	2.34	0.82	3.17
<i>Prunus persica</i>	20.00	40.00	8957.01	0.01	4.68	0.94	5.63
<i>Salix babylonica</i>	20.00	20.00	15923.57	0.01	2.34	1.68	4.03
<i>Sophora japonica</i>	100.00	40.00	246624.20	0.04	4.68	25.98	30.70
<b>SHRUBS</b>							
<i>Abelia × grandiflora</i>	320.00	60.00	9564.09	0.14	5.86	1.01	7.01
<i>Forsythia viridissima</i>	280.00	40.00	1981.80	0.12	4.68	0.21	5.01
<i>Lavandula angustifolia</i>	200.00	20.00	919.75	0.09	2.34	0.10	2.52
<i>Rosa × damascena</i>	440.00	50.00	2504.03	0.19	5.85	0.26	6.30
<i>Spiraea japonica</i>	80.00	10.00	917.20	0.03	1.17	0.10	1.30
<i>Viburnum opulus</i>	120.00	30.00	663.48	0.05	3.51	0.07	3.63
<i>Wigelia florida</i>	320.00	30.00	2006.77	0.14	3.51	0.21	3.86
<i>Yucca aloiflora</i>	280.00	50.00	769.46	0.12	5.85	0.08	6.05
<b>SUB-SHRUB</b>							
<i>Zinnia elegans</i>	12500.00	15.00	35.18	5.35	1.75	0.004	7.11

Contd...

Table 6: contd....

Species	Average Density/ha	Frequency (%)	Average Basal Area cm <sup>2</sup> / ha	Relative Density	Relative Frequency	Relative Basal Area	IVI
<b>HERBS</b>							
<i>Alcea rosea</i>	9000.00	15.00	27.09	3.85	1.75	0.003	5.61
<i>Amaranthus caudatus</i>	6000.00	10.00	20.73	2.57	1.17	0.002	3.74
<i>Amaranthus tricolor</i>	9500.00	15.00	35.22	4.07	1.75	0.004	5.83
<i>Antirrhinum majus</i>	19000.00	20.00	63.74	8.14	2.34	0.01	10.48
<i>Callistephus chinensis</i>	6000.00	10.00	20.73	2.57	1.17	0.002	3.74
<i>Canna indica</i>	1500.00	5.00	26.01	0.64	0.58	0.003	1.23
<i>Celosia argentea</i>	6000.00	10.00	17.55	2.57	1.17	0.002	3.74
<i>Clarkia pulchella</i>	10000.00	10.00	30.27	4.28	1.17	0.003	5.46
<i>Dahlia pinnata</i>	9000.00	10.00	22.64	3.85	1.17	0.002	5.03
<i>Dianthus caryophyllus</i>	17000.00	15.00	62.39	7.28	1.75	0.01	9.04
<i>Dianthus chinensis</i>	16500.00	15.00	43.43	7.07	1.75	0.005	8.82
<i>Eschscholzia californica</i>	15500.00	15.00	90.61	6.64	1.75	0.01	8.40
<i>Gomphrena globosa</i>	9000.00	10.00	37.17	3.85	1.17	0.004	5.03
<i>Halianthus annuus</i>	5000.00	10.00	21.06	2.00	1.17	0.002	3.17
<i>Iberis amara</i>	17500.00	15.00	67.44	7.49	1.75	0.01	9.26
<i>Phlox drummondii</i>	18500.00	20.00	107.56	7.92	2.34	0.01	10.27
<i>Tagetes minuta</i>	18000.00	15.00	78.02	7.71	1.75	0.01	9.47
<i>Tagetes patula</i>	10000.00	10.00	114.97	4.28	1.17	0.01	5.46
<i>Viola tricolor</i>	12000.00	10.00	65.83	5.14	1.17	0.01	6.32
<i>Zantedeschia aethiopica</i>	3500.00	10.00	30.07	1.50	1.17	0.003	2.67
<b>PALM</b>							
<i>Trachycarpus fortunei</i>	320.00	10.00	8254.78	0.14	1.16	0.86	2.16
<b>TOTAL</b>	<b>233840.00</b>	<b>865.00</b>	<b>957428.67</b>	<b>100.00</b>	<b>100.00</b>	<b>100.00</b>	<b>300.00</b>

Whereas, IVI= Importance Value Index

### Site 5 (Fathepora)

Table 7 data reveals the presence of eight tree species, eight shrub species, one sub-shrub species and thirteen herb species. *Platanus orientalis* stood out as the most dominant tree species, boasting an IVI value of 49.25 and representing the highest basal area at 46.61 %. Among the shrubs, *Rosa moschata* emerged as the dominant species with an IVI value of 7.73, while *Yucca aloiflora* exhibited the lowest IVI value at 1.69. Among the herb species, *Trifolium repens* took the lead in dominance with an IVI value of 31.65. Concerning basal area, *Rosa × damascena* contributes the most in the shrub category, accounting for 1.48 %. In the herb category, *Trifolium repens* also took the top spot, contributing 0.19 % to the total basal area. *Ailanthus altissima* made up a small portion of the density at 0.07 %, with *Rosa moschata* dominated the shrubs in density at 0.17 %. In the herb category, *Trifolium repens* once again dominated with a substantial density share of 26.23 %.

### Site 6 (Ganderbal)

Table 8 presents data on eight tree species, six shrub species and nineteen herb species. *Aesculus indica* emerged as the dominant tree species with an IVI value of 44.16, boasting the highest basal area of 42.09 %. In the shrub category, *Rosa multiflora* took the lead in dominance with an IVI value of 9.47, contributing the highest basal area at 2.84 % and also exhibiting the highest density at 0.44 %. Among the herb species, *Urtica dioica* stood out as the most dominant with an IVI value of 17.37, followed closely by *Cannabis sativa* with an IVI value of 15.42. The herb species with the lowest IVI value was *Veronica persica* at 3.80. *Urtica dioica* also demonstrated the highest density among herbs, accounting for 12.18 %, while the lowest density among herbs was observed for *Galinsoga parviflora* at 2.53 %.

**Table 7: Floristic composition and phytosociological attributes of plant species at Fathepora (1597 m amsl)**

Species	Average Density/ha	Frequency (%)	Average Basal Area cm <sup>2</sup> / ha	Relative Density	Relative Frequency	Relative Basal Area	IVI
<b>TREES</b>							
<i>Aesculus indica</i>	80.00	60.00	164078.03	0.05	7.84	17.95	25.84
<i>Ailanthus altissima</i>	120.00	60.00	11703.82	0.07	7.84	1.28	9.20
<i>Juglans regia</i>	40.00	40.00	239095.54	0.02	5.23	26.16	31.41
<i>Morus alba</i>	20.00	20.00	269.11	0.01	2.61	0.03	2.66
<i>Platanus orientalis</i>	40.00	20.00	426052.16	0.02	2.61	46.61	49.25
<i>Populus nigra</i>	40.00	20.00	7961.78	0.02	2.61	0.87	3.51
<i>Populus deltoides</i>	20.00	20.00	3369.43	0.01	2.61	0.37	2.99
<i>Robinia psuedoacacia</i>	60.00	20.00	14803.10	0.04	2.61	1.62	4.27
<b>SHRUBS</b>							
<i>Hibiscus syriacus</i>	160.00	20.00	3468.15	0.10	2.61	0.38	3.09
<i>Indigofera heterantha</i>	200.00	30.00	6167.24	0.12	3.92	0.67	4.72
<i>Rosa × damascena</i>	240.00	30.00	13486.42	0.14	3.92	1.48	5.54
<i>Rosa moschata</i>	280.00	50.00	9431.44	0.17	6.54	1.03	7.73
<i>Rosa multiflora</i>	160.00	30.00	2070.86	0.10	3.92	0.23	4.24
<i>Rubus niveus</i>	200.00	20.00	184.73	0.12	2.61	0.02	2.75
<i>Viburnum opulus</i>	80.00	20.00	5436.41	0.05	2.61	0.59	3.26
<i>Yucca aloiflora</i>	40.00	10.00	3261.15	0.02	1.31	0.36	1.69
<b>SUB-SHRUB</b>							
<i>Rumex hastatus</i>	440.00	40.00	223.86	0.26	5.23	0.02	5.52

Contd....

Table 7: contd....

Species	Average Density/ha	Frequency (%)	Average Basal Area cm <sup>2</sup> / ha	Relative Density	Relative Frequency	Relative Basal Area	IVI
<b>HERBS</b>							
<i>Myosotis arvensis</i>	4500.00	10.00	7.47	2.68	1.31	0.00	3.99
<i>Oxalis corniculata</i>	9500.00	15.00	44.53	5.66	1.96	0.00	7.63
<i>Papaver dubium</i>	5000.00	10.00	8.49	2.98	1.31	0.00	4.29
<i>Polygonum hydropiper</i>	11500.00	20.00	508.59	6.86	2.61	0.06	9.53
<i>Rumex dentatus</i>	10500.00	20.00	426.18	6.26	2.61	0.05	8.92
<i>Setaria viridis</i>	15000.00	25.00	13.67	8.94	3.27	0.00	12.21
<i>Tagetes minuta</i>	1500.00	5.00	0.00	0.89	0.65	0.00	1.55
<i>Trifolium pratense</i>	5500.00	35.00	84.78	3.28	4.58	0.01	7.86
<i>Trifolium repens</i>	44000.00	40.00	1738.70	26.23	5.23	0.19	31.65
<i>Urtica dioica</i>	32500.00	40.00	9.17	19.38	5.23	0.00	24.61
<i>Verbascum thapsus</i>	2000.00	10.00	0.03	1.19	1.31	0.00	2.50
<i>Veronica persica</i>	12500.00	15.00	218.35	7.45	1.96	0.02	9.44
<i>Vinca major</i>	11500.00	10.00	12.62	6.86	1.31	0.00	8.17
<b>TOTAL</b>	<b>167720.00</b>	<b>765.00</b>	<b>914135.81</b>	<b>100.00</b>	<b>100.00</b>	<b>100.00</b>	<b>300.00</b>

Whereas, IVI= Importance Value Index

**Table 8: Floristic composition and phytosociological attributes of plant species at Ganderbal (1619m amsl)**

Species	Average Density/ha	Frequency (%)	Average Basal Area cm <sup>2</sup> / ha	Relative Density	Relative Frequency	Relative Basal Area	IVI
<b>TREES</b>							
<i>Aesculus indica</i>	15.00	20.00	28445.99	0.01	2.06	42.09	44.16
<i>Ailanthus altissima</i>	25.00	40.00	1324.92	0.01	4.12	1.96	6.10
<i>Celtis australis</i>	30.00	40.00	1985.74	0.01	4.12	2.94	7.08
<i>Ficus carica</i>	10.00	20.00	458.60	0.00	2.06	0.68	2.75
<i>Juglans regia</i>	5.00	20.00	21242.44	0.00	2.06	31.43	33.50
<i>Morus alba</i>	10.00	20.00	2278.86	0.00	2.06	3.37	5.44
<i>Populus deltoides</i>	30.00	40.00	3695.33	0.01	4.12	5.47	9.61
<i>Robinia psuedoacacia</i>	10.00	20.00	1950.84	0.00	2.06	2.89	4.95
<b>SHRUBS</b>							
<i>Berberis lycium</i>	400.00	40.00	514.66	0.18	4.12	0.76	5.07
<i>Indigofera heterantha</i>	520.00	30.00	1038.22	0.24	3.09	1.54	4.87
<i>Rosa moschata</i>	240.00	20.00	874.93	0.11	2.06	1.29	3.47
<i>Rosa multiflora</i>	960.00	60.00	1920.39	0.44	6.19	2.84	9.47
<i>Rubus niveus</i>	800.00	60.00	949.02	0.37	6.19	1.40	7.96
<i>Rubus ulmifolius</i>	480.00	30.00	753.96	0.22	3.09	1.12	4.43

Contd....

Table 8: cont...

Species	Average Density/ha	Frequency (%)	Average Basal Area cm <sup>2</sup> / ha	Relative Density	Relative Frequency	Relative Basal Area	IVI
<b>HERBS</b>							
<i>Anthemis cotula</i>	10500.00	30.00	8.12	4.83	3.09	0.01	7.93
<i>Arctium lappa</i>	6500.00	30.00	4.59	2.99	3.09	0.01	6.09
<i>Bothriochloa ischaemum</i>	10000.00	30.00	6.89	4.60	3.09	0.01	7.70
<i>Cannabis sativa</i>	24500.00	40.00	22.74	11.26	4.12	0.03	15.42
<i>Cirsium arvense</i>	7000.00	30.00	5.26	3.22	3.09	0.01	6.32
<i>Convolvulus arvense</i>	8000.00	20.00	4.40	3.68	2.06	0.01	5.75
<i>Conyza canadensis</i>	10500.00	30.00	7.81	4.83	3.09	0.01	7.93
<i>Euphorbia peplus</i>	7000.00	20.00	2.01	3.22	2.06	0.003	5.28
<i>Galinsoga parviflora</i>	5500.00	20.00	2.09	2.53	2.06	0.003	4.59
<i>Lupinus polyphyllus</i>	7000.00	20.00	4.09	3.22	2.06	0.01	5.29
<i>Malva neglecta</i>	15000.00	30.00	7.97	6.90	3.09	0.01	10.00
<i>Marrubium vulgare</i>	7500.00	20.00	3.10	3.45	2.06	0.005	5.51
<i>Matricaria aurea</i>	13500.00	30.00	7.66	6.21	3.09	0.01	9.31
<i>Plantago major</i>	12500.00	30.00	11.10	5.75	3.09	0.02	8.86
<i>Polygonum hydropiper</i>	15000.00	30.00	8.63	6.90	3.09	0.01	10.00
<i>Trifolium pratens</i>	11500.00	20.00	6.58	5.29	2.06	0.01	7.36
<i>Trifolium repens</i>	10000.00	20.00	5.35	4.60	2.06	0.01	6.67
<i>Urtica dioica</i>	26500.00	50.00	21.82	12.18	5.15	0.03	17.37
<i>Veronica persica</i>	6000.00	10.00	5.96	2.76	1.03	0.01	3.80
<b>TOTAL</b>	<b>217535.00</b>	<b>970.00</b>	<b>67580.05</b>	<b>100.00</b>	<b>100.00</b>	<b>100.00</b>	<b>300.00</b>

Whereas, IVI= Importance Value Index

### Site 7 (Gangerhama)

Table 9 presents phytosociological data for site 7, showcasing a diverse range of plant species, including 08 tree species, 06 shrub species, one sub-shrub species and 18 herb species. Among the tree species, *Juglans regia* exhibited the highest IVI values at 22.58, followed by *Populus deltoides* at 11.20. In terms of basal area, *Juglans regia* contributed the most with 20.23 %. Within the shrub category, *Crataegus songarica* stood out with the highest IVI value of 17.46 and accounted for 16.25 % of the basal area. *Rosa moschata* displayed the highest density among shrubs at 0.25 %. Among the herbaceous plants, *Trifolium repens* showed the highest IVI value at 21.99 and the highest density at 18.46 %. On the other hand, *Verbascum thapsus* exhibited the lowest density among herbs, with a value of 0.90 %.

### Site 8 (Saloor)

The data collected from site 7 in the urban area of Ganderbal depicted the presence of five tree species, nine shrub species and thirteen herb species. The IVI values indicated that among the tree species, *Populus deltoides* had the highest value at 19.90, followed by *Cupressus sempervirens* at 18.37. For shrubs, the maximum IVI value was observed for *Buxus sempervirens* at 20.89. Among the herbaceous plants, *Conyza canadensis* was the prominent species with an IVI value of 18.44, followed by *Cannabis sativa* and *Foeniculum vulgare* at 16.30. When considering basal area, *Populus deltoides* contributed the most among trees, accounting for 14.14 % of the total basal area. Among shrubs, *Buxus sempervirens* had the highest basal area at 15.03 %. However, for herbs, *Arctium lappa* recorded the maximum basal area at 0.01 %. In terms of density, *Cupressus sempervirens* exhibited the highest tree density at 0.09 %. Among shrubs, *Lavandula angustifolia* recorded the maximum density at 0.39 % (Table 10).

### Site 9 (Wanipora)

The tabulated data for site 9 revealed that the highest IVI value among tree species was attributed to *Populus nigra* (46.34), followed by *Salix alba* (26.71) as shown in Table 11. On the other hand, *Ficus carica* exhibited the lowest IVI value at 3.17, indicating its minimal dominance. *Populus nigra* also made the largest contribution to both basal area and density, accounting for 38.27 % of the basal area and 0.07 % of the density among trees. In the shrub category, *Euonymus japonicus* emerged as the dominant species at the site with an IVI value of 12.11, followed by *Nerium indicum* at 9.54. *Euonymus japonicus* also contributed the highest share of basal area among shrubs, making up 6.46 %. Among herbaceous plants, *Cannabis sativa* exhibited the highest dominance with an IVI value of 21.82, followed by *Convolvulus arvensis* at 14.54. In contrast, *Marrubium vulgare* had the lowest dominance with an IVI value of 1.82. The maximum density among herbs was recorded for *Cannabis sativa*, reaching 17.82 %.

**Table 9: Floristic composition and phytosociological attributes of plant species at Gangerhama (1563 m amsl)**

Species	Average Density/ha	Frequency (%)	Average Basal Area cm <sup>2</sup> / ha	Relative Density	Relative Frequency	Relative Basal Area	IVI
<b>TREES</b>							
<i>Aesculus indica</i>	5.00	20.00	4729.70	0.002	2.35	4.14	6.49
<i>Ailanthus altissima</i>	15.00	40.00	766.45	0.01	4.71	0.67	5.38
<i>Juglans regia</i>	5.00	20.00	23121.42	0.002	2.35	20.23	22.58
<i>Morus alba</i>	10.00	40.00	2152.87	0.005	4.71	1.88	6.59
<i>Populus nigra</i>	15.00	40.00	5576.56	0.01	4.71	4.88	9.59
<i>Populus deltoides</i>	25.00	40.00	7406.45	0.01	4.71	6.48	11.20
<i>Robinia psuedoacacia</i>	15.00	40.00	1975.06	0.01	4.71	1.73	6.44
<i>Salix alba</i>	30.00	60.00	1917.46	0.01	7.06	1.68	8.75
<b>SHRUBS</b>							
<i>Crataegus songarica</i>	80.00	10.00	18573.25	0.04	1.18	16.25	17.46
<i>Indigofera heterantha</i>	280.00	60.00	9434.00	0.13	7.06	8.25	15.44
<i>Rosa moschata</i>	560.00	70.00	8667.71	0.25	8.24	7.58	16.07
<i>Rosa multiflora</i>	240.00	30.00	3577.69	0.11	3.53	3.13	6.77
<i>Rubus niveus</i>	160.00	20.00	8777.87	0.07	2.35	7.68	10.10
<i>Rubus ulmifolius</i>	320.00	40.00	11504.78	0.14	4.71	10.07	14.92
<b>SUB-SHRUB</b>							
<i>Rumex hastatus</i>	400.00	40.00	6021.10	0.18	4.71	5.27	10.15

Contd....

Table 9: contd....

Species	Average Density/ha	Frequency (%)	Average Basal Area cm <sup>2</sup> / ha	Relative Density	Relative Frequency	Relative Basal Area	IVI
<b>HERBS</b>							
<i>Cirsium arvense</i>	2500.00	5.00	4.60	1.13	0.59	0.004	1.72
<i>Convolvulus arvense</i>	8000.00	10.00	2.74	3.60	1.18	0.002	4.78
<i>Daucus carota</i>	3000.00	15.00	2.72	1.35	1.76	0.002	3.12
<i>Foeniculum vulgare</i>	8500.00	15.00	4.02	3.83	1.76	0.004	5.59
<i>Fragaria nubicola</i>	3500.00	5.00	4.40	1.58	0.59	0.004	2.17
<i>Lepidium sativum</i>	6000.00	10.00	3.19	2.70	1.18	0.003	3.88
<i>Malva neglecta</i>	11000.00	10.00	3.11	4.95	1.18	0.003	6.13
<i>Matricaria aurea</i>	9500.00	10.00	3.54	4.28	1.18	0.003	5.46
<i>Papaver dubium</i>	3500.00	10.00	4.50	1.58	1.18	0.004	2.76
<i>Plantago major</i>	21500.00	25.00	7.47	9.68	2.94	0.01	12.63
<i>Stellaria media</i>	5500.00	10.00	8.47	2.48	1.18	0.01	3.66
<i>Trifolium pratense</i>	16500.00	15.00	2.82	7.43	1.76	0.002	9.19
<i>Trifolium repens</i>	41000.00	30.00	9.92	18.46	3.53	0.01	21.99
<i>Tropaeolum majus</i>	7500.00	10.00	2.55	3.38	1.18	0.002	4.55
<i>Urtica dioica</i>	36500.00	35.00	12.05	16.43	4.12	0.01	20.56
<i>Verbascum thapsus</i>	2000.00	10.00	4.08	0.90	1.18	0.004	2.08
<i>Veronica persica</i>	27500.00	35.00	14.14	12.38	4.12	0.01	16.51
<i>Xanthium spinosum</i>	6500.00	20.00	2.82	2.93	2.35	0.002	5.28
<b>TOTAL</b>	<b>222160.00</b>	<b>850.00</b>	<b>114299.50</b>	<b>100.00</b>	<b>100.00</b>	<b>100.00</b>	<b>300.00</b>

Whereas, IVI= Importance Value Index

**Table 10: Floristic composition and phytosociological attributes of plant species at Saloora (1589m amsl)**

Species	Average Density/ha	Frequency (%)	Average Basal Area cm <sup>2</sup> / ha	Relative Density	Relative Frequency	Relative Basal Area	IVI
<b>TREES</b>							
<i>Ailanthus altissima</i>	80.00	60.00	40764.33	0.07	8.57	6.62	15.26
<i>Cryptomeria japonica</i>	20.00	20.00	40764.33	0.02	2.86	6.62	9.49
<i>Cupressus sempervirens</i>	100.00	40.00	77404.14	0.09	5.71	12.57	18.37
<i>Ficus carica</i>	40.00	20.00	35783.44	0.04	2.86	5.81	8.70
<i>Populus deltoides</i>	60.00	40.00	87062.10	0.05	5.71	14.14	19.90
<b>SHRUBS</b>							
<i>Abelia × grandiflora</i>	120.00	20.00	31041.40	0.11	2.86	5.04	8.00
<i>Buddleja davidii</i>	120.00	30.00	73987.26	0.11	4.29	12.01	16.41
<i>Buxus sempervirens</i>	160.00	40.00	92580.41	0.14	5.71	15.03	20.89
<i>Euonymus japonicus</i>	360.00	30.00	24849.54	0.32	4.29	4.03	8.64
<i>Hydrangea macrophylla</i>	120.00	30.00	42462.89	0.11	4.29	6.89	11.29
<i>Lavandula angustifolia</i>	440.00	20.00	1299.65	0.39	2.86	0.21	3.46
<i>Nerium indicum</i>	120.00	30.00	61657.06	0.11	4.29	10.01	14.40
<i>Rosa × damascena</i>	280.00	40.00	4020.04	0.25	5.71	0.65	6.62
<i>Rubus niveus</i>	120.00	30.00	2055.21	0.11	4.29	0.33	4.73

Contd....

Table 10: contd....

Species	Average Density/ha	Frequency (%)	Average Basal Area cm <sup>2</sup> / ha	Relative Density	Relative Frequency	Relative Basal Area	IVI
<b>HERBS</b>							
<i>Alcea rosea</i>	3500.00	15.00	15.11	3.14	2.14	0.002	5.28
<i>Amaranthus tricolor</i>	6500.00	15.00	23.84	5.82	2.14	0.004	7.97
<i>Anthemis cotula</i>	7500.00	25.00	19.63	6.72	3.57	0.003	10.29
<i>Arctium lappa</i>	10000.00	30.00	63.99	8.96	4.29	0.01	13.25
<i>Brassica rapa</i>	7000.00	15.00	2.57	6.27	2.14	0.0004	8.41
<i>Canna indica</i>	2500.00	10.00	23.55	2.24	1.43	0.004	3.67
<i>Cannabis sativa</i>	15000.00	20.00	14.80	13.44	2.86	0.002	16.30
<i>Conyza canadensis</i>	15000.00	35.00	6.36	13.44	5.00	0.001	18.44
<i>Daucus carota</i>	5500.00	20.00	0.55	4.93	2.86	0.0001	7.78
<i>Eschscholzia californica</i>	11000.00	15.00	1.85	9.85	2.14	0.000	12.00
<i>Euphorbia peplus</i>	6500.00	20.00	3.12	5.82	2.86	0.001	8.68
<i>Foeniculum vulgare</i>	15000.00	20.00	17.20	13.44	2.86	0.003	16.30
<i>Galinsoga parviflora</i>	4500.00	10.00	6.48	4.03	1.43	0.001	5.46
<b>TOTAL</b>	<b>111640.00</b>	<b>700.00</b>	<b>615930.85</b>	<b>100.00</b>	<b>100.00</b>	<b>100.00</b>	<b>300.00</b>

Whereas, IVI= Importance Value Index

**Table 11: Floristic composition and phytosociological attributes of plant species at Wanipora (1595m amsl)**

Species	Average Density/ha	Frequency (%)	Average Basal Area cm <sup>2</sup> / ha	Relative Density	Relative Frequency	Relative Basal Area	IVI
<b>TREES</b>							
<i>Ficus carica</i>	20.00	20.00	624.27	0.01	2.67	0.49	3.17
<i>Morus alba</i>	60.00	20.00	3237.58	0.03	2.67	2.52	5.23
<i>Populus nigra</i>	120.00	60.00	49071.17	0.07	8.00	38.27	46.34
<i>Populus deltoides</i>	80.00	40.00	21797.77	0.05	5.33	17.00	22.38
<i>Robinia psuedoacacia</i>	80.00	40.00	4729.70	0.05	5.33	3.69	9.07
<i>Salix alba</i>	100.00	40.00	27340.45	0.06	5.33	21.32	26.71
<i>Thuja orientalis</i>	20.00	20.00	3369.43	0.01	2.67	2.63	5.31
<b>SHRUBS</b>							
<i>Berberis lycium</i>	280.00	20.00	395.93	0.16	2.67	0.31	3.14
<i>Euonymus japonicus</i>	560.00	40.00	8281.35	0.32	5.33	6.46	12.11
<i>Hibiscus syriacus</i>	240.00	40.00	1724.52	0.14	5.33	1.34	6.82
<i>Hydrangea macrophylla</i>	80.00	20.00	1500.78	0.05	2.67	1.17	3.88
<i>Indigofera heterantha</i>	160.00	30.00	156.05	0.09	4.00	0.12	4.21
<i>Nerium indicum</i>	240.00	40.00	5212.77	0.14	5.33	4.07	9.54
<i>Rosa moschata</i>	440.00	40.00	761.91	0.25	5.33	0.59	6.18

Contd....

Table 11: contd....

Species	Average Density/ha	Frequency (%)	Average Basal Area cm <sup>2</sup> / ha	Relative Density	Relative Frequency	Relative Basal Area	IVI
<b>HERBS</b>							
<i>Anthemis cotula</i>	11000.00	15.00	1.22	6.32	2.00	0.00	8.32
<i>Arctium lappa</i>	10500.00	25.00	1.11	6.04	3.33	0.00	9.37
<i>Brassica rapa</i>	7500.00	10.00	0.04	4.31	1.33	0.00	5.64
<i>Cannabis sativa</i>	31000.00	30.00	4.23	17.82	4.00	0.00	21.82
<i>Carpesium abrotanoides</i>	3000.00	10.00	0.03	1.72	1.33	0.00	3.06
<i>Chenopodium album</i>	10500.00	15.00	0.62	6.04	2.00	0.00	8.04
<i>Cirsium arvense</i>	13500.00	35.00	0.86	7.76	4.67	0.00	12.43
<i>Convolvulus arvense</i>	19500.00	25.00	1.66	11.21	3.33	0.00	14.54
<i>Conyza canadensis</i>	9500.00	15.00	1.70	5.46	2.00	0.00	7.46
<i>Euphorbia peplus</i>	3500.00	10.00	0.48	2.01	1.33	0.00	3.35
<i>Foeniculum vulgare</i>	7000.00	10.00	1.09	4.02	1.33	0.00	5.36
<i>Lepidium sativum</i>	7000.00	10.00	2.46	4.02	1.33	0.00	5.36
<i>Lupinus polyphyllus</i>	2500.00	10.00	0.02	1.44	1.33	0.00	2.77
<i>Malva neglecta</i>	7000.00	10.00	1.84	4.02	1.33	0.00	5.36
<i>Marrubium vulgare</i>	2000.00	5.00	0.00	1.15	0.67	0.00	1.82
<i>Matricaria aurea</i>	8000.00	10.00	1.48	4.60	1.33	0.00	5.93
<i>Myosotis arvensis</i>	4500.00	10.00	0.21	2.59	1.33	0.00	3.92
<i>Oxalis corniculata</i>	6500.00	10.00	0.16	3.74	1.33	0.00	5.07
<i>Plantago major</i>	7500.00	15.00	0.23	4.31	2.00	0.00	6.31
<b>TOTAL</b>	<b>173980.00</b>	<b>750.00</b>	<b>128223.10</b>	<b>100.00</b>	<b>100.00</b>	<b>100.00</b>	<b>300.00</b>

Whereas, IVI= Importance Value Index

#### 4.1.2 Floristic diversity at different sites of Peri-urban areas of Ganderbal

##### Site 10 (Arch)

In Table 12, *Aesculus indica* had the highest Importance Value Index (IVI) among the eleven tree species at 54.78, followed by *Juglans regia* at 13.30. *Aesculus indica* also contributed the most to basal area, accounting for 49.70 %. Among shrubs, *Nerium indicum* had the highest IVI at 11.57, while *Euonymus japonicus* had the highest density at 0.24 %. *Nerium indicum* also had the highest share of basal area among shrubs at 6.34 %. In the herb category, *Cannabis sativa* had the highest IVI at 19.85, followed by *Trifolium pratense* at 17.08, while *Euphorbia peplus* had the lowest IVI value at 1.44. *Cannabis sativa* also recorded the highest density at 16.05 %.

##### Site 11 (Badhra Kund)

In Table 13, it is evident that the area had 8 trees, 5 shrubs, 1 sub-shrub and 17 herb species. Among the tree species, *Platanus orientalis* displayed the highest dominance, with an IVI (Importance Value Index) value of 55.39, while *Melia azedarach* had the lowest IVI value at 4.23. *Platanus orientalis* also contributed the most to basal area, accounting for 52.89 %, whereas, *Melia azedarach* had the smallest basal area contribution at 1.73 %. Within the 17 herb species observed, *Urtica dioica* had the highest IVI value (22.05) and the highest density (17.01 %). Among shrubs, *Rubus ulmifolius* had the maximum IVI (10.09) and density (0.23 %). In contrast, *Indigofera heterantha* had the highest basal area contribution at 3.64 %.

**Table 12: Floristic composition and phytosociological attributes of plant species at Arch (1581m amsl)**

Species	Average Density/ha	Frequency (%)	Average Basal Area cm <sup>2</sup> / ha	Relative Density	Relative Frequency	Relative Basal Area	IVI
<b>TREES</b>							
<i>Aesculus indica</i>	20.00	40.00	98926.05	0.01	5.06	49.70	54.78
<i>Ailanthus altissima</i>	25.00	60.00	5177.15	0.01	7.59	2.60	10.21
<i>Cedrus deodara</i>	5.00	20.00	6936.31	0.003	2.53	3.49	6.02
<i>Celtis australis</i>	5.00	20.00	407.64	0.003	2.53	0.20	2.74
<i>Ficus carica</i>	5.00	20.00	1787.02	0.003	2.53	0.90	3.43
<i>Juglans regia</i>	5.00	20.00	21426.75	0.003	2.53	10.77	13.30
<i>Morus alba</i>	10.00	20.00	4598.73	0.01	2.53	2.31	4.85
<i>Populus nigra</i>	10.00	20.00	2364.85	0.01	2.53	1.19	3.73
<i>Populus deltoides</i>	10.00	20.00	4720.54	0.01	2.53	2.37	4.91
<i>Robinia psuedoacacia</i>	5.00	20.00	2421.97	0.003	2.53	1.22	3.75
<i>Salix alba</i>	10.00	20.00	2278.86	0.01	2.53	1.15	3.68
<b>SHRUBS</b>							
<i>Euonymus japonicus</i>	440.00	30.00	7328.51	0.24	3.80	3.68	7.72
<i>Hibiscus syriacus</i>	160.00	20.00	7491.24	0.09	2.53	3.76	6.38
<i>Indigofera heterantha</i>	80.00	10.00	460.19	0.04	1.27	0.23	1.54
<i>Nerium indicum</i>	320.00	40.00	12613.06	0.17	5.06	6.34	11.57
<i>Rosa × damascena</i>	360.00	30.00	7266.40	0.19	3.80	3.65	7.64
<i>Rosa moschata</i>	160.00	10.00	2030.45	0.09	1.27	1.02	2.37
<i>Rosa multiflora</i>	240.00	30.00	985.98	0.13	3.80	0.50	4.42
<i>Rubus ulmifolius</i>	200.00	20.00	4910.09	0.11	2.53	2.47	5.11
<i>Viburnum opulus</i>	80.00	20.00	3369.43	0.04	2.53	1.69	4.27
<b>SUB-SHRUB</b>							
<i>Rumex hastatus</i>	280.00	30.00	1447.19	0.15	3.80	0.73	4.67

Contd....

Table 12: contd....

Species	Average Density/ha	Frequency (%)	Average Basal Area cm <sup>2</sup> / ha	Relative Density	Relative Frequency	Relative Basal Area	IVI
<b>HERBS</b>							
<i>Anthemis cotula</i>	6500.00	15.00	0.08	3.48	1.90	0.00004	5.38
<i>Arctium lappa</i>	5000.00	15.00	7.16	2.67	1.90	0.004	4.58
<i>Avena sativa</i>	11000.00	10.00	4.93	5.88	1.27	0.002	7.15
<i>Bothriochloa ischaemum</i>	8000.00	15.00	0.11	4.28	1.90	0.0001	6.18
<i>Brassica rapa</i>	6500.00	10.00	7.84	3.48	1.27	0.004	4.75
<i>Cannabis sativa</i>	30000.00	30.00	13.14	16.05	3.80	0.01	19.85
<i>Carpesium abrotanoides</i>	3000.00	10.00	0.15	1.60	1.27	0.0001	2.87
<i>Chenopodium album</i>	7500.00	15.00	0.36	4.01	1.90	0.0002	5.91
<i>Cirsium arvense</i>	3000.00	10.00	5.99	1.60	1.27	0.003	2.87
<i>Convolvulus arvense</i>	2500.00	5.00	1.47	1.34	0.63	0.001	1.97
<i>Euphorbia peplus</i>	1500.00	5.00	0.01	0.80	0.63	0.000	1.44
<i>Galinsoga parviflora</i>	2000.00	5.00	0.08	1.07	0.63	0.000	1.70
<i>Matricaria aurea</i>	4000.00	5.00	0.58	2.14	0.63	0.0003	2.77
<i>Myosotis arvensis</i>	6500.00	10.00	1.63	3.48	1.27	0.001	4.74
<i>Oxalis corniculata</i>	7500.00	10.00	5.58	4.01	1.27	0.003	5.28
<i>Plantago major</i>	11000.00	15.00	2.69	5.88	1.90	0.001	7.78
<i>Polygonum hydropiper</i>	5500.00	10.00	1.35	2.94	1.27	0.001	4.21
<i>Tagetes minuta</i>	3000.00	5.00	3.83	1.60	0.63	0.002	2.24
<i>Trifolium pratense</i>	26000.00	25.00	7.84	13.91	3.16	0.004	17.08
<i>Trifolium repens</i>	19500.00	15.00	7.72	10.43	1.90	0.004	12.33
<i>Urtica dioica</i>	8500.00	10.00	3.84	4.55	1.27	0.002	5.81
<i>Xanthium spinosum</i>	3000.00	10.00	0.15	1.60	1.27	0.0001	2.87
<b>Total</b>	<b>186930.00</b>	<b>790.00</b>	<b>199027.20</b>	<b>100.00</b>	<b>100.00</b>	<b>100.00</b>	<b>300.00</b>

Whereas, IVI= Importance Value Index

**Table 13: Floristic composition and phytosociological attributes of plant species at Badhra Kund (1537m amsl)**

Species	Average Density/ha	Frequency (%)	Average Basal Area cm <sup>2</sup> / ha	Relative Density	Relative Frequency	Relative Basal Area	IVI
<b>TREES</b>							
<i>Juniperus communis</i>	10.00	20.00	867.04	0.003	2.50	2.16	4.66
<i>Melia azedarach</i>	10.00	20.00	692.87	0.003	2.50	1.73	4.23
<i>Morus alba</i>	10.00	20.00	920.38	0.003	2.50	2.29	4.79
<i>Picea smithiana</i>	5.00	20.00	1428.35	0.002	2.50	3.56	6.06
<i>Platanus orientalis</i>	5.00	20.00	21242.44	0.002	2.50	52.89	55.39
<i>Populus nigra</i>	25.00	40.00	1628.11	0.01	5.00	4.05	9.06
<i>Populus deltoides</i>	25.00	60.00	3378.66	0.01	7.50	8.41	15.92
<i>Robinia psuedoacacia</i>	25.00	40.00	3313.38	0.01	5.00	8.25	13.26
<b>SHRUBS</b>							
<i>Indigofera heterantha</i>	640.00	40.00	1461.88	0.21	5.00	3.64	8.85
<i>Rosa moschata</i>	400.00	30.00	959.88	0.13	3.75	2.39	6.27
<i>Rosa multiflora</i>	520.00	40.00	1019.17	0.17	5.00	2.54	7.71
<i>Rubus niveus</i>	560.00	50.00	1282.99	0.19	6.25	3.19	9.63
<i>Rubus ulmifolius</i>	680.00	50.00	1450.73	0.23	6.25	3.61	10.09
<b>SUB- SHRUB</b>							
<i>Rumex hastatus</i>	360.00	30.00	433.47	0.12	3.75	1.08	4.95

Contd....

Table 13L contd....

Species	Average Density/ha	Frequency (%)	Average Basal Area cm <sup>2</sup> / ha	Relative Density	Relative Frequency	Relative Basal Area	IVI
<b>HERBS</b>							
<i>Anthemis cotula</i>	6000.00	10.00	0.07	2.00	1.25	0.0002	3.25
<i>Arctium lappa</i>	3000.00	10.00	0.32	1.00	1.25	0.001	2.25
<i>Cirsium arvense</i>	4000.00	10.00	0.03	1.33	1.25	0.0001	2.58
<i>Convolvulus arvense</i>	14000.00	20.00	0.04	4.67	2.50	0.0001	7.17
<i>Conyza canadensis</i>	12000.00	20.00	0.72	4.00	2.50	0.002	6.50
<i>Euphorbia peplus</i>	9500.00	15.00	0.05	3.17	1.88	0.0001	5.04
<i>Foeniculum vulgare</i>	2500.00	5.00	0.01	0.83	0.63	0.00004	1.46
<i>Malva neglecta</i>	32000.00	20.00	10.56	10.67	2.50	0.03	13.20
<i>Mentha arvensis</i>	26500.00	20.00	17.02	8.84	2.50	0.04	11.38
<i>Oxalis corniculata</i>	18000.00	30.00	0.15	6.00	3.75	0.0004	9.75
<i>Plantago major</i>	18000.00	30.00	2.95	6.00	3.75	0.01	9.76
<i>Polygonum hydropiper</i>	16000.00	25.00	0.08	5.34	3.13	0.0002	8.46
<i>Tagetes patula</i>	2500.00	5.00	0.00	0.83	0.63	0.00001	1.46
<i>Trifolium pratense</i>	42500.00	30.00	17.97	14.18	3.75	0.04	17.97
<i>Trifolium repens</i>	33500.00	20.00	20.40	11.18	2.50	0.05	13.73
<i>Urtica dioica</i>	51000.00	40.00	16.11	17.01	5.00	0.04	22.05
<i>Veronica persica</i>	5500.00	10.00	0.02	1.83	1.25	0.00	3.08
<b>TOTAL</b>	<b>299775.00</b>	<b>800.00</b>	<b>40165.86</b>	<b>100.00</b>	<b>100.00</b>	<b>100.00</b>	<b>300.00</b>

Whereas, IVI= Importance Value Index

### Site 12 (Harran)

The tabulated data pertaining to site 12 reveals noteworthy findings about the plant species present: In terms of trees, *Aesculus indica* exhibited the highest IVI value, standing at an impressive 95.92, followed by *Populus deltoides* with a much lower IVI value of 14.98. Additionally, *Aesculus indica* made the largest contribution to basal area, accounting for a substantial 86.14 %, while *Ficus carica* contributed a mere 0.35 % to basal area. Among the shrubs, *Indigofera heterantha* emerged as the dominant species within the area, boasting an IVI value of 8.14. On the other hand, *Euonymus japonicus* contributed the most to basal area, representing 0.47 % of the total. *Indigofera heterantha* also had the highest density, reaching 0.41 %. Turning to the herbaceous species, *Malva neglecta* exhibited the maximum dominance with an IVI value of 8.79, closely followed by *Vinca major* and *Conyza canadensis*, both of which had IVI values of 7.99. In contrast, *Verbascum thapsus* displayed the lowest dominance, with an IVI value of 0.87 (Table 14).

### Site 13 (Rakh Kujjar)

The floristic composition data for Site 13 in Ganderbal provides insights into the dominant plant species: In the category of trees, *Aesculus indica* emerged as the dominant species with the highest IVI value, reaching 40.26. *Aesculus indica* also contributed significantly to the basal area, accounting for 35.29 %, followed by *Picea smithiana* at 17.66 %. Among the shrubs, *Rosa moschata* displayed the highest IVI value at 14.32, followed by *Rosa multiflora* with an IVI of 12.17. In contrast, *Rubus ulmifolius* had the lowest IVI value at 3.75. *Rosa moschata* not only had the highest IVI but also the highest basal area contribution at 5.26 % and a density of 0.37 %. When it comes to herbaceous species, *Cannabis sativa* stood out as the most dominant, boasting an IVI value of 19.93, followed by *Urtica dioica* with an IVI value of 12.86. *Eschscholzia californica* had the lowest IVI value at 2.62. *Cannabis sativa* also had the highest density among herbs at 16.13 % (Table 15).

**Table 14: Floristic composition and phytosociological attributes of plant species at Harran (1583 m amsl)**

Species	Average Density/ha	Frequency (%)	Average Basal Area cm <sup>2</sup> / ha	Relative Density	Relative Frequency	Relative Basal Area	IVI
<b>TREES</b>							
<i>Aesculus indica</i>	160.00	80.00	596409.43	0.09	9.70	86.14	95.92
<i>Ficus carica</i>	40.00	40.00	2408.44	0.02	4.85	0.35	5.22
<i>Morus alba</i>	40.00	40.00	4013.54	0.02	4.85	0.58	5.45
<i>Populus deltoides</i>	100.00	60.00	53014.01	0.05	7.27	7.66	14.98
<i>Robinia psuedoacacia</i>	40.00	40.00	17675.96	0.02	4.85	2.55	7.42
<i>Salix alba</i>	60.00	20.00	8970.26	0.03	2.42	1.30	3.75
<b>SHRUBS</b>							
<i>Berberis lycium</i>	320.00	30.00	305.45	0.17	3.64	0.04	3.85
<i>Crataegus songarica</i>	160.00	20.00	364.62	0.09	2.42	0.05	2.56
<i>Euonymus japonicus</i>	440.00	30.00	3271.45	0.24	3.64	0.47	4.34
<i>Hibiscus syriacus</i>	80.00	20.00	417.90	0.04	2.42	0.06	2.53
<i>Indigofera heterantha</i>	760.00	60.00	3192.13	0.41	7.27	0.46	8.14
<i>Nerium indicum</i>	80.00	10.00	749.82	0.04	1.21	0.11	1.36
<i>Rosa moschata</i>	480.00	50.00	844.20	0.26	6.06	0.12	6.44
<i>Rosa multiflora</i>	240.00	30.00	624.47	0.13	3.64	0.09	3.86
<b>HERBS</b>							
<i>Anthemis cotula</i>	8000.00	15.00	4.27	4.29	1.82	0.001	6.11
<i>Arctium lappa</i>	7000.00	15.00	3.70	3.75	1.82	0.001	5.57
<i>Bothriochloa ischaemum</i>	9000.00	15.00	8.67	4.83	1.82	0.001	6.65
<i>Cannabis sativa</i>	6000.00	10.00	4.70	3.22	1.21	0.001	4.43
<i>Chenopodium album</i>	9500.00	15.00	9.24	5.09	1.82	0.001	6.91

Contd....

Table 14: contd....

Species	Average Density/ha	Frequency (%)	Average Basal Area cm <sup>2</sup> / ha	Relative Density	Relative Frequency	Relative Basal Area	IVI
<i>Cirsium arvense</i>	6000.00	15.00	9.47	3.22	1.82	0.001	5.04
<i>Convolvulus arvense</i>	9500.00	15.00	7.97	5.09	1.82	0.001	6.91
<i>Conyza canadensis</i>	11500.00	15.00	7.06	6.17	1.82	0.001	7.99
<i>Daucus carota</i>	2500.00	10.00	0.20	1.34	1.21	0.00003	2.55
<i>Foeniculum vulgare</i>	7500.00	10.00	3.39	4.02	1.21	0.0005	5.23
<i>Galinsoga parviflora</i>	5000.00	10.00	2.12	2.68	1.21	0.0003	3.89
<i>Lupinus polyphyllus</i>	5500.00	10.00	1.98	2.95	1.21	0.0003	4.16
<i>Malva neglecta</i>	13000.00	15.00	8.38	6.97	1.82	0.001	8.79
<i>Marrubium vulgare</i>	7500.00	10.00	3.10	4.02	1.21	0.0004	5.23
<i>Oxalis corniculata</i>	5000.00	10.00	4.39	2.68	1.21	0.001	3.89
<i>Plantago major</i>	10500.00	15.00	6.70	5.63	1.82	0.001	7.45
<i>Rumex dentatus</i>	3500.00	10.00	1.48	1.88	1.21	0.0002	3.09
<i>Setaria viridis</i>	5500.00	10.00	5.75	2.95	1.21	0.001	4.16
<i>Stellaria media</i>	6000.00	10.00	4.39	3.22	1.21	0.001	4.43
<i>Trifolium pratense</i>	11500.00	10.00	5.24	6.17	1.21	0.001	7.38
<i>Trifolium repens</i>	9500.00	10.00	6.79	5.09	1.21	0.001	6.31
<i>Tropaeolum majus</i>	1500.00	5.00	2.45	0.80	0.61	0.0004	1.41
<i>Urtica dioica</i>	8000.00	10.00	6.13	4.29	1.21	0.001	5.50
<i>Verbascum thapsus</i>	500.00	5.00	3.83	0.27	0.61	0.001	0.87
<i>Veronica persica</i>	3000.00	5.00	2.55	1.61	0.61	0.000	2.22
<i>Vinca major</i>	11500.00	15.00	4.60	6.17	1.82	0.001	7.99
<b>TOTAL</b>	<b>186500.00</b>	<b>825.00</b>	<b>692390.23</b>	<b>100.00</b>	<b>100.00</b>	<b>100.00</b>	<b>300.00</b>

Whereas, IVI= Importance Value Index

**Table 15: Floristic composition and phytosociological attributes of plant species at Rakh Kujjar (1623m amsl)**

Species	Average Density/ha	Frequency (%)	Average Basal Area cm <sup>2</sup> / ha	Relative Density	Relative Frequency	Relative Basal Area	IVI
<b>TREES</b>							
<i>Aesculus indica</i>	15.00	40.00	9108.81	0.01	4.97	35.29	40.26
<i>Cedrus deodara</i>	5.00	20.00	2299.36	0.002	2.48	8.91	11.39
<i>Ficus carica</i>	5.00	20.00	175.56	0.002	2.48	0.68	3.17
<i>Juniperus communis</i>	10.00	20.00	790.01	0.004	2.48	3.06	5.55
<i>Morus alba</i>	10.00	20.00	893.51	0.004	2.48	3.46	5.95
<i>Picea smithiana</i>	20.00	60.00	4557.72	0.01	7.45	17.66	25.12
<i>Populus deltoides</i>	15.00	20.00	1027.60	0.01	2.48	3.98	6.47
<i>Robinia psuedoacacia</i>	25.00	40.00	2438.30	0.01	4.97	9.44	14.43
<b>SHRUBS</b>							
<i>Berberis lycium</i>	360.00	40.00	627.18	0.16	4.97	2.43	7.56
<i>Crataegus songarica</i>	160.00	20.00	392.39	0.07	2.48	1.52	4.08
<i>Indigofera heterantha</i>	320.00	30.00	452.11	0.14	3.73	1.75	5.62
<i>Rosa moschata</i>	840.00	70.00	1357.17	0.37	8.70	5.26	14.32
<i>Rosa multiflora</i>	680.00	60.00	1139.75	0.30	7.45	4.42	12.17
<i>Rubus ulmifolius</i>	160.00	20.00	308.99	0.07	2.48	1.20	3.75
<b>SUB –SHRUB</b>							
<i>Rumex hastatus</i>	120.00	10.00	182.17	0.05	1.24	0.71	2.00

Contd....

Table 15: contd....

Species	Average Density/ha	Frequency (%)	Average Basal Area cm <sup>2</sup> / ha	Relative Density	Relative Frequency	Relative Basal Area	IVI
<b>HERBS</b>							
<i>Anthemis cotula</i>	15000.00	20.00	4.252	6.63	2.48	0.02	9.13
<i>Arctium lappa</i>	8500.00	25.00	0.089	3.76	3.11	0.00	6.86
<i>Bothriochloa ischaemum</i>	8000.00	15.00	1.789	3.54	1.86	0.01	5.41
<i>Brassica rapa</i>	6500.00	15.00	0.057	2.87	1.86	0.00	4.74
<i>Cannabis sativa</i>	36500.00	30.00	18.91	16.13	3.73	0.07	19.93
<i>Cirsium arvense</i>	4500.00	10.00	1.51	1.99	1.24	0.01	3.24
<i>Convolvulus arvense</i>	20000.00	20.00	6.27	8.84	2.48	0.02	11.35
<i>Conyza canadensis</i>	11500.00	20.00	0.95	5.08	2.48	0.00	7.57
<i>Daucus carota</i>	3000.00	15.00	0.03	1.33	1.86	0.000	3.19
<i>Eschscholzia californica</i>	4500.00	5.00	3.19	1.99	0.62	0.01	2.62
<i>Galinsoga parviflora</i>	12000.00	15.00	2.58	5.30	1.86	0.01	7.18
<i>Malva neglecta</i>	21000.00	15.00	7.91	9.28	1.86	0.03	11.18
<i>Marrubium vulgare</i>	5000.00	10.00	0.71	2.21	1.24	0.00	3.46
<i>Mentha arvensis</i>	21500.00	25.00	6.73	9.50	3.11	0.03	12.63
<i>Plantago major</i>	9500.00	15.00	0.12	4.20	1.86	0.00	6.06
<i>Polygonum hydropiper</i>	9500.00	20.00	0.05	4.20	2.48	0.00	6.68
<i>Urtica dioica</i>	22000.00	25.00	9.05	9.72	3.11	0.04	12.86
<i>Xanthium spinosum</i>	5000.00	15.00	0.07	2.21	1.86	0.000	4.07
<b>TOTAL</b>	<b>226245.00</b>	<b>805.00</b>	<b>25814.96</b>	<b>100.00</b>	<b>100.00</b>	<b>100.00</b>	<b>300.00</b>

Whereas, IVI= Importance Value Index

#### **Site 14 (Rangil)**

Among the trees in Site 14, *Aesculus indica* stood out as the most dominant species with an IVI value of 44.07, closely followed by *Juglans regia* with an IVI value of 42.66. In contrast, *Morus alba* had the lowest IVI value among trees, indicating its minimal dominance in the area, with a value of 4.85. *Juglans regia* also had the highest basal area contribution, accounting for 37.70 % of the tree population's basal area. Moving on to shrubs, *Indigofera heterantha* was the dominant species with an IVI value of 5.93. Additionally, it had the highest basal area contribution at 0.59 % and a density of 0.40 %, further emphasizing its prevalence in the shrub category. In the herbaceous plants category, *Malva neglecta* emerged as the most dominant species, boasting an IVI value of 13.56. *Trifolium repens* followed with an IVI value of 9.16, indicating significant dominance as well. Conversely, *Verbascum thapsus* had the lowest IVI value among herbs, suggesting it has the least dominance in this group, with an IVI value of 0.87. *Malva neglecta* also holds the highest density among herbs, accounting for 11.10 % of the herbaceous plant population (Table 16).

#### **Site 15 (Sarich Chodri Bagh)**

The data for site 15 depicted that among seven tree species present *Aesculus indica* dominated both IVI value (37.45) and share of basal area (32.77 %) followed by *Juglans regia* with value at 32.75 and 30.41 %, respectively. *Rosa moschata* shrub with maximum IVI value of 6.19 and basal area of 1.33 % was observed. Both *Rosa moschata* and *Rubus ulmifolius* showed the highest density of 0.18 %. Among herbs the prominent specie was *Urtica dioica* and *Cannabis sativa* with IVI value of 19.46 and 14.43 respectively followed by *Malva neglecta* with IVI value of 10.87. Whereas *Fragaria nubicola* had minimum IVI value 2.46 (Table 17).

**Table 16: Floristic composition and phytosociological attributes of plant species at Rangil (1699m amsl)**

Species	Average Density/ha	Frequency (%)	Average Basal Area cm <sup>2</sup> / ha	Relative Density	Relative Frequency	Relative Basal Area	IVI
<b>TREES</b>							
<i>Aesculus indica</i>	80.00	60.00	65943.07	0.04	7.41	36.62	44.07
<i>Ailanthus altissima</i>	40.00	40.00	2321.66	0.02	4.94	1.29	6.25
<i>Ficus carica</i>	40.00	40.00	2321.66	0.02	4.94	1.29	6.25
<i>Juglans regia</i>	40.00	40.00	67885.35	0.02	4.94	37.70	42.66
<i>Morus alba</i>	40.00	20.00	4242.83	0.02	2.47	2.36	4.85
<i>Populus nigra</i>	60.00	40.00	22524.63	0.03	4.94	12.51	17.48
<i>Populus deltoides</i>	40.00	20.00	8611.46	0.02	2.47	4.78	7.27
<b>SHRUBS</b>							
<i>Berberis lycium</i>	240.00	20.00	280.79	0.12	2.47	0.16	2.75
<i>Hibiscus syriacus</i>	320.00	20.00	562.80	0.16	2.47	0.31	2.94
<i>Hydrangea macrophylla</i>	160.00	20.00	501.60	0.08	2.47	0.28	2.83
<i>Indigofera heterantha</i>	800.00	40.00	1065.48	0.40	4.94	0.59	5.93
<i>Lavandula angustifolia</i>	320.00	10.00	559.81	0.16	1.23	0.31	1.71
<i>Nerium indicum</i>	120.00	10.00	1053.34	0.06	1.23	0.58	1.88
<i>Rosa × damascena</i>	520.00	30.00	793.14	0.26	3.70	0.44	4.41
<i>Rosa moschata</i>	360.00	30.00	633.15	0.18	3.70	0.35	4.24
<i>Rosa multiflora</i>	120.00	10.00	179.41	0.06	1.23	0.10	1.39
<i>Rubus ulmifolius</i>	120.00	10.00	265.01	0.06	1.23	0.15	1.44
<b>SUB- SHRUB</b>							
<i>Rumex hastatus</i>	360.00	40.00	324.87	0.18	4.94	0.18	5.30

Contd....

Table 16: contd....

Species	Average Density/ha	Frequency (%)	Average Basal Area cm <sup>2</sup> / ha	Relative Density	Relative Frequency	Relative Basal Area	IVI
<b>HERBS</b>							
<i>Anthemis cotula</i>	8500.00	15.00	0.09	4.29	1.85	0.00005	6.14
<i>Arctium lappa</i>	1500.00	5.00	0.01	0.76	0.62	0.000004	1.37
<i>Bothriochloa ischaemum</i>	5500.00	10.00	0.04	2.77	1.23	0.00002	4.01
<i>Cannabis sativa</i>	12000.00	15.00	0.08	6.05	1.85	0.00004	7.90
<i>Carpesium abrotanoides</i>	1500.00	5.00	0.01	0.76	0.62	0.000004	1.37
<i>Convolvulus arvensis</i>	12000.00	20.00	0.07	6.05	2.47	0.00004	8.52
<i>Coryza canadensis</i>	10000.00	15.00	0.07	5.04	1.85	0.00004	6.90
<i>Daucus carota</i>	3000.00	15.00	0.10	1.51	1.85	0.00005	3.36
<i>Foeniculum vulgare</i>	2500.00	5.00	0.06	1.26	0.61	0.00003	1.878
<i>Galinsoga parviflora</i>	9500.00	20.00	0.07	4.79	2.46	0.00004	7.26
<i>Malva neglecta</i>	22000.00	20.00	4.07	11.10	2.46	0.002	13.56
<i>Marrubium vulgare</i>	9500.00	15.00	0.03	4.79	1.85	0.000	6.64
<i>Matricaria aurea</i>	8500.00	15.00	0.05	4.29	1.85	0.00003	6.13
<i>Oxalis corniculata</i>	10000.00	15.00	0.05	5.04	1.85	0.00003	6.89
<i>Plantago major</i>	7500.00	15.00	0.03	3.78	1.85	0.00002	5.63
<i>Rumex dentatus</i>	7000.00	15.00	0.08	3.53	1.85	0.00005	5.38
<i>Scilla siberica</i>	6000.00	10.00	0.05	3.03	1.23	0.00003	4.26
<i>Stellaria media</i>	6000.00	10.00	0.03	3.03	1.23	0.00002	4.26
<i>Tagetes minuta</i>	5000.00	10.00	0.05	2.52	1.23	0.00003	3.75
<i>Trifolium pratense</i>	14000.00	15.00	1.08	7.06	1.85	0.001	8.91
<i>Trifolium repens</i>	14500.00	15.00	1.82	7.31	1.852	0.001	9.16
<i>Urtica dioica</i>	11500.00	10.00	3.95	5.80	1.23	0.002	7.03
<i>Verbascum thapsus</i>	500.00	5.00	0.20	0.25	0.61	0.0001	0.87
<i>Vinca major</i>	1500.00	5.00	0.01	0.75	0.61	0.00001	1.37
<i>Xanthium spinosum</i>	5000.00	10.00	0.04	2.52	1.23	0.00002	3.75
<b>Total</b>	<b>198280.00</b>	<b>810.00</b>	<b>180082.23</b>	<b>100.00</b>	<b>100.00</b>	<b>100.00</b>	<b>300.00</b>

Whereas, IVI= Importance Value Index

Table 17: Floristic composition and phytosociological attributes of plant species at Sarich Chodri Bagh (1522m amsl)

Species	Average Density/ha	Frequency (%)	Average Basal Area cm <sup>2</sup> / ha	Relative Density	Relative Frequency	Relative Basal Area	IVI
<b>TREES</b>							
<i>Aesculus indica</i>	10.00	40.00	17675.96	0.004	4.68	32.77	37.45
<i>Ailanthus altissima</i>	15.00	40.00	958.73	0.01	4.68	1.78	6.46
<i>Juglans regia</i>	5.00	20.00	16404.86	0.002	2.34	30.41	32.75
<i>Populus nigra</i>	20.00	40.00	2209.49	0.01	4.68	4.10	8.78
<i>Populus deltoides</i>	40.00	60.00	9459.39	0.01	7.02	17.54	24.57
<i>Robinia psuedoacacia</i>	15.00	40.00	1490.98	0.01	4.68	2.76	7.45
<i>Salix alba</i>	20.00	40.00	1922.87	0.01	4.68	3.56	8.25
<b>SHRUBS</b>							
<i>Crataegus songarica</i>	80.00	10.00	273.26	0.03	1.17	0.51	1.71
<i>Hibiscus syriacus</i>	400.00	40.00	501.94	0.15	4.68	0.93	5.76
<i>Indigofera heterantha</i>	80.00	10.00	28.09	0.03	1.17	0.05	1.25
<i>Rosa moschata</i>	480.00	40.00	717.62	0.18	4.68	1.33	6.19
<i>Rosa multiflora</i>	440.00	40.00	675.42	0.16	4.68	1.25	6.09
<i>Rubus niveus</i>	400.00	40.00	537.96	0.15	4.68	1.00	5.82
<i>Rubus ulmifolius</i>	480.00	40.00	516.14	0.18	4.68	0.96	5.81
<b>SUB-SHRUB</b>							
<i>Rumex hastatus</i>	400.00	40.00	507.01	0.15	4.68	0.94	5.77
<b>HERBS</b>							
<i>Anthemis cotula</i>	8000.00	15.00	0.09	2.96	1.75	0.0002	4.71
<i>Bothriochloa ischaemum</i>	10500.00	15.00	0.06	3.88	1.75	0.0001	5.64
<i>Cannabis sativa</i>	31000.00	25.00	20.86	11.47	2.92	0.04	14.43

Contd...

Table 17: contd....

Species	Average Density/ha	Frequency (%)	Average Basal Area cm <sup>2</sup> / ha	Relative Density	Relative Frequency	Relative Basal Area	IVI
<i>Chenopodium album</i>	12500.00	20.00	0.08	4.62	2.34	0.0002	6.96
<i>Cirsium arvense</i>	7500.00	10.00	2.46	2.77	1.17	0.005	3.95
<i>Convolvulus arvense</i>	7000.00	10.00	0.05	2.59	1.17	0.0001	3.76
<i>Conyza canadensis</i>	6500.00	10.00	0.04	2.40	1.17	0.0001	3.57
<i>Euphorbia peplus</i>	7000.00	10.00	0.03	2.59	1.17	0.0001	3.76
<i>Foeniculum vulgare</i>	5500.00	10.00	0.02	2.03	1.17	0.00003	3.20
<i>Fragaria nubicola</i>	3500.00	10.00	0.05	1.29	1.17	0.0001	2.46
<i>Lepidium sativum</i>	5500.00	10.00	0.04	2.03	1.17	0.0001	3.20
<i>Lupinus polyphyllus</i>	5500.00	10.00	0.03	2.03	1.17	0.00005	3.20
<i>Malva neglecta</i>	23000.00	20.00	11.89	8.51	2.34	0.02	10.87
<i>Marrubium vulgare</i>	6500.00	10.00	0.04	2.40	1.17	0.0001	3.57
<i>Matricaria aurea</i>	11000.00	15.00	0.04	4.07	1.75	0.0001	5.82
<i>Mentha arvensis</i>	13500.00	10.00	8.35	4.99	1.17	0.02	6.18
<i>Myosotis arvensis</i>	6000.00	10.00	0.04	2.22	1.17	0.0001	3.39
<i>Oxalis corniculata</i>	11000.00	15.00	0.07	4.07	1.75	0.0001	5.82
<i>Plantago major</i>	9500.00	15.00	0.06	3.51	1.75	0.0001	5.27
<i>Polygonum hydropiper</i>	10000.00	10.00	0.09	3.70	1.17	0.0002	4.87
<i>Trifolium pratense</i>	12500.00	10.00	2.70	4.62	1.17	0.01	5.80
<i>Trifolium repens</i>	13000.00	10.00	6.43	4.81	1.17	0.01	5.99
<i>Urtica dioica</i>	41500.00	35.00	9.92	15.35	4.09	0.02	19.46
<b>Total</b>	<b>270385.00</b>	<b>855.00</b>	<b>53943.15</b>	<b>100.00</b>	<b>100.00</b>	<b>100.00</b>	<b>300.00</b>

Whereas, IVI= Importance Value Index

### Site 16 (Sehpora)

In Table 18, the data from Site 16 revealed a diverse plant community with 8 tree species, 8 shrub species and 22 herb species. Among the trees, *Populus deltoides* emerged as the dominant species with an IVI value of 46.79, followed closely by *Juglans regia* with an IVI value of 39.20. *Populus deltoides* also contributed significantly to the basal area, accounting for 41.91 %. In the shrub category, *Euonymus japonicus* took the lead with an IVI value of 6.76, followed by *Forsythia viridissima* with an IVI value of 5.24. The highest basal area share among shrubs was from *Nerium indicum*, at 0.79 %, while *Rubus ulmifolius* had the lowest basal area share at 0.07 %. Among herbaceous plants, *Convolvulus arvensis* was the prominent species with an IVI value of 10.98, closely followed by *Cannabis sativa* with an IVI value of 10.37. The lowest IVI value among herbs was recorded for *Clarkia pulchella* at 1.31. Interestingly, both *Cannabis sativa* and *Clarkia pulchella* exhibited the same density at 7.95 %.

### Site 17 (Tulmulla)

The data presented in Table 19 revealed the presence of nine tree species, eight shrub species, one sub-shrub species and twenty-one herb species. Among the tree species, *Juniperus communis* had the maximum dominance, followed by *Populus deltoides*, with IVI values of 6.13 and 5.39, respectively. *Morus alba* recorded the minimum IVI value of 2.61 among the trees. In the case of shrubs, *Rosa moschata* was the dominant species with an IVI value of 5.83, closely followed by *Rosa × damascena* with an IVI of 5.51. Among herbs, *Cannabis sativa* had the maximum dominance, followed by *Conyza canadensis*, with IVI values of 25.79 and 20.43, respectively. Similarly, the maximum share for basal area was contributed by *Aesculus indica* at 1.93 %. Among shrubs, the maximum share for basal area was contributed by *Indigofera heterantha* at 0.57 %.

### Site 18 (Wahidpora)

In Site 18, the analysis of the data revealed that *Aesculus indica* stood out among the trees with the highest IVI value, which was 67.67, indicating its dominant presence. On the other hand, *Salix alba* exhibited the lowest IVI value among trees, demonstrating its minimal dominance with a value of 3.33. *Aesculus indica* also contributed significantly to the basal area, accounting for a substantial 62.46 %, while *Salix alba* made a minimal contribution to basal area, with only 0.72 %. Within the shrub category, *Rosa moschata* emerged as the dominant species in the area, boasting an IVI value of 6.72. In the herbaceous plant group, *Cannabis sativa* exhibited the highest dominance with an IVI value of 16.84, followed closely by *Urtica dioica* with an IVI value of 13.62. Conversely, *Chenopodium album* had the lowest IVI value among herbs, recording just 1.42 (Table 20).

**Table 18: Floristic composition and phytosociological attributes of plant species at Sehpora (1584m amsl)**

Species	Average Density/ha	Frequency (%)	Average Basal Area cm <sup>2</sup> / ha	Relative Density	Relative Frequency	Relative Basal Area	IVI
<b>TREES</b>							
<i>Aesculus indica</i>	20.00	20.00	62426.75	0.01	2.42	13.84	16.28
<i>Ficus carica</i>	40.00	40.00	1078.22	0.02	4.85	0.24	5.11
<i>Juglans regia</i>	40.00	40.00	154841.56	0.02	4.85	34.34	39.20
<i>Morus alba</i>	80.00	40.00	5637.34	0.04	4.85	1.25	6.14
<i>Populus nigra</i>	80.00	40.00	8957.01	0.04	4.85	1.99	6.87
<i>Populus deltoides</i>	80.00	40.00	188981.29	0.04	4.85	41.91	46.79
<i>Robinia psuedoacacia</i>	40.00	20.00	15828.82	0.02	2.42	3.51	5.95
<i>Salix alba</i>	40.00	20.00	2678.34	0.02	2.42	0.59	3.04
<b>SHRUBS</b>							
<i>Euonymus japonicus</i>	520.00	50.00	2068.97	0.24	6.06	0.46	6.76
<i>Forsythia viridissima</i>	160.00	40.00	1431.34	0.07	4.85	0.32	5.24
<i>Hibiscus syriacus</i>	160.00	40.00	1105.93	0.07	4.85	0.25	5.17
<i>Indigofera heterantha</i>	320.00	30.00	688.92	0.15	3.64	0.15	3.94
<i>Nerium indicum</i>	120.00	30.00	3571.11	0.06	3.64	0.79	4.48
<i>Rosa × damascena</i>	280.00	20.00	609.45	0.13	2.42	0.14	2.69
<i>Rosa moschata</i>	320.00	20.00	712.30	0.15	2.42	0.16	2.73
<i>Rubus ulmifolius</i>	120.00	20.00	325.10	0.06	2.42	0.07	2.55
<b>HERBS</b>							
<i>Anthemis cotula</i>	8500.00	10.00	0.04	3.97	1.21	0.00001	5.19
<i>Arctium lappa</i>	9000.00	20.00	0.06	4.21	2.42	0.00001	6.63
<i>Bothriochloa ischaemum</i>	9000.00	15.00	0.07	4.21	1.82	0.00001	6.03

Contd....

Table 18: contd....

Species	Average Density/ha	Frequency (%)	Average Basal Area cm <sup>2</sup> / ha	Relative Density	Relative Frequency	Relative Basal Area	IVI
<i>Brassica rapa</i>	5500.00	15.00	0.04	2.57	1.82	0.00001	4.39
<i>Cannabis sativa</i>	17000.00	20.00	1.66	7.95	2.42	0.00037	10.37
<i>Chenopodium album</i>	9000.00	15.00	0.09	4.21	1.82	0.00002	6.03
<i>Cirsium arvense</i>	7500.00	15.00	0.02	3.51	1.82	0.000004	5.32
<i>Clarkia pulchella</i>	1500.00	5.00	0.01	0.70	0.61	0.000002	1.31
<i>Convolvulus arvense</i>	17000.00	25.00	0.21	7.95	3.03	0.00005	10.98
<i>Conyza canadensis</i>	14500.00	15.00	0.08	6.78	1.82	0.00002	8.60
<i>Euphorbia peplus</i>	13000.00	20.00	0.11	6.08	2.42	0.00002	8.50
<i>Lepidium sativum</i>	8500.00	10.00	0.13	3.97	1.21	0.00003	5.19
<i>Lupinus polyphyllus</i>	9000.00	15.00	0.06	4.21	1.82	0.00001	6.03
<i>Marrubium vulgare</i>	8500.00	10.00	0.14	3.97	1.21	0.00003	5.19
<i>Oxalis corniculata</i>	15500.00	20.00	0.18	7.25	2.42	0.00004	9.67
<i>Plantago major</i>	9500.00	15.00	0.06	4.44	1.82	0.00001	6.26
<i>Polygonum hydropiper</i>	6000.00	15.00	0.08	2.80	1.82	0.00002	4.62
<i>Stellaria media</i>	6000.00	10.00	0.02	2.80	1.21	0.00000	4.02
<i>Trifolium pratense</i>	13500.00	15.00	0.07	6.31	1.82	0.00001	8.13
<i>Trifolium repens</i>	8000.00	10.00	0.03	3.74	1.21	0.00001	4.95
<i>Urtica dioica</i>	12000.00	15.00	0.18	5.61	1.82	0.00004	7.43
<i>Xanthium spinosum</i>	3500.00	5.00	0.04	1.64	0.61	0.00001	2.24
<b>TOTAL</b>	<b>213920.00</b>	<b>825.00</b>	<b>450945.80</b>	<b>100.00</b>	<b>100.00</b>	<b>100.00</b>	<b>300.00</b>

Whereas IVI= Importance Value Index

**Table 19: Floristic composition and phytosociological attributes of plant species at Tulmulla (1586m amsl)**

Species	Average Density/ha	Frequency (%)	Average Basal Area cm <sup>2</sup> / ha	Relative Density	Relative Frequency	Relative Basal Area	IVI
<b>TREES</b>							
<i>Aesculus indica</i>	10.00	20.00	26083.60	0.00	2.50	1.93	4.43
<i>Ailanthus altissima</i>	10.00	20.00	1612.26	0.00	2.50	0.12	2.62
<i>Cedrus deodara</i>	5.00	20.00	9441.08	0.00	2.50	0.70	3.20
<i>Juniperus communis</i>	25.00	40.00	15204.54	0.01	5.00	1.12	6.13
<i>Morus alba</i>	10.00	20.00	1404.46	0.00	2.50	0.10	2.61
<i>Picea smithiana</i>	10.00	20.00	5095.54	0.00	2.50	0.38	2.88
<i>Populus deltoides</i>	25.00	40.00	5096.26	0.01	5.00	0.38	5.39
<i>Robinia psuedoacacia</i>	25.00	40.00	3612.18	0.01	5.00	0.27	5.28
<i>Salix alba</i>	30.00	40.00	4080.67	0.01	5.00	0.30	5.31
<b>SHRUBS</b>							
<i>Berberis lycium</i>	240.00	30.00	3491.11	0.09	3.75	0.26	4.10
<i>Crataegus songarica</i>	200.00	20.00	596.41	0.08	2.50	0.04	2.62
<i>Forsythia viridissima</i>	80.00	20.00	465.62	0.03	2.50	0.03	2.57
<i>Hypericum androsaemum</i>	120.00	20.00	632.01	0.05	2.50	0.05	2.59
<i>Indigofera heterantha</i>	320.00	30.00	7691.48	0.13	3.75	0.57	4.44
<i>Rosa × damascena</i>	640.00	40.00	3483.98	0.25	5.00	0.26	5.51
<i>Rosa moschata</i>	680.00	40.00	7613.79	0.27	5.00	0.56	5.83
<i>Viburnum opulus</i>	120.00	20.00	332.58	0.05	2.50	0.02	2.57
<b>SUB-SHRUB</b>							
<i>Rumex hastatus</i>	480.00	30.00	3540.41	0.19	3.75	0.26	4.20

Contd....

Table 19: contd....

Species	Average Density/ha	Frequency (%)	Average Basal Area cm <sup>2</sup> / ha	Relative Density	Relative Frequency	Relative Basal Area	IVI
<b>HERBS</b>							
<i>Cannabis sativa</i>	34000.00	25.00	125496.16	13.38	3.13	9.28	25.79
<i>Carpesium abrotanoides</i>	6000.00	15.00	2157.15	2.36	1.88	0.16	4.40
<i>Celosia argentea</i>	5500.00	10.00	34051.24	2.17	1.25	2.52	5.93
<i>Convolvulus arvensis</i>	9500.00	15.00	130950.49	3.74	1.88	9.68	15.30
<i>Conyza canadensis</i>	20000.00	25.00	127551.75	7.87	3.13	9.43	20.43
<i>Euphorbia peplus</i>	4500.00	10.00	35828.03	1.77	1.25	2.65	5.67
<i>Foeniculum vulgare</i>	13000.00	15.00	86727.44	5.12	1.88	6.41	13.41
<i>Fragaria nubicola</i>	3000.00	5.00	13435.51	1.18	0.63	0.99	2.80
<i>Galinsoga parviflora</i>	11500.00	20.00	27960.55	4.53	2.50	2.07	9.09
<i>Malva neglecta</i>	27500.00	20.00	79780.93	10.83	2.50	5.90	19.22
<i>Marrubium vulgare</i>	9500.00	15.00	50988.61	3.74	1.88	3.77	9.39
<i>Matricaria aurea</i>	14000.00	15.00	57440.46	5.51	1.88	4.25	11.63
<i>Mentha arvensis</i>	13500.00	15.00	68789.81	5.31	1.88	5.09	12.28
<i>Myosotis arvensis</i>	14000.00	15.00	76656.90	5.51	1.88	5.67	13.05
<i>Rumex dentatus</i>	9500.00	15.00	61265.92	3.74	1.88	4.53	10.15
<i>Trifolium pratens</i>	16000.00	15.00	44438.70	6.30	1.88	3.29	11.46
<i>Trifolium repens</i>	21500.00	15.00	110831.41	8.46	1.88	8.20	18.53
<i>Urtica dioica</i>	7000.00	5.00	34405.90	2.76	0.63	2.54	5.92
<i>Verbascum thapsus</i>	500.00	5.00	46019.11	0.20	0.63	3.40	4.22
<i>Veronica persica</i>	6000.00	5.00	29312.38	2.36	0.63	2.17	5.15
<i>Xanthium spinosum</i>	5000.00	10.00	8793.79	1.97	1.25	0.65	3.87
<b>TOTAL</b>	<b>254030.00</b>	<b>800.00</b>	<b>1352360.21</b>	<b>100.00</b>	<b>100.00</b>	<b>100.00</b>	<b>300.00</b>

Whereas, IVI= Importance Value Index

**Table 20: Floristic composition and phytosociological attributes of plant species at Wahidpora (1587m amsl)**

Species	Average Density/ha	Frequency (%)	Average Basal Area cm <sup>2</sup> / ha	Relative Density	Relative Frequency	Relative Basal Area	IVI
<b>TREES</b>							
<i>Aesculus indica</i>	40.00	40.00	85134.55	0.02	5.19	62.46	67.67
<i>Ailanthus altissima</i>	60.00	40.00	1380.57	0.03	5.19	1.01	6.24
<i>Cedrus deodara</i>	20.00	20.00	5542.99	0.01	2.60	4.07	6.67
<i>Cupressus sempervirens</i>	20.00	20.00	1160.83	0.01	2.60	0.85	3.46
<i>Morus alba</i>	60.00	40.00	2527.07	0.03	5.19	1.85	7.08
<i>Populus nigra</i>	40.00	20.00	19875.80	0.02	2.60	14.58	17.20
<i>Populus deltoides</i>	20.00	20.00	4472.93	0.01	2.60	3.28	5.89
<i>Robinia psuedoacacia</i>	40.00	20.00	7491.24	0.02	2.60	5.50	8.11
<i>Salix alba</i>	40.00	20.00	975.32	0.02	2.60	0.72	3.33
<b>SHRUBS</b>							
<i>Berberis lycium</i>	160.00	20.00	235.54	0.08	2.60	0.17	2.85
<i>Crataegus songarica</i>	80.00	10.00	285.92	0.04	1.30	0.21	1.55
<i>Euonymus japonicus</i>	440.00	30.00	2211.57	0.23	3.90	1.62	5.74
<i>Forsythia viridissima</i>	80.00	10.00	377.64	0.04	1.30	0.28	1.62
<i>Indigofera heterantha</i>	400.00	40.00	577.95	0.21	5.19	0.42	5.82
<i>Nerium indicum</i>	160.00	20.00	953.15	0.08	2.60	0.70	3.38
<i>Rosa × damascena</i>	240.00	20.00	218.73	0.12	2.60	0.16	2.88
<i>Rosa moschata</i>	320.00	40.00	1851.61	0.16	5.19	1.36	6.72
<i>Rosa multiflora</i>	160.00	20.00	692.87	0.08	2.60	0.51	3.19
<i>Rubus niveus</i>	120.00	10.00	140.39	0.06	1.30	0.10	1.46
<i>Rubus ulmifolius</i>	80.00	10.00	175.56	0.04	1.30	0.13	1.47

Contd...

Table 20: contd....

Species	Average Density/ha	Frequency (%)	Average Basal Area cm <sup>2</sup> / ha	Relative Density	Relative Frequency	Relative Basal Area	IVI
<b>HERBS</b>							
<i>Arctium lappa</i>	7500.00	15.00	0.11	3.84	1.95	0.0001	5.79
<i>Cannabis sativa</i>	26500.00	25.00	8.71	13.58	3.25	0.01	16.84
<i>Carpesium abrotanoides</i>	3000.00	10.00	0.02	1.54	1.30	0.00001	2.84
<i>Chenopodium album</i>	1500.00	5.00	0.01	0.77	0.65	0.000004	1.42
<i>Cirsium arvense</i>	5000.00	15.00	0.05	2.56	1.95	0.00003	4.51
<i>Convolvulus arvense</i>	8000.00	10.00	0.08	4.10	1.30	0.0001	5.40
<i>Euphorbia peplus</i>	10000.00	15.00	0.06	5.13	1.95	0.0000	7.07
<i>Foeniculum vulgare</i>	10000.00	15.00	0.09	5.13	1.95	0.0001	7.07
<i>Lupinus polyphyllus</i>	6000.00	15.00	0.04	3.08	1.95	0.0000	5.02
<i>Marrubium vulgare</i>	10000.00	15.00	2.54	5.13	1.95	0.0019	7.08
<i>Matricaria aurea</i>	9000.00	15.00	0.07	4.61	1.95	0.00005	6.56
<i>Mentha arvensis</i>	12500.00	15.00	2.08	6.41	1.95	0.0015	8.36
<i>Myosotis arvensis</i>	9000.00	15.00	0.11	4.61	1.95	0.0001	6.56
<i>Oxalis corniculata</i>	6000.00	10.00	1.75	3.08	1.30	0.0013	4.38
<i>Plantago major</i>	13500.00	25.00	0.08	6.92	3.25	0.0001	10.17
<i>Polygonum hydropiper</i>	7000.00	15.00	0.07	3.59	1.95	0.0001	5.54
<i>Setaria viridis</i>	6500.00	10.00	0.07	3.33	1.30	0.00005	4.63
<i>Urtica dioica</i>	21500.00	20.00	5.28	11.02	2.60	0.0039	13.62
<i>Veronica persica</i>	4500.00	10.00	0.06	2.31	1.30	0.00005	3.61
<i>Xanthium spinosum</i>	5000.00	10.00	0.05	2.56	1.30	0.00004	3.86
<b>TOTAL</b>	<b>195080.00</b>	<b>770.00</b>	<b>136303.61</b>	<b>100.00</b>	<b>100.00</b>	<b>100.00</b>	<b>300.00</b>

Whereas, IVI= Importance Value Index

#### **4.1.3 Shannon-Wiener Index (H') of Urban and Peri-urban areas of Ganderbal**

The calculation of the Shannon-Wiener Index was performed based on the IVI values to assess species richness. The information provided in Table 21 and Fig 7 displayed the Shannon-Wiener diversity index for various urban areas in Ganderbal. The data indicated that Duderhama exhibited the highest Shannon-Wiener diversity Index at 1.53, followed closely by Gangerhama at 1.43, Ganderbal at 1.40 and Salooru at 1.39. Both Bamloora and Wanipora urban sites shared an identical Shannon-Wiener diversity Index of 1.38. Conversely, Beehama displayed the lowest Shannon-Wiener diversity index, recorded at 1.23.

The information in Table 22 and Fig 8 presented the Shannon-Wiener diversity index for various peri-urban areas in Ganderbal. According to the data, Tulumulla had the highest Shannon-Wiener diversity Index at 1.49, with Arch closely following at 1.47, Rangil at 1.44 and Sarich Chodri Bagh at 1.43. Both Sehpora and Wahidpora peri-urban sites shared an identical Shannon-Wiener diversity Index of 1.42. In contrast, Harran had the lowest Shannon-Wiener diversity index, which was recorded at 1.32.

**Table 21: Shannon Diversity index (H') of Urban areas of Ganderbal**

S. No	Urban Area	Shannon Diversity Index (H')
1	Arampora	1.24
2	Bamloora	1.38
3	Beehama	1.23
4	Duderhama	1.53
5	Fathepora	1.28
6	Ganderbal	1.40
7	Gangerhama	1.43
8	Saloor	1.39
9	Wanipora	1.38

**Table 22: Shannon Diversity index (H') of Peri-urban areas of Ganderbal**

S. No	Peri-urban Area	Shannon Diversity Index (H')
1	Arch	1.47
2	Badhra Kund	1.35
3	Harran	1.32
4	Rakh Kujjar	1.41
5	Rangil	1.44
6	Sarich Chodri Bagh	1.43
7	Sehpora	1.42
8	Tulmulla	1.49
9	Wahidpora	1.42

#### **4.1.4 Similarity Index of Urban and Peri-urban areas of Ganderbal**

- **Similarity Index of Trees**

The data in Table 23 indicated that the highest similarity index for trees was observed between two sites: Sarich Chodri Bagh and Gangerhama, which reached 93 %. This was followed by Gangerhama and Fathepora at 88 % and Sehpora and Gangerhama, also at 88 %.

- **Similarity Index of Shrubs**

In Table 24, the data revealed that the most significant similarity index for shrubs was found between two sites: Sarich Chodri Bagh and Gangerhama, reaching a value of 93 %. Following was an 86 % similarity index observed between Rakh Kujjar and Gangerhama, as well as between Sarich Chodri Bagh and Badhra Kund.

- **Similarity Index of Herbs**

In Table 25, the data indicated that the highest similarity index for herbs was identified between two sites: Rangil and Harran, with a value of 78 %. Additionally, a notable similarity index of 76 % was observed between Sarich Chodri Bagh and Wanipora, as well as between Sarich Chodri Bagh and Ganderbal and likewise between Sarich Chodri Bagh and Sehpora.

**Table 23: Index of Similarity for trees in Urban and Peri-urban areas of Ganderbal**

	BH	GB	AP	DH	FP	GH	WP	BL	SL	AC	TL	HR	RL	SH	BK	SCB	RK	WD
BH		0.77	0	0	0.46	0.46	0.33	0.33	0.40	0.63	0.29	0.36	0.67	0.46	0.15	0.33	0.31	0.29
GB	0.23		0.29	0	0.63	0.75	0.53	0.13	0.46	0.74	0.59	0.71	0.80	0.75	0.38	0.67	0.63	0.59
AP	1.00	0.72		0.11	0.43	0.43	0.62	0.15	0.36	0.35	0.40	0.50	0.15	0.43	0.43	0.46	0.29	0.53
DH	1.00	1	0.89		0.10	0.00	0.00	0.00	0.12	0.00	0.00	0.00	0.00	0.00	0.10	0.00	0.00	0.00
FP	0.54	0.38	0.57	0.90		0.88	0.53	0.53	0.31	0.74	0.59	0.57	0.80	0.75	0.63	0.80	0.50	0.71
GH	0.54	0.25	0.57	1.00	0.13		0.67	0.53	0.31	0.84	0.71	0.71	0.80	0.88	0.50	0.93	0.50	0.82
WP	0.67	0.47	0.39	1.00	0.47	0.33		0.29	0.17	0.67	0.50	0.77	0.57	0.80	0.53	0.57	0.53	0.63
BL	0.67	0.87	0.85	1.00	0.47	0.47	0.72		0.17	0.44	0.38	0.31	0.57	0.53	0.53	0.43	0.40	0.50
SL	0.60	0.54	0.65	0.88	0.69	0.69	0.83	0.83		0.38	0.29	0.36	0.50	0.31	0.15	0.33	0.31	0.43
AC	0.38	0.26	0.645	1.00	0.26	0.16	0.33	0.56	0.63		0.70	0.56	0.63	0.70	0.40	0.63	0.50	0.67
TL	0.72	0.41	0.60	1.00	0.41	0.30	0.50	0.63	0.72	0.30		0.67	0.50	0.59	0.47	0.62	0.82	0.78
HR	0.64	0.29	0.50	1.00	0.43	0.29	0.23	0.69	0.64	0.45	0.33		0.62	0.86	0.43	0.62	0.71	0.67
RL	0.33	0.20	0.85	1.00	0.20	0.20	0.43	0.43	0.50	0.37	0.50	0.39		0.80	0.40	0.71	0.53	0.63
SH	0.54	0.25	0.57	1.00	0.25	0.13	0.20	0.47	0.69	0.30	0.41	0.14	0.20		0.50	0.80	0.63	0.71
BK	0.85	0.63	0.57	0.90	0.38	0.50	0.47	0.47	0.85	0.60	0.53	0.57	0.60	0.50		0.40	0.50	0.47
SCB	0.67	0.33	0.54	1.00	0.20	0.07	0.43	0.57	0.67	0.37	0.38	0.39	0.29	0.20	0.60		0.40	0.75
RK	0.69	0.38	0.72	1.00	0.50	0.50	0.47	0.60	0.69	0.50	0.18	0.29	0.47	0.38	0.50	0.60		0.59
WD	0.72	0.41	0.47	1.00	0.30	0.18	0.38	0.50	0.57	0.33	0.22	0.33	0.38	0.30	0.53	0.25	0.41	

**Table 24: Index of Similarity for shrubs in Urban and Peri-urban areas of Ganderbal**

	BH	GB	AP	DH	FP	GH	WP	BL	SL	AC	TL	HR	RL	SH	BK	SCB	RK	WD
BH		0.33	0.73	0.14	0.13	0.15	0.62	0.13	0.40	0.25	0.40	0.43	0.47	0.43	0.17	0.14	0.31	0.47
GB	0.67		0.36	0.00	0.53	0.77	0.46	0.66	0.13	0.50	0.40	0.57	0.59	0.43	0.83	0.71	0.77	0.71
AP	0.27	0.64		0.00	0.14	0.17	0.83	0.14	0.43	0.40	0.29	0.62	0.50	0.46	0.18	0.15	0.33	0.50
DH	0.86	1.00	1.00		0.35	0.00	0.00	0.24	0.35	0.22	0.35	0.00	0.21	0.25	0	0	0	0.21
FP	0.87	0.47	0.86	0.65		0.63	0.38	0.56	0.22	0.73	0.44	0.47	0.60	0.47	0.67	0.71	0.50	0.50
GH	0.85	0.23	0.83	1.00	0.38		0.29	0.50	0.13	0.33	0.38	0.53	0.56	0.40	0.92	0.93	0.86	0.67
WP	0.39	0.54	0.17	1.00	0.63	0.72		0.13	0.38	0.47	0.38	0.67	0.67	0.67	0.31	0.40	0.29	0.56
BL	0.87	0.34	0.86	0.77	0.45	0.50	0.88		0.33	0.63	0.56	0.35	0.60	0.35	0.67	0.59	0.63	0.60
SL	0.60	0.87	0.57	0.65	0.78	0.88	0.63	0.67		0.32	0.11	0.24	0.40	0.35	0.13	0.12	0	0.40
AC	0.72	0.50	0.60	0.78	0.26	0.63	0.53	0.37	0.69		0.53	0.67	0.76	0.78	0.63	0.67	0.59	0.70
TL	0.60	0.60	0.72	0.65	0.56	0.63	0.63	0.45	0.89	0.48		0.47	0.50	0.47	0.27	0.35	0.50	0.60
HR	0.57	0.43	0.39	1.00	0.53	0.47	0.33	0.65	0.77	0.33	0.53		0.63	0.50	0.43	0.63	0.66	0.74
RL	0.53	0.41	0.50	0.79	0.40	0.45	0.33	0.40	0.60	0.24	0.50	0.37		0.63	0.59	0.63	0.67	0.64
SH	0.57	0.57	0.54	0.75	0.53	0.60	0.33	0.65	0.65	0.22	0.53	0.50	0.37		0.43	0.50	0.40	0.74
BK	0.83	0.17	0.82	1.00	0.33	0.08	0.69	0.33	0.87	0.38	0.73	0.57	0.41	0.57		0.86	0.77	0.59
SCB	0.86	0.29	0.84	1.00	0.30	0.07	0.60	0.41	0.88	0.33	0.65	0.38	0.37	0.50	0.14		0.80	0.63
RK	0.69	0.23	0.67	1.00	0.50	0.14	0.71	0.38	1.00	0.41	0.50	0.34	0.33	0.60	0.23	0.20		0.67
WD	0.53	0.29	0.50	0.79	0.50	0.33	0.45	0.40	0.60	0.30	0.40	0.26	0.36	0.26	0.41	0.37	0.33	

**Table 25: Index of Similarity for herbs in Urban and Peri-urban areas of Ganderbal**

	BH	GB	AP	DH	FP	GH	WP	BL	SL	AC	TL	HR	RL	SH	BK	SCB	RK	WD
BH		0.43	0.09	0.00	0.00	0.22	0.50	0.08	0.55	0.44	0.20	0.40	0.35	0.42	0.38	0.31	0.59	0.27
GB	0.57		0.50	0.00	0.31	0.43	0.63	0.51	0.38	0.67	0.60	0.71	0.64	0.73	0.67	0.76	0.70	0.60
AP	0.91	0.50		0.00	0.54	0.65	0.19	0.55	0.00	0.39	0.41	0.51	0.47	0.40	0.53	0.39	0.39	0.35
DH	1.00	1.00	1.00		0.06	0.00	0.00	0.00	0.12	0.05	0.05	0.00	0.04	0.05	0.05	0.00	0.05	0.00
FP	1	0.69	0.46	0.94		0.39	0.06	0.55	0.00	0.39	0.35	0.46	0.42	0.29	0.40	0.33	0.13	0.35
GH	0.78	0.57	0.36	1.00	0.61		0.38	0.47	0.39	0.39	0.51	0.59	0.56	0.45	0.51	0.54	0.39	0.41
WP	0.50	0.37	0.81	1.00	0.94	0.62		0.40	0.44	0.63	0.50	0.63	0.53	0.68	0.56	0.76	0.54	0.70
BL	0.92	0.49	0.45	1.00	0.45	0.53	0.60		0.21	0.51	0.70	0.57	0.04	0.42	0.55	0.62	0.47	0.54
SL	0.46	0.63	1.00	0.88	1.00	0.61	0.56	0.79		0.33	0.29	0.36	0.32	0.34	0.33	0.28	0.52	0.24
AC	0.56	0.33	0.61	0.96	0.61	0.61	0.37	0.49	0.67		0.50	0.53	0.63	0.71	0.55	0.63	0.59	0.68
TL	0.80	0.40	0.59	0.95	0.65	0.49	0.50	0.30	0.71	0.50		0.55	0.66	0.42	0.47	0.64	0.46	0.57
HR	0.60	0.29	0.49	1.00	0.54	0.41	0.37	0.43	0.64	0.47	0.45		0.78	0.67	0.60	0.65	0.32	0.51
RL	0.65	0.36	0.53	0.96	0.58	0.44	0.47	0.95	0.69	0.38	0.35	0.22		0.60	0.52	0.58	0.60	0.48
SH	0.58	0.27	0.60	0.95	0.72	0.55	0.32	0.58	0.66	0.29	0.58	0.33	0.41		0.62	0.76	0.65	0.60
BK	0.62	0.33	0.47	0.95	0.60	0.49	0.45	0.46	0.67	0.45	0.53	0.40	0.48	0.39		0.70	0.57	0.58
SCB	0.69	0.24	0.61	1.00	0.67	0.46	0.24	0.39	0.72	0.38	0.36	0.35	0.42	0.25	0.30		0.59	0.68
RK	0.41	0.30	0.61	0.95	0.87	0.61	0.46	0.53	0.48	0.41	0.54	0.68	0.40	0.35	0.43	0.42		0.51
WD	0.73	0.40	0.65	1.00	0.65	0.59	0.30	0.46	0.77	0.32	0.43	0.49	0.52	0.40	0.42	0.32	0.49	

**Abbreviations used:** BH=Beehama; GB=Ganderbal; AP=Arampora; DH=Duderhama; FP=Fathepora; GH=Gangerhama; WP=Wanipora; BL=Bamloora; SL=Saloor; TL=Tulmulla; AC=Arch; HR=Harran; RL=Rangil; SH=Sehpora; BK=Badhra Kund; SCB=Sarich Chodri Bagh; RK=Rakh Kujjar; WB=Wahidpora.

#### 4.1.5 Biological Spectrum of Urban and Peri-urban areas of Ganderbal

Table 26 presents the biological spectrum of the entire flora in urban and peri-urban areas of Ganderbal. The data revealed that out of a total of 115 plant species, 29 (25.22 %) were classified as trees, 22 (19.13 %) as shrubs, 02 (1.74 %) as sub-shrubs, 02 (1.74 %) as climbers, 01 (0.87 %) as palm and 59 (51.30 %) as herb species (Fig 9).

When assessed using the Raunkiaer biological spectrum classification, it was found that 34.78 % of the species fell under the category of therophytes, followed by nano-phanerophytes at 17.39 %, hemicryptophytes at 11.30 % and meso-phanerophytes at 9.57 %. Micro-phanerophytes and mega-phanerophytes were equally represented, each accounting for 8.70 %. The total percentage of geophytes was 6.96 %, while chamaephytes were the least represented category at 2.61 % (Fig 10).

When the present spectrum is compared with normal spectrum of Raunkiaer (1934) it was found that cryptophytes percentage was approximately the same (Table 27) as that of normal spectrum, but mesophanerophytes, chamaephytes and hemicryptophytes were less than the normal spectrum. However, the therophytes showed variation from normal spectrum and were significantly higher than the normal spectrum (Fig 14). Based on the findings of the current study and following Raunkiaer's terminology, the phytoclimate of the area can be classified as thero-phanerophytic.

In the leaf spectra classification, the most prevalent leaf form was microphyll, constituting 40 of the totals, followed by mesophylls at 33, nanophylls at 30, leptophylls at 6, macrophylls at 4 and megaphylls at 2 (Fig 11). In the case of leaf spectra, the presence of nanophylls 15 (13.04 %), mesophyll 07 (6.09 %) and microphyll 15 (13.04 %), have the maximum in comparison to therophytes (Table 28, Fig 15).

The majority of the species had simple leaf lamina, accounting for 76, followed by compound leaf lamina at 23, dissected leaf lamina at 10 and needle leaf lamina at 6 (Fig 12).

The distribution of plant species across various habitats indicated that the majority of plant species were located in park habitats, accounting for 56 of the totals. This was followed by species in moist places at 18, in forests at 17, in crop-fields and on dry slopes at 15, along roadsides at 14, in waste places at 10 and in graveyards at 7 (Fig 13).

**Table 26: Biological Spectrum of Urban and Peri-urban areas of Ganderbal**

Species	Growth Form	Life Form	Leaf Size	Leaf Lamina	Habitat
<i>Abelia × grandiflora</i>	S	MSP	MS	SL	I
<i>Aesculus indica</i>	T	MGP	MS	DI	II, III
<i>Ailanthus altissima</i>	T	MGP	MI	CP	IV, V
<i>Alcea rosea</i>	H	HCP	MC	SL	I
<i>Amaranthus caudatus</i>	H	THE	MS	SL	I
<i>Amaranthus tricolor</i>	H	THE	MS	SL	I
<i>Anthemis cotula</i>	H	THE	NP	DI	III, IV, VI
<i>Antirrhinum majus</i>	H	THE	LP	SL	I, V
<i>Arctium lappa</i>	H	HCP	MI	SL	III, IV
<i>Avena sativa</i>	H	THE	NP	SL	IV
<i>Berberis lycium</i>	S	NOP	NP	SL	II
<i>Bothriochloa ischaemum</i>	H	HCP	MI	SL	V
<i>Brassica rapa</i>	H	THE	MI	SL	I
<i>Buddleja davidii</i>	S	NOP	MI	SL	I
<i>Buxus sempervirens</i>	S	NOP	MI	SL	I
<i>Callistephus chinensis</i>	H	THE	MI	SL	I
<i>Campsis grandiflora</i>	C	NOP	MS	CP	I
<i>Canna indica</i>	H	CHA	MG	SL	I
<i>Cannabis sativa</i>	H	THE	MI	CP	III, VII
<i>Carpesium abrotanoides</i>	H	HCP	MI	SL	II, VI
<i>Catalpa bignoniodes</i>	T	MSP	MC	SL	I
<i>Cedrus deodara</i>	T	MGP	NP	NL	II
<i>Celosia argentea</i>	H	THE	NP	SL	VI
<i>Celtis australis</i>	T	MSP	MI	SL	II, VIII
<i>Cercis siliquastrum</i>	T	MSP	MI	CP	I
<i>Chenopodium album</i>	H	THE	NP	SL	IX, IV
<i>Cirsium arvense</i>	H	GEO	MI	SL	III, VII
<i>Clarkia pulchella</i>	H	THE	MI	CP	I
<i>Convolvulus arvense</i>	H	THE	MI	SL	IV, I
<i>Conyza canadensis</i>	H	THE	NP	SL	V
<i>Crataegus songarica</i>	S	MCP	MS	CP	II

Contd...

Table 26: contd....

Species	Growth Form	Life Form	Leaf Size	Leaf Lamina	Habitat
<i>Cryptomeria japonica</i>	T	MGP	NP	NL	I
<i>Cupressus sempervirens</i>	T	MCP	NP	NL	I
<i>Dahlia pinnata</i>	H	THE	NP	SL	I
<i>Daucus carota</i>	H	GEO	MS	DI	IV, VIII
<i>Dianthus caryophyllus</i>	H	HCP	NP	SL	I
<i>Dianthus chinensis</i>	H	HCP	NP	SL	I
<i>Eschscholzia californica</i>	H	THE	NP	CP	III
<i>Euonymus japonicus</i>	S	NOP	NP	SL	I
<i>Euphorbia peplus</i>	H	THE	NP	SL	VI
<i>Ficus carica</i>	T	NOP	MG	DI	I
<i>Foeniculum vulgare</i>	H	GEO	NP	DI	IV
<i>Forsythia viridissima</i>	S	MCP	MI	SL	I
<i>Fragaria nubicola</i>	H	THE	MI	SL	II
<i>Galinsoga parviflora</i>	H	HCP	MI	SL	VII, III
<i>Gomphrena globosa</i>	H	THE	MI	SL	I
<i>Halianthus annuus</i>	H	THE	MS	SL	I
<i>Hedera helix</i>	C	NOP	MS	SL	I
<i>Hibiscus syriacus</i>	S	THE	MI	SL	I
<i>Hydrangea macrophylla</i>	S	MCP	MS	SL	I
<i>Hypericum androsaemum</i>	S	HCP	NP	SL	VI
<i>Iberis amara</i>	H	THE	NP	SL	V
<i>Indigofera heteratha</i>	S	NOP	LP	CP	II, V
<i>Juglans regia</i>	T	MGP	MS	CP	I, V
<i>Juniperus communis</i>	T	NOP	LP	NL	V
<i>Lagerstroemia indica</i>	T	MSP	MI	DI	I
<i>Lavandula angustifolia</i>	S	CHA	NP	SL	I
<i>Lepidium sativum</i>	H	THE	NP	SL	VII
<i>Ligustrum lucidum</i>	T	NOP	MS	SL	I
<i>Lupinus polyphyllus</i>	H	THE	MS	CP	III
<i>Magnolia kobus</i>	T	MSP	MS	SL	I
<i>Magnolia liliflora</i>	T	MCP	MS	SL	I

Contd...

**Table 26: contd....**

<b>Species</b>	<b>Growth Form</b>	<b>Life Form</b>	<b>Leaf Size</b>	<b>Leaf Lamina</b>	<b>Habitat</b>
<i>Malva neglecta</i>	H	THE	MS	SL	II, IV
<i>Marrubium vulgare</i>	H	THE	MI	SL	II, VIII
<i>Matricaria aurea</i>	H	THE	NP	DI	III, VII
<i>Melia azedarach</i>	T	MSP	MI	CP	VIII
<i>Mentha arvensis</i>	H	GEO	NP	SL	IV, VI
<i>Morus alba</i>	T	MSP	MS	SL	I
<i>Myosotis arvensis</i>	H	HCP	NP	SL	II, VI
<i>Nerium indicum</i>	S	NOP	MI	SL	V
<i>Oxalis corniculata</i>	H	THE	NP	CP	II, VI
<i>Papaver dubium</i>	H	THE	MS	CP	IV, V
<i>Phlox drummondii</i>	H	THE	NP	SL	I
<i>Picea smithiana</i>	T	MGP	NP	NL	II
<i>Plantago major</i>	H	GEO	MC	SL	VI
<i>Platanus orientalis</i>	T	MGP	MC	CP	III
<i>Polygonum hydropiper</i>	H	GEO	MS	SL	VI
<i>Populus nigra</i>	T	MGP	MS	SL	I, VI
<i>Populus deltoides</i>	T	MGP	MS	SL	I
<i>Prunus avium</i>	T	MCP	MS	SL	I
<i>Prunus cerasifera</i>	T	MCP	MS	SL	I
<i>Prunus persica</i>	T	MCP	MI	SL	I
<i>Robinia psuedoacacia</i>	T	MSP	MI	CP	I, II
<i>Rosa × damascena</i>	S	NOP	MI	CP	I
<i>Rosa moschata</i>	S	NOP	MI	CP	II
<i>Rosa multiflora</i>	S	NOP	MI	CP	II
<i>Rubus niveus</i>	S	NOP	NP	CP	II,V
<i>Rubus ulmifolius</i>	S	NOP	MS	CP	V
<i>Rumex dentatus</i>	H	CHA	MS	SL	IV, V, VI
<i>Rumex hastatus</i>	S S	THE	NP	DI	VI
<i>Salix alba</i>	T	MSP	MS	SL	I, III
<i>Salix babylonica</i>	T	MGP	MS	SL	I
<i>Scilla siberica</i>	H	THE	MI	SL	VII

**Contd...**

**Table 26: contd....**

<b>Species</b>	<b>Growth Form</b>	<b>Life Form</b>	<b>Leaf Size</b>	<b>Leaf Lamina</b>	<b>Habitat</b>
<i>Setaria viridis</i>	H	THE	LP	SL	V
<i>Sophora japonica</i>	T	MCP	MI	CP	I, IV
<i>Spiraea japonica</i>	S	THE	MI	SL	I
<i>Stellaria media</i>	H	THE	LP	SL	VII
<i>Tagetes minuta</i>	H	THE	MI	DI	I, VIII
<i>Tagetes patula</i>	H	THE	MI	DI	I, VIII
<i>Thuja orientalis</i>	T	NOP	LP	NL	I
<i>Trachycarpus fortunei</i>	P	MCP	MS	SL	I
<i>Trifolium pratense</i>	H	HCP	NP	CP	IV, VI
<i>Trifolium repens</i>	H	HCP	MI	CP	IV, VI
<i>Tropaeolum majus</i>	H	HCP	MI	SL	III, VII
<i>Urtica dioica</i>	H	THE	MI	SL	VIII, III
<i>Verbascum thapsus</i>	H	GEO	MS	SL	VI
<i>Veronica persica</i>	H	THE	NP	SL	VI
<i>Viburnum opulus</i>	S	NOP	MS	SL	V
<i>Vinca major</i>	H	THE	MI	SL	VI
<i>Viola tricolor</i>	H	HCP	MI	SL	I
<i>Wigelia florida</i>	S	NOP	MI	SL	I
<i>Xanthium spinosum</i>	H	THE	MS	SL	III, VII
<i>Yucca aloiflora</i>	S	NOP	MI	SL	I
<i>Zantedeschia aethiopica</i>	H	GEO	MS	SL	I
<i>Zinnia elegans</i>	S S	MSP	MS	SL	I

**Abbreviations used:**

**Growth Form:** T- Tree, S- Shrub, H- Herb, C- Climber, S S- Sub-Shrub, P-Palm

**Life Form:** GEO- Geophyte, THE- Therophyte, HCP- Hemicryptophyte, CHA- Chamaephyte, NOP- Nano-phanerophyte, MCP- Micro-phanerophyte, MSP- Meso-phanerophyte, MGP-Mega-phanerophyte

**Leaf Size:** NP- Nanophyll, MI- Microphyll, MS- Mesophyll, MC- Macrophyll, MG- Megaphyll, LP- Leptophyll

**Leaf Lamina:** SL- Simple, DI- Dissected, CP- Compound, NL- Needle

**Habitat:** I- Parks, II- Forest, III- Roadside, IV-Crop-Field, V- Dry Slope, VI- Moist Places, VII- Waste Places, VIII- Graveyard

**Table 27: Biological spectrum ( % of all life forms) of the study area and its comparison with Raunkiaer's normal spectrum**

<b>Life Form</b>	<b>Total no. of species</b>	<b>Biological spectrum ( %) of study area</b>	<b>Raunkiaer's normal spectrum ( %)</b>	<b>Deviation = (Raunkiaer's normal spectrum- Biological spectrum)</b>
Megaphanerophytes	10.00	8.70	3.00	5.70
Mesophanerophytes	21.00	18.26	28.00	-9.74
Nanophanerophytes	20.00	17.39	15.00	2.39
Chamaephytes	3.00	2.61	9.00	-6.39
Hemicryptophytes	13.00	11.30	26.00	-14.70
Cryptophytes	8.00	6.96	6.00	0.96
Therophytes	40.00	34.78	13.00	21.78
<b>TOTAL</b>	115.00	100.00	100.00	

**Table 28: Life-form analysis with different leaf sizes**

Life form	Leaf spectra						
	Nanophyll	Microphyll	Mesophyll	Macrophyll	Megaphyll	Leptophyll	Total
Geophyte	2	1	4	1	-	-	8
Therophyte	15	15	7	-	-	3	40
Hemicryptophyte	5	7	-	1	-	-	13
Chamaephyte	1	-	1	-	1	-	3
Nano-phanerophyte	3	8	5	-	1	3	20
Micro-phanerophyte	1	3	6	-	-	-	10
Meso-phanerophyte	-	5	5	1	-	-	11
Mega-phanerophyte	3	1	5	1	-	-	10
<b>Total</b>	30	40	33	4	2	6	115

## **4.2 To study the conservation prioritization of forest communities and habitats in Urban and Peri-urban areas of Ganderbal**

### **4.2.1 Plant Community diversity and species composition**

In the study encompassing urban and peri-urban areas of Ganderbal, a total of 18 sites were sampled, leading to the identification of 07 distinct plant communities. These communities were categorized as *Aesculus indica*, *Aesculus indica - Juglans regia*, *Juglans regia - Ailanthus altissima*, *Platanus orientalis*, *Populus nigra - Salix alba*, *Populus deltoides* and Mixed Communities. Among these communities, the Mixed Communities exhibited the highest species richness, with a total of 97 species, followed by the *Aesculus indica* Community with 65 species. In contrast, the *Juglans regia - Ailanthus altissima* Community had the lowest species richness, containing only 22 species. However, it's worth noting that the *Juglans regia - Ailanthus altissima* Community had the highest percentage of native species, accounting for 18.18 % and also boasted the highest percentage of economically important species, reaching 40.90 %. Regarding endemic species, *Populus deltoides* showed the highest percentage at 3.27 %. In terms of threatened species, *Populus nigra - Salix alba* had the highest percentage, which was 9.09 %, as indicated in Table 29.

### **4.2.2 Habitat diversity**

Six distinct habitats, namely Shady moist, Riverine, Near Road, Near Settlement, Garden Area and Degraded habitats, were identified as outlined in Table 30. The representation of sites within these habitats varied from 1 to 5, with species richness ranging from 43 to 67. Among these habitats, the near settlement habitat exhibited the highest species richness, with 67 species, closely followed by the near road habitat with 65 species. In contrast, the degraded habitat had the lowest species richness, containing only 43 species. Notably, the degraded habitat had the highest percentage of threatened species, accounting for 6.97 %. The near road habitat had the highest percentage of native species at 18.46 %, while the

riverine habitat had the maximum number of endemic species, standing at 3.27 %. Furthermore, the garden habitat was remarkable for containing 39.34 % of economically important species.

#### **4.2.3 Prioritization of plant communities and habitats**

Among the various communities, *Juglans regia* - *Ailanthus altissima*, *Aesculus indica* - *Juglans regia*, *Platanus orientalis* and *Populus deltoides* displayed the highest Conservation Priority Index (CPI), each scoring 46. Following closely was *Aesculus indica* with a CPI of 44 and the Mixed Communities with a CPI of 42. In contrast, the *Populus nigra* - *Salix alba* community had the lowest CPI, recording a value of 40 (Fig 16).

In terms of habitats, the Garden Area habitat exhibited the highest Conservation Priority Index (CPI), reaching a value of 40. It was followed closely by the Shady Moist and Riverine habitats, both with a CPI of 38. The Near Road and Degraded habitats had a CPI of 36 each. Conversely, the Near Settlement habitat had the lowest CPI, recording a value of 32 (Fig 17).

**Table 29: Prioritization of plant communities for conservation using different parameters**

<b>Community Type</b>	<b>Habitats</b>	<b>Sr</b>	<b>Alt (M)</b>	<b>Spr</b>	<b>Native (%)</b>	<b>Endemic (%)</b>	<b>Eip (%)</b>	<b>Ts (%)</b>	<b>Cpi</b>
<i>Aesculus indica</i>	3	4	1623-1581	65	15.38	3.07	40.00	4.62	44
<i>Aesculus indica - Juglans regia</i>	2	3	1699-1522	58	12.06	1.72	36.20	5.17	46
<i>Juglans regia - Ailanthus altissima</i>	1	1	1590	22	18.18	0.00	40.90	4.55	46
<i>Platanus orientalis</i>	2	2	1597-1537	46	13.04	2.17	36.95	2.17	46
<i>Populus nigra - Salix alba</i>	1	1	1595	33	15.15	0.00	30.30	9.09	40
<i>Populus deltoides</i>	2	3	1602-1584	61	11.47	3.27	36.06	6.55	46
Mixed Communities	3	4	1607-1563	97	11.34	2.06	39.17	4.12	42

Whereas SR=Site Representation; ALT= Altitude; SPR= Species Richness; EIP= Economically Important Plants; TS= Threatened Species; CPI= Conservation Prioritization Index

**Table 30: Prioritization of habitats for conservation using different parameters**

<b>Habitat Type</b>	<b>SR</b>	<b>Altitude(m)</b>	<b>Species Richness</b>	<b>Native ( %)</b>	<b>Endemic ( %)</b>	<b>Threatened ( %)</b>	<b>EIP ( %)</b>	<b>CPI</b>
Shady Moist	3	1623-1583	57	12.28	1.75	5.26	36.84	38
Near Road	4	1619-1586	65	18.46	3.07	6.15	38.46	36
Near Settlement	5	1587-1522	67	17.91	2.98	5.97	34.32	32
Riverine	3	1581-1563	61	16.39	3.27	1.63	37.70	38
Garden Area	2	1589-1607	61	3.27	0.00	1.63	39.34	40
Degraded	1	1699	43	13.95	2.32	6.97	32.55	36

Whereas SR=Site Representation; EIP= Economically Important Plants; CPI= Conservation Prioritization Index

## Chapter - 5

### DISCUSSION

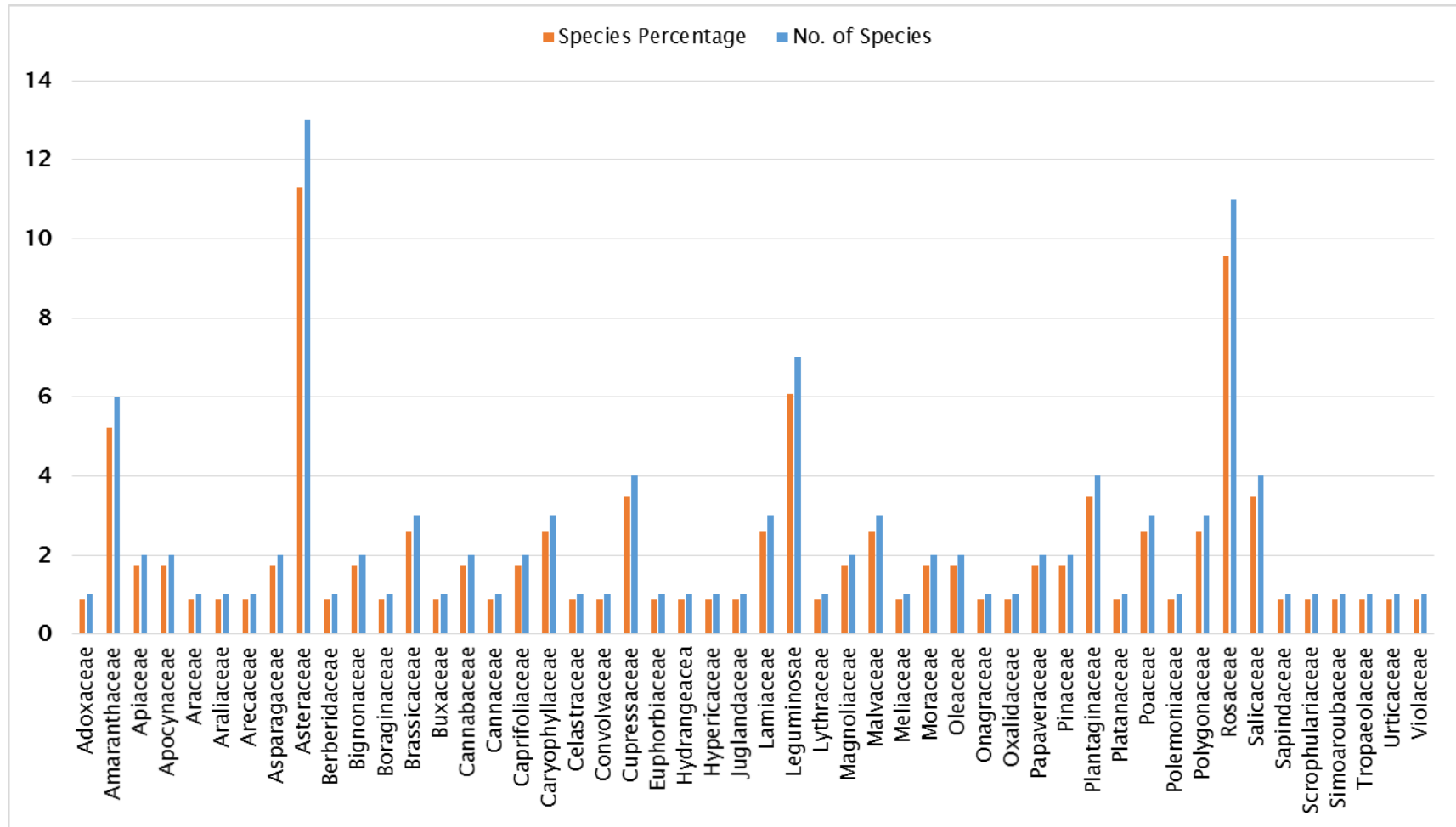
The current chapter is focused on discussing the outcomes of this study with the aim of establishing causal connections among the various parameters investigated. This discussion is intended to draw coherent conclusions by integrating relevant literature and is organized into the following sections:

- 5.1 Assessment of floristic diversity and biological spectrum in Urban and Peri-urban areas of Ganderbal.
- 5.2 To study the conservation prioritization of forest communities and habitats in Urban and Peri-urban areas of Ganderbal.

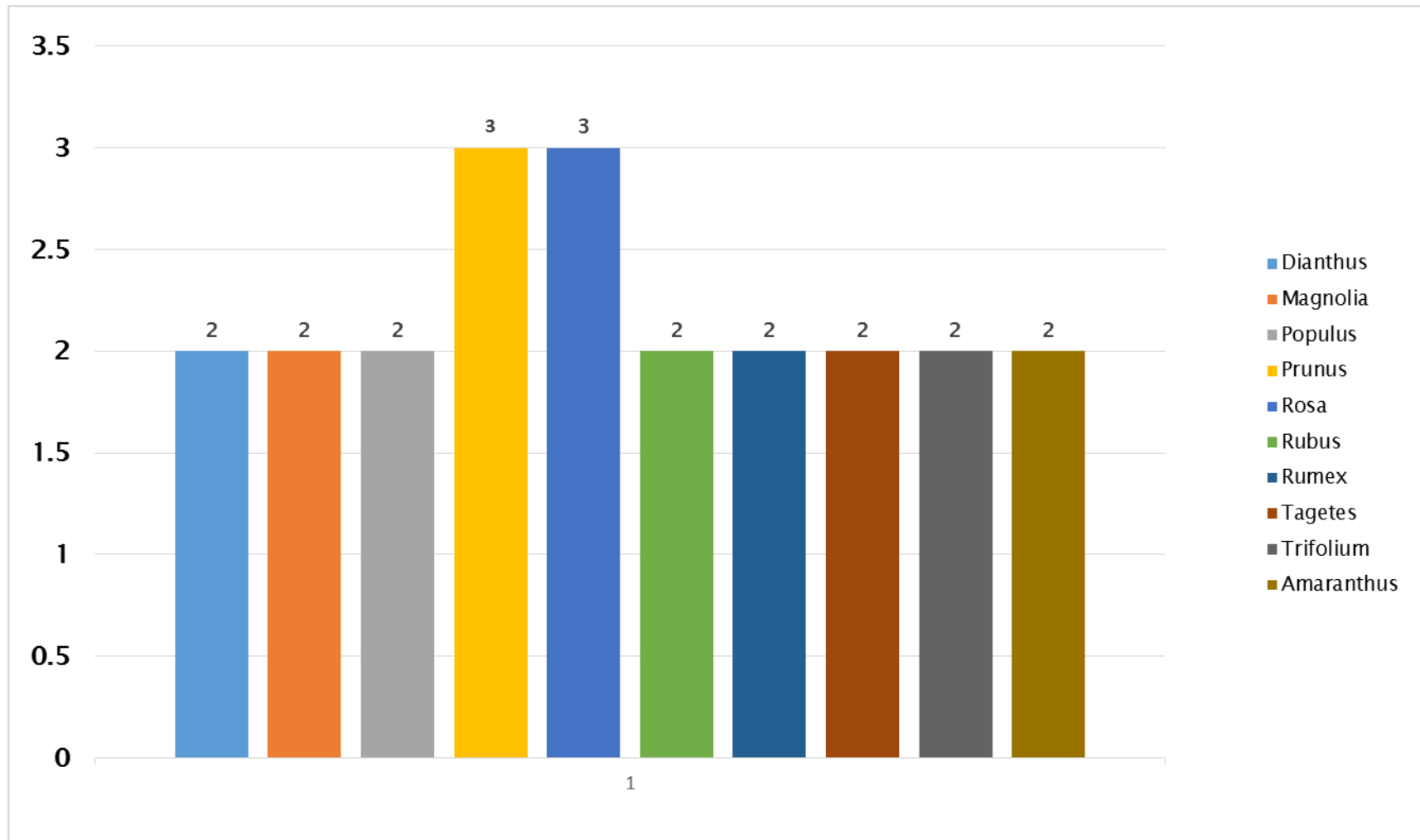
#### **5.1 Assessment of floristic diversity and biological spectrum in Urban and Peri-urban areas of Ganderbal**

##### **5.1.1 Floristic diversity**

The present investigation which was conducted at 09 urban and 09 peri-urban locations of Ganderbal, Kashmir revealed a total of 115 plant species, as indicated in Table 1. These species were distributed across 102 different genera and belonged to 29 distinct plant orders (Fig 3). These diverse plant species were recorded from 50 unique plant families (Fig 1). Among them, 8 species were categorized as monocotyledons, 6 as gymnosperms and 101 as dicotyledons (Fig 4). Our findings align with those of Ali *et al.* (2018); Mahmood *et al.* (2015) and Bhellum (2014) all of whom similarly reported dicots as the dominant group in while working in different places in Himalayan region. In terms of plant families, Asteraceae exhibited the highest diversity with 13 species, followed by Rosaceae with 11 species. Additionally, Leguminosae and Amaranthaceae were noteworthy, comprising 7 and 6 species, respectively. The families Cupressaceae, Plantaginaceae and Salicaceae were each represented by 04 species. Additionally, the families Brassicaceae, Caryophyllaceae, Lamiaceae, Malvaceae, Poaceae and



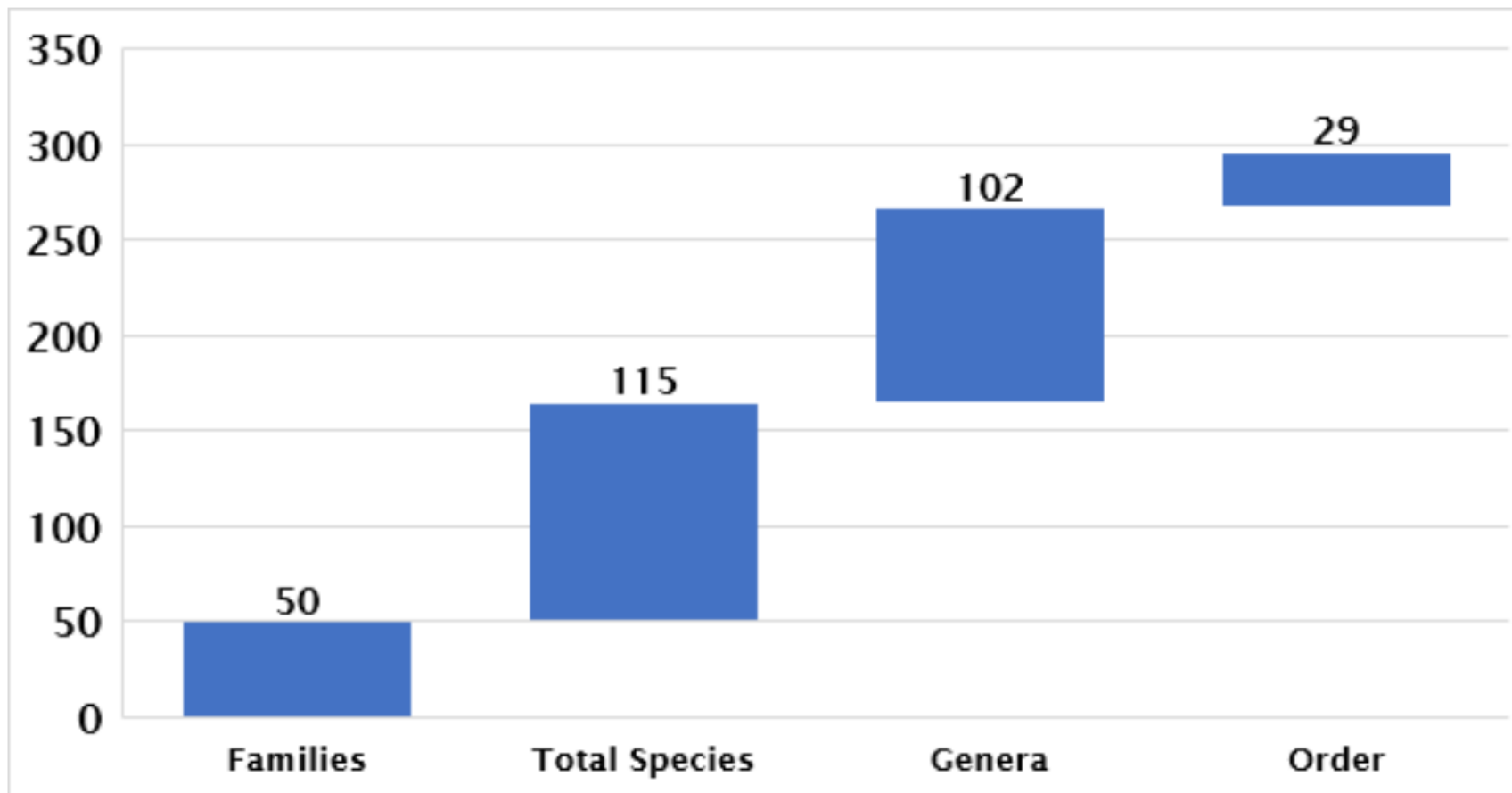
**Fig. 1: Family wise distribution of plants from the urban and peri-urban areas of Ganderbal**



**Fig. 2: The richest Genera from the study area with 2 or greater than 2 species**

Polygonaceae each had 03 species. Families such as Apiaceae, Apocynaceae, Asparagaceae, Bignoniaceae, Cannabaceae, Caprifoliaceae, Magnoliaceae, Moraceae, Oleaceae, Papaveraceae and Pinaceae were represented by 02 species each. The remaining 26 families were represented by only one species each (Table 2). The findings of our study align with the research conducted by Verma and Kapoor (2011) in district Kinnaur, Himachal Pradesh who reported 160 plant species distributed across 51 families. Notably, they, too, recognized Asteraceae, Polygonaceae and Rosaceae as the dominant families in their study area. Further Farooq (2023) which focused on plant communities and habitats within urban green spaces in Srinagar, reported a total of 101 plant species distributed across 46 families with the dominant families Asteraceae and Rosaceae. In the course of research in the Gulmarg Forest Range of the Kashmir Himalayas, Tasveer (2022) identified dominant plant families, including Asteraceae, Poaceae and Rosaceae. Tantray (2018) in a study on the floristic diversity of the Manasbal Range in the Sindh Forest division, similarly, identified Asteraceae and Rosaceae as dominant families. This concurrence in findings provides support for the prevalence and significance of these specific plant families within diverse ecological contexts in the Himalayan region. Further, the distribution of these species in the study area can be attributed to a complex interplay of multiple factors like the presence of an efficient and adaptive seed dispersal mechanism among species within the Asteraceae family, as suggested by Awas and Demissew (2009). As the members of the Asteraceae family tend to have larger ecological tolerances the likelihood of encountering plants from this family increases. Also, these species can thrive in a range of environmental conditions, from cool temperatures to high irradiances. Furthermore, a few of these species are capable of thriving across a wide spectrum of environmental gradients (Brown, 2001).

In the present study, it was ascertained that among the 115 total plant species, two (02) were found exclusively in the region (endemic) and an additional twelve (12) were recognized as naturally existing in the study area



**Fig. 3:** Graphical representation of flora in the urban and peri-urban areas of Ganderbal



**Fig. 4: Distribution of different groups according to taxonomic categories in the Urban and Peri-urban areas of Ganderbal**

(native), whereas the remainder (101) were considered non-native or alien species (Fig 6). These findings align with the results of Khuroo *et al.* (2017), who conducted a study on floristic diversity along the roadsides of an urban biodiversity hotspot in the Indian Himalayas. They recorded a total of 206 vascular plant species in their study area. Notably, their findings revealed that the proportion of alien species was relatively higher at 52 % compared to native species, which accounted for 48 % of the total. This congruence in results underscores the prevalence of non-native species, particularly along roadsides in the urban biodiversity hotspot. The underlying reasons may be that the roadside environments are subject to frequent anthropogenic disturbances, as noted by Trombulak and Frissell (2000); Parendes and Jones (2000), which include factors such as fragmentation as well as runoff water, elevated temperatures due to the heat island effect and pollution stemming from vehicular traffic. These conditions not only serve as pathways for the dispersal of non-native species but also create favorable conditions for the establishment and naturalization of these species. This phenomenon has been observed in previous studies, including those by Forman and Alexander (1998); Gelbard and Belnap (2003); Lippe and Kowarik (2008) and Knapp *et al.* (2010). Studies have also found that species capable of tolerating anthropogenic disturbances, including the presence of traffic, especially those belonging to the Asteraceae or Poaceae families, often become dominant invaders in highly disturbed sites like roads, as highlighted by Lippe and Kowarik (2008). Consequently, in densely urbanized and heavily disturbed areas such as roads, there tends to be a significant prevalence of alien species belonging to these particular plant families.

### **5.1.2 Importance Value Index (%)**

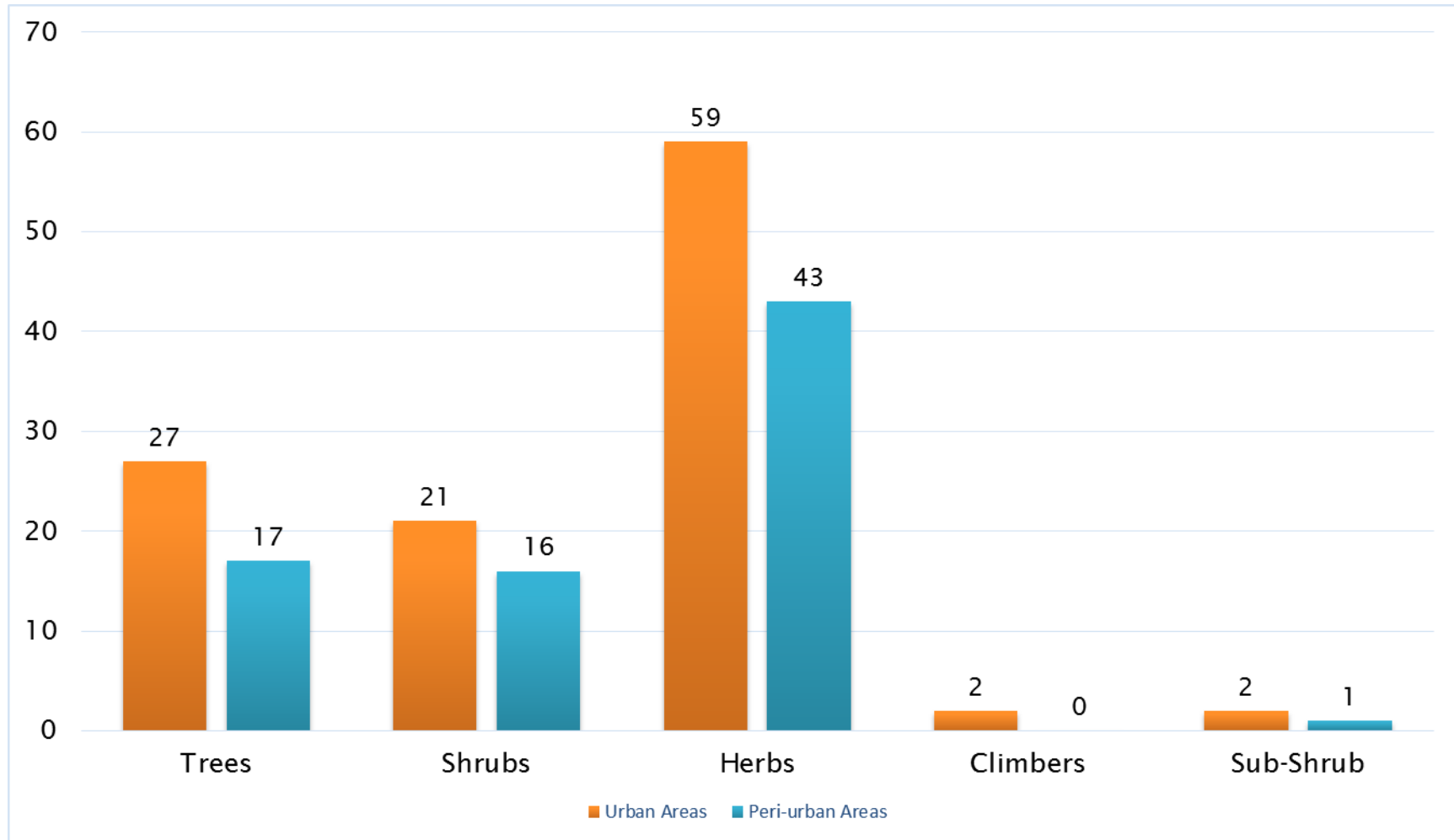
The Importance Value Index serves as a valuable metric for assessing the dominance and ecological performance of a given species (Misra, 1968). This index encapsulates the comprehensive phytosociological role of a species within a community, providing a holistic perspective on its ecological importance. It

proves to be an essential tool for gaining a comprehensive understanding of a species' ecological significance within its ecosystem. Curtis and McIntosh (1951) proposed that a high Importance Value Index (IVI) for a species signifies its dominance, ecological success, strong regenerative capabilities and broader ecological adaptability. Such species often require monitoring and management attention. Conversely, species with low importance values, as categorized by Abba *et al.* (2015), demand increased conservation efforts to ensure their preservation. The results of the investigation conducted in both urban and peri-urban areas of Ganderbal revealed that the Importance Value Index (IVI) of various species exhibited variations, which were influenced by the specific location and the extent of disturbances in the area (Table 3-20).

In Arampora (Site 1), the dominant species with high IVI values (Table 3) were *Platanus orientalis* (47.47 %), *Euonymus japonicus* (41.41 %) and *Urtica dioica* (25.80 %), highlighting their ecological importance. *Platanus orientalis* contributed the most to basal area among tree species at 40.56 %, while *Euonymus japonicus* held the highest share among shrubs at 37.79 %. Among herbs, *Xanthium spinosum* contributed the most to basal area at 0.0021 %. In Bamloora (Site 2), *Populus deltoides* stood out as the dominant tree species, boasting the highest IVI value of 40.62 % and contributing the most to basal area at 32.09 %, while among shrubs, *Viburnum opulus* and *Buxus sempervirens* were prominent, with IVI values of 11.31 % and 9.60 %, respectively and in the herbaceous category, *Myosotis arvensis* displayed dominance with an IVI value of 17.49 % (Table 4). At site 3 (Beehama), *Juglans regia* dominated with an IVI value (Table 5) of 48.30 % and 41.57 % basal area share. *Ailanthus altissima* followed with IVI of 22.87 % and 12.76 % basal area share. *Ailanthus altissima* had the highest density at 0.03 %, while *Buddleja davidii* led the shrubs with an IVI of 15.65 % and 13.93 % basal area share. *Cannabis sativa* was the prominent herbaceous plant with an IVI of 29.96 % and 0.005 % basal area share, recording the highest density at 24.08 %. *Hedera helix* was the dominant climber with an IVI value of

5.52 %. At site 4 (Duderhama), there was a diverse plant population, including twelve tree species (Table 6). The highest IVI values were observed for *Sophora japonica* (30.70 %) and *Ligustrum lucidum* (24.56 %). Among shrubs, *Abelia × grandiflora* had the highest IVI (7.01 %), while *Rosa × damascena* had the highest density (0.19 %). *Antirrhinum majus* displayed the highest IVI (10.48 %) and density (8.14 %) among herbaceous plants. At site 5 (Fathepora), *Platanus orientalis* was the dominant tree species with an IVI value of 49.25 % and the highest basal area share at 46.61 %. *Rosa moschata* led among the shrub species with an IVI of 7.73 %, while *Trifolium repens* dominated the herb category with an IVI of 31.65 %. *Rosa × damascena* contributed the most to basal area in shrubs at 1.48 % and *Trifolium repens* also had the highest basal area contribution in herbs at 0.19 % (Table 7). Farooq (2023) have also reported the highest value of IVI in case of *Platanus orientalis* while working within urban green spaces in Srinagar, while as, Kumari *et al.* (2023) reported highest value of IVI in case of *Pinus roxburghi*.

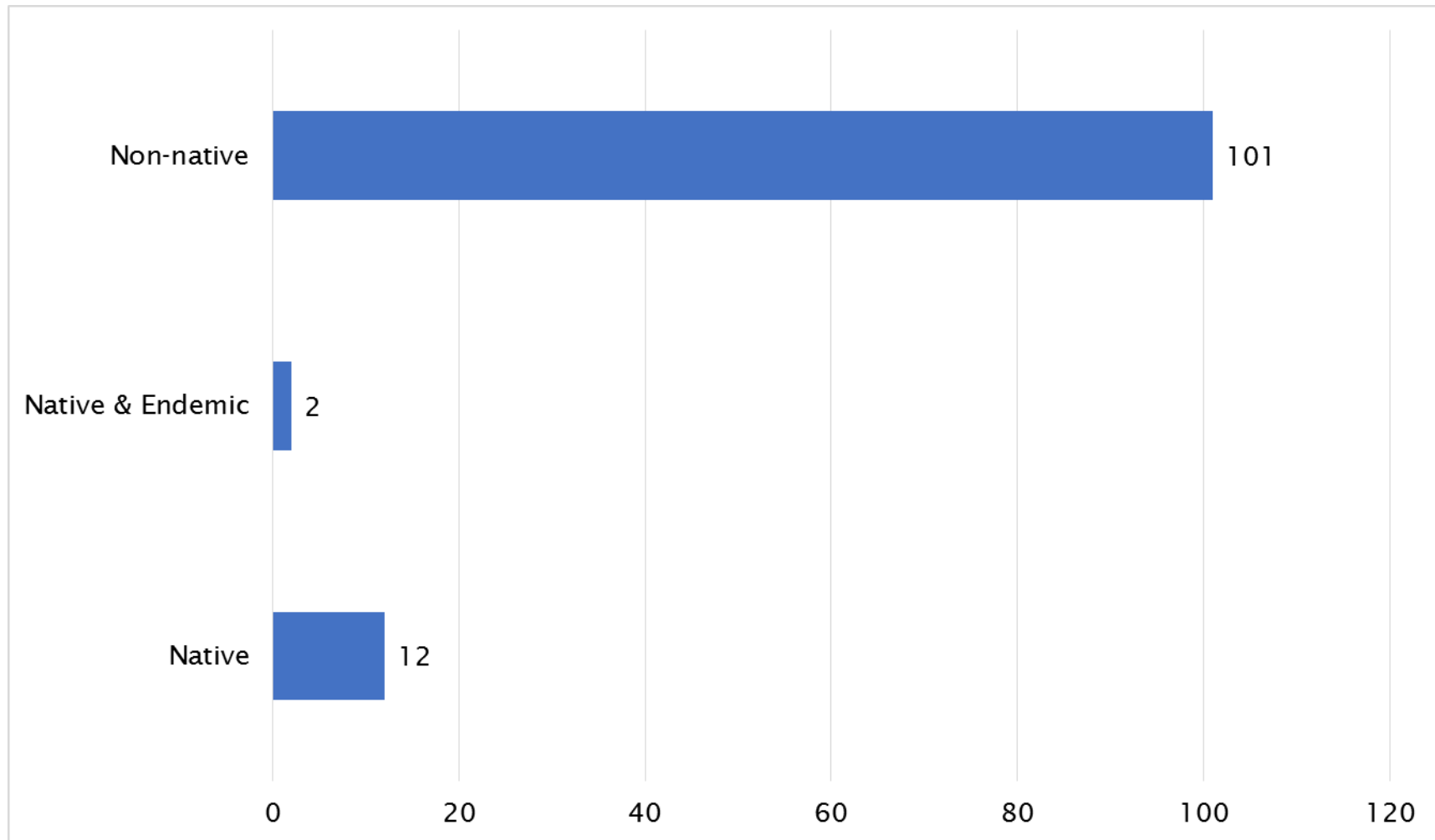
At site 6 (Ganderbal), *Aesculus indica* was the dominant tree species with an IVI (Table 8) of 44.16 % and the highest basal area at 42.09 %. In the shrub category, *Rosa multiflora* led with an IVI of 9.47 %, contributing 2.84 % to basal area and having the highest density at 0.44 %. At site 7 (Gangerhama), *Juglans regia* had the highest IVI value (Table 9) among tree species (22.58 %), *Crataegus songarica* led among shrub species (17.46 %) and *Trifolium repens* dominated among herbaceous plants (21.99 %). Site 8 (Saloor) featured five tree species, nine shrub species and thirteen herb species (Table 10). *Populus deltoides*, with an IVI of 19.90 %, dominated the trees, while *Buxus sempervirens* led among shrubs with an IVI of 20.89 %. Among the herbs, *Conyza canadensis* had the highest IVI at 18.44 %. In terms of basal area, *Populus deltoides* contributed the most for trees (14.14 %), *Buxus sempervirens* led for shrubs (15.03 %) and *Arctium lappa* had the highest basal area among herbs (0.01 %). Saima and Kamili (2016) found that *Populus deltoides* had the highest density at



**Fig. 5: Comparative analysis of different plant growth forms in the urban and peri-urban areas of Ganderbal**

6.60 % while working on floristic diversity along the banks of Nigeen Lake in Kashmir, while as, Tasveer (2022) recorded the highest IVI value for *Abies pindrow* while working on different conifers in Gulmarg Forest Range of Kashmir Himalayas.

At site 9 (Wanipora), *Populus nigra* had the highest IVI (Table 11) among tree species (46.34 %), while *Ficus carica* had the lowest IVI (3.17 %). *Populus nigra* also contributed the most to basal area (38.27 %) and density (0.07 %) among trees. In the shrub category, *Euonymus japonicus* had the highest IVI (12.11 %) and contributed 6.46 % to basal area. Among herbs, *Cannabis sativa* dominated with an IVI of 21.82 % and a density of 17.82 %. At site 10 (Arch), *Aesculus indica* dominated among tree species with the highest IVI (Table 12) (54.78 %) and contributed significantly to basal area (49.70 %). Among shrubs, *Nerium indicum* had the highest IVI (11.57 %) and *Euonymus japonicus* had the highest density (0.24 %). In the herb category, *Cannabis sativa* led with the highest IVI (19.85 %) and density (16.05 %). At site 11 (Badhra Kund), *Platanus orientalis* stood out as the dominant tree species with the highest IVI (55.39 %), contributing significantly to the basal area (52.89 %). Among herbs, *Urtica dioica* was the most prominent with the highest IVI (22.05 %) and density (17.01 %), while among shrubs, *Rubus ulmifolius* led with the highest IVI (10.09 %) and density (0.23 %). Furthermore, *Indigofera heterantha* made the largest contribution to basal area among shrubs, accounting for 3.64 % (Table 13). Rana *et al.* (2015) identified *Cupressus torulosa* as the dominant tree species with a high Importance Value Index (IVI) ranging from 205 to 300 while working in Central Himalayan Central Forest. While as Mumshad *et al.* (2021) highlighted several dominant plant species, such as *Pinus roxburghii*, *Pinus wallichiana*, *Berberis lycium*, *Punica granatum* and *Avena fatua* while focusing on the phyto-ecological aspects and distribution patterns of plant species and communities in Dhirkot, Pakistan.



**Fig. 6: Nativity and endemism of flora in the urban and peri-urban areas of Ganderbal**

At site 12 (Harran), *Aesculus indica* had the highest IVI value (Table 14) among trees (95.92), contributing significantly to basal area (86.14 %), while in the shrub category, *Indigofera heterantha* led with an IVI of 8.14 %, while *Euonymus japonicus* contributed the most to basal area (0.47 %). *Indigofera heterantha* also had the highest density (0.41 %). Among herbaceous species, *Malva neglecta* dominated with an IVI of 8.79 %, followed by *Vinca major* and *Conyza canadensis*, both with IVI values of 7.99 %. At Site 13 (Rakh Kujjar), *Aesculus indica* (Table 15) dominated the tree category with the highest IVI (40.26 %) and contributed significantly to basal area (35.29 %), followed by *Picea smithiana* (17.66 %). Among shrubs, *Rosa moschata* had the highest IVI (14.32 %), while *Cannabis sativa* led among herbaceous species with an IVI of 19.93 % and the highest density (16.13 %). At Site 14 (Rangil), *Aesculus indica* and *Juglans regia* were the dominant tree species with IVI values (Table 16). of 44.07 % and 42.66 %, respectively. *Juglans regia* had the highest basal area contribution (37.70 %) among trees. In the shrub category, *Indigofera heterantha* had the highest IVI (5.93 %) and basal area contribution (0.59 %). Among herbaceous plants, *Malva neglecta* dominated with an IVI of 13.56 % and the highest density (11.10 %), while *Verbascum thapsus* had the lowest IVI among herbs (0.87 %). While as Shahid and Joshi (2016) recorded the *Shorea robusta* as the dominant species in three ranges: Barkot range (141.32 %), Lachchiwala range (126.36 %) and Thano range (187 %) while working on phytosociological assessment and distribution patterns of tree species in the forests of Doon Valley.

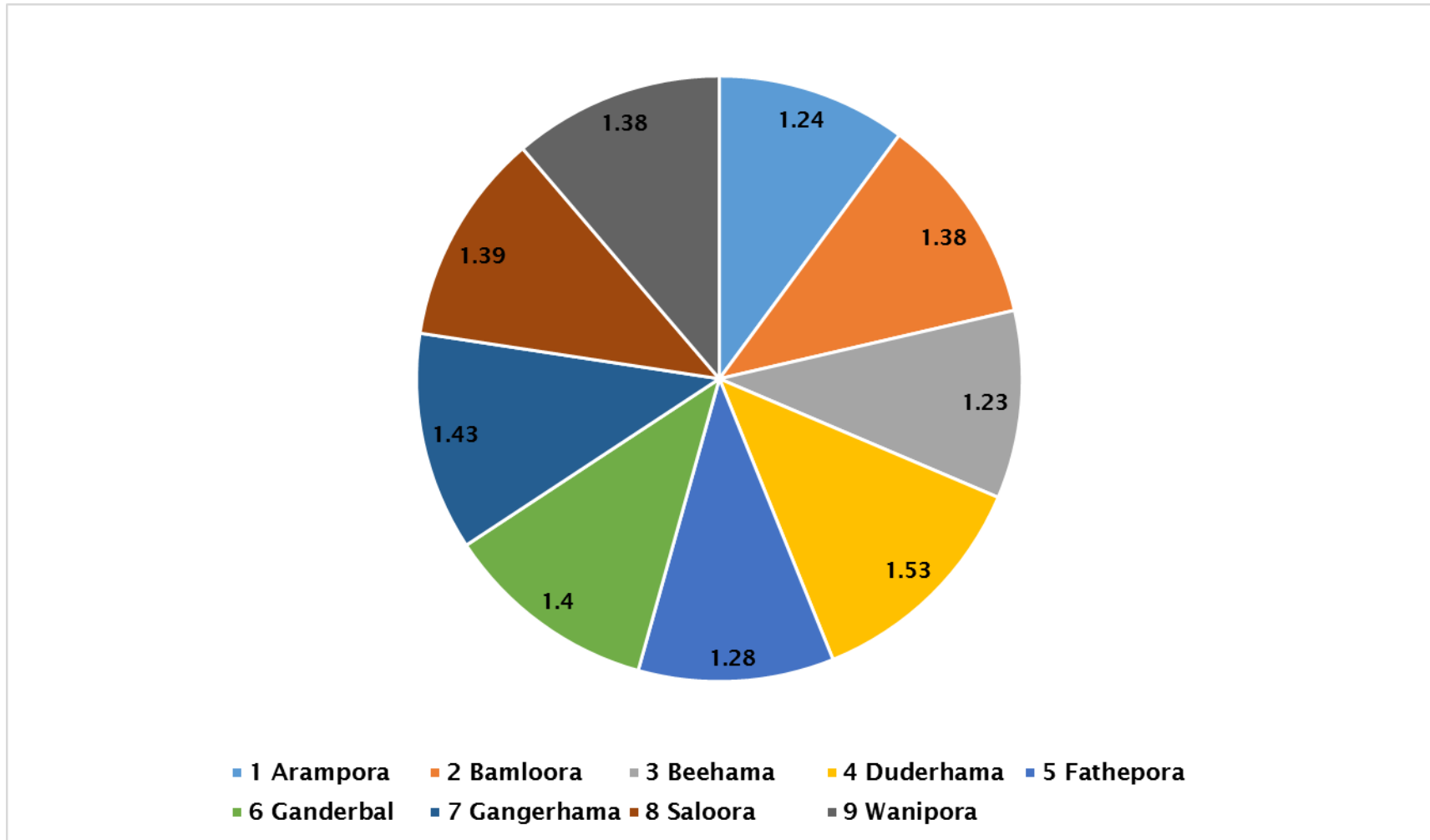
At site 15 (Sarich Chodri Bagh), *Aesculus indica* dominated among seven tree species (Table 17) with the highest IVI value (37.45 %) and basal area share (32.77 %), followed closely by *Juglans regia* (IVI 32.75 %, basal area 30.41 %). *Rosa moschata* was the dominant shrub with a maximum IVI of 6.19 % and 1.33 % basal area, while both *Rosa moschata* and *Rubus ulmifolius* had the highest density at 0.18 %. Among herbs, *Urtica dioica* and *Cannabis sativa* were prominent with IVI values of 19.46 % and 14.43 %. At Site 16 (Sehpura), *Populus*

*deltoides* had the highest IVI value (Table 18) among trees (46.79 %), followed by *Juglans regia* (39.20 %). Among shrubs, *Euonymus japonicus* had the highest IVI (6.76 %) and *Nerium indicum* contributed the most to basal area (0.79 %). Among herbaceous plants, *Convolvulus arvensis* had the highest IVI (10.98 %). At Site 17 (Tulmulla), *Juniperus communis* dominated the tree category (6.13 %), followed by *Populus deltoides* (5.39 %). Among shrubs, *Rosa moschata* was the dominant species (5.83 %) and among herbs, *Cannabis sativa* had the highest dominance (25.79 %) (Table 19). At Site 18 (Wahidpora), *Aesculus indica* was the dominant tree species (Table 20) with the highest IVI value (67.67 %) and contributed significantly to basal area (62.46 %). *Rosa moschata* dominated the shrub category with an IVI of 6.72 %, while among herbaceous plants, *Cannabis sativa* had the highest dominance (IVI 16.84 %), followed by *Urtica dioica* (13.62 %).

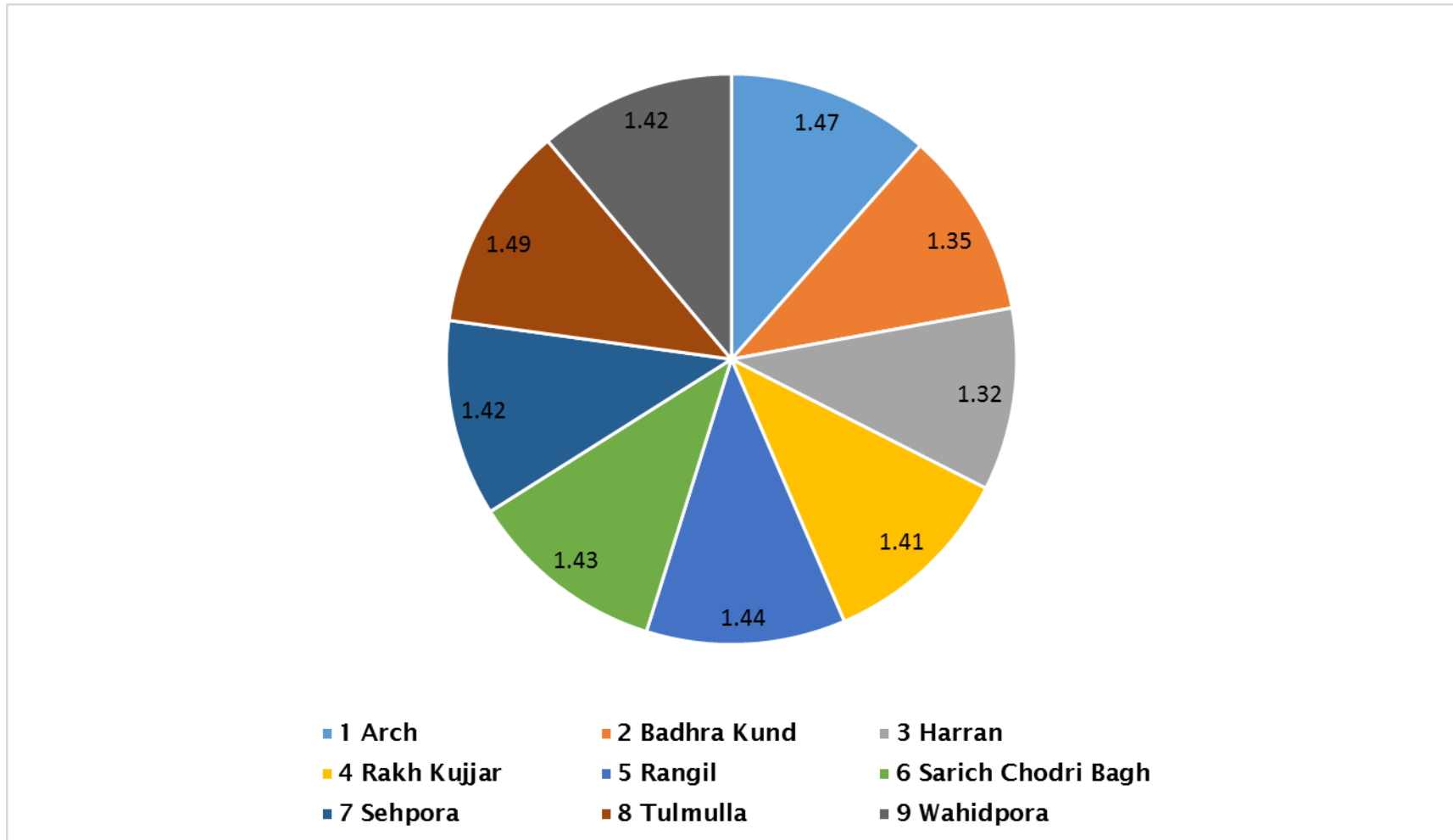
The findings from the present research indicate that fluctuations in density, basal area and phytosociology influence the composition, distribution and dominance of plant species. These variations could be attributed to both abiotic factors such as rainfall, soil moisture and temperature, as well as biotic factors like livestock and other associated plant species.

### **5.1.3 Shannon-Wiener Index (H')**

As per the Indian Institute of Remote Sensing (2002) biodiversity indices are calculated to standardize the relative abundance and diversity of species across various ecosystem habitats, with higher values indicating greater species richness. Ecosystems with rich species diversity tend to have higher values of the H' index, while ecosystems with lower species diversity typically exhibit lower values of this index (Sobuj and Rahman, 2011). The diversity of plants observed in this study, as indicated by the Shannon-Wiener diversity index (Table 21; Table 22), exhibited a range of values (1.23-1.49). In urban areas of Ganderbal, the index ranged from 1.23 (lowest in Beehama) to 1.53 (highest in Duderhama) (Fig 7), while in peri-urban areas, it varied from 1.32 (lowest in Harran) to 1.49 (highest



**Fig. 7: Shannon diversity index value of all experimental sites under Urban areas of Ganderbal**



**Fig. 8: Shannon diversity index value of all experimental sites under Peri-urban areas of Ganderbal**

in Tulumulla) (Fig 8). This increased diversity can be attributed to the comprehensive sampling across various habitats and the inclusion of a greater number of sampling sites. The diversity levels observed in this study are similar to those reported by Dar and Sundarapandian (2016) (ranging from 0.17 to 1.06) and Sharma *et al.* (2010) (ranging from 0.28 to 1.75). However, they are lower than the diversity levels reported by Malik and Bhat (2015) (ranging from 2.30 to 3.53) and Bhat *et al.* (2020) (ranging from 2.09 to 3.37) in other parts of the Indian Himalayan Region. The lower diversity value observed in the present study could potentially be attributed to uneven distribution of individuals, environmental stress, disturbances, habitat fragmentation, invasive species, ecological succession stage, sampling bias or a homogeneous environment within the studied ecosystem.

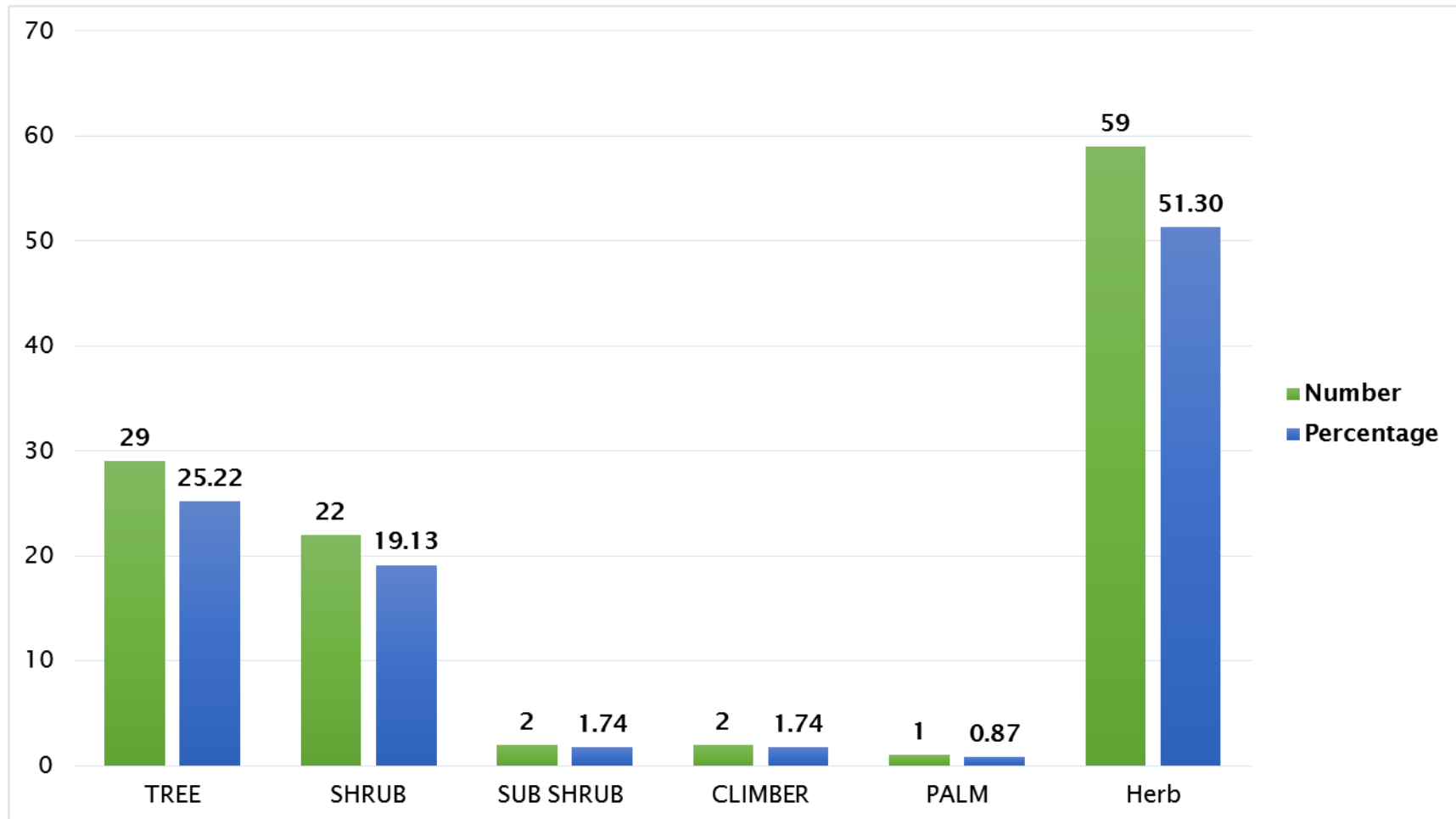
#### **5.1.4 Similarity Index**

The highest similarity index for trees was 93 %, observed between Sarich Chodri Bagh and Gangerhama, followed by 88 % between Gangerhama and Fatepora and also between Sehpora and Gangerhama (Table 24). For shrubs, the most significant similarity index was 93 % between Sarich Chodri Bagh and Gangerhama, with 86 % between Rakh Kujjar and Gangerhama and Sarich Chodri Bagh and Badhra Kund (Table 25). In the herb category, the highest similarity index of 78 % was noted between Rangil and Harran, along with 76 % similarity between Sarich Chodri Bagh and Wanipora, Ganderbal and Sehpora (Table 26). It's worth noting that lower species similarity index values indicate a greater variation in species composition between two plant communities, while higher values suggest a higher degree of similarity. The highest similarity index, typically around 50 %, is often observed in stands with a consistently uniform forest composition (Rikhari *et al.*, 1991). The overall high similarity across different sites indicates a uniform distribution of vegetation, possibly influenced by the presence of species with broad geographical ranges. Regional species patterns are reported to be influenced by multiple factors, including plant efficiency, competition, geography, historical and evolutionary development,

regional species dynamics, the regional species pool, environmental variables and human activity (Criddle *et al.*, 2003). Altitude, environmental factors, habitat and soil characteristics are likely pivotal factors contributing to variations in species diversity and density, with soil characteristics and habitat conditions suggested as potential causes for differences in species composition (Murphy and Logo, 1986).

### **5.1.5 Biological Spectrum**

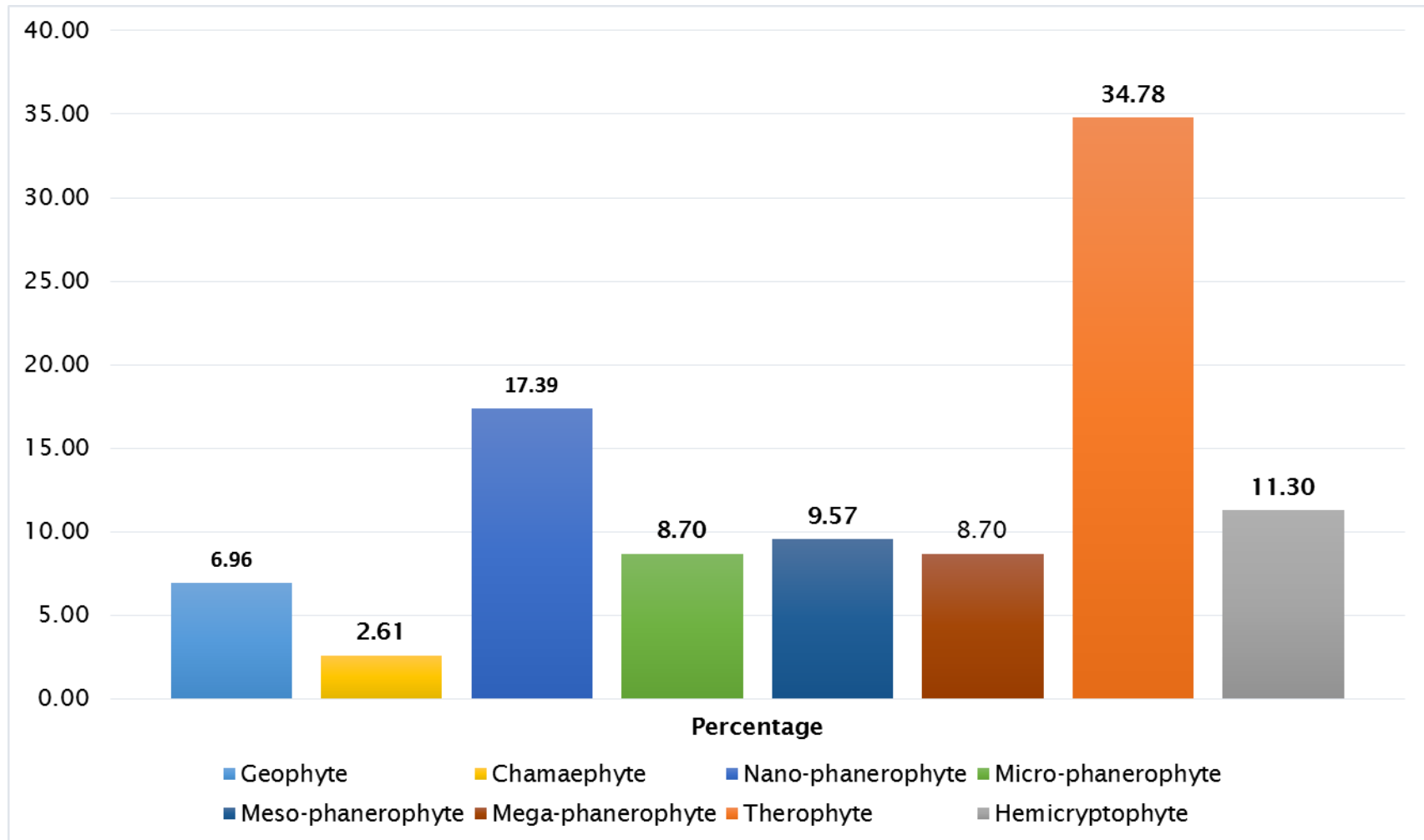
In this study, the growth form (Fig 9) of 115 plant flora was analyzed, revealing a total of 29 (25.22 %) trees, 22 (19.13 %) shrubs, 02 (1.74 %) sub-shrubs, 02 (1.74 %) climber, 01 (0.87 %) palm and the majority, 59 (51.30 %), as herbaceous plants (Table 26). The predominance of herbaceous growth forms is consistent with findings from various research endeavors conducted across the Indian Himalayan Region (IHR), as demonstrated in studies by Tasveer (2022); Rawat (2021); Rahman *et al.* (2021); Rizvi (2021); Haq *et al.* (2021); Sheeraz (2020); Sharma *et al.* (2019); Tantray (2018) Malik and Bhatt (2015) and Samant *et al.* (2007). A likely explanation could be attributed to the continental temperate climate prevalent in the Himalayan region, which might favor the prevalence of herbaceous species over woody ones (Mehraj *et al.*, 2018). Additionally, the prevalence of herbaceous plants is also likely due to their short life cycle, which enables them to adapt and thrive in the face of the ecosystem's inherent instability (Gomaa, 2012). This trend is further clarified by the adaptability of herbs to diverse environmental conditions, a characteristic that makes them a prevalent growth form in many mountainous regions (Ahmad *et al.*, 2021). The high prevalence of herbs in urban area is in line with the outcomes of a study conducted by Salma (2023) and Khuroo *et al.* (2017) while working in urban regions of the Indian Himalayas, where herbs constituted a substantial proportion of the total documented species, with 53 species and 165 species, respectively. This might be due to the the high level of disturbance in urban areas, particularly along roadsides, which may provide an opportunity for rapidly colonizing alien herbaceous species that have the ability to quickly and efficiently exploit available



**Fig. 9: Growthform distribution in Urban and Peri-urban areas of Ganderbal**

resources, as observed in studies by Hobbs and Huenneke (1992) and Lake and Leishman (2004).

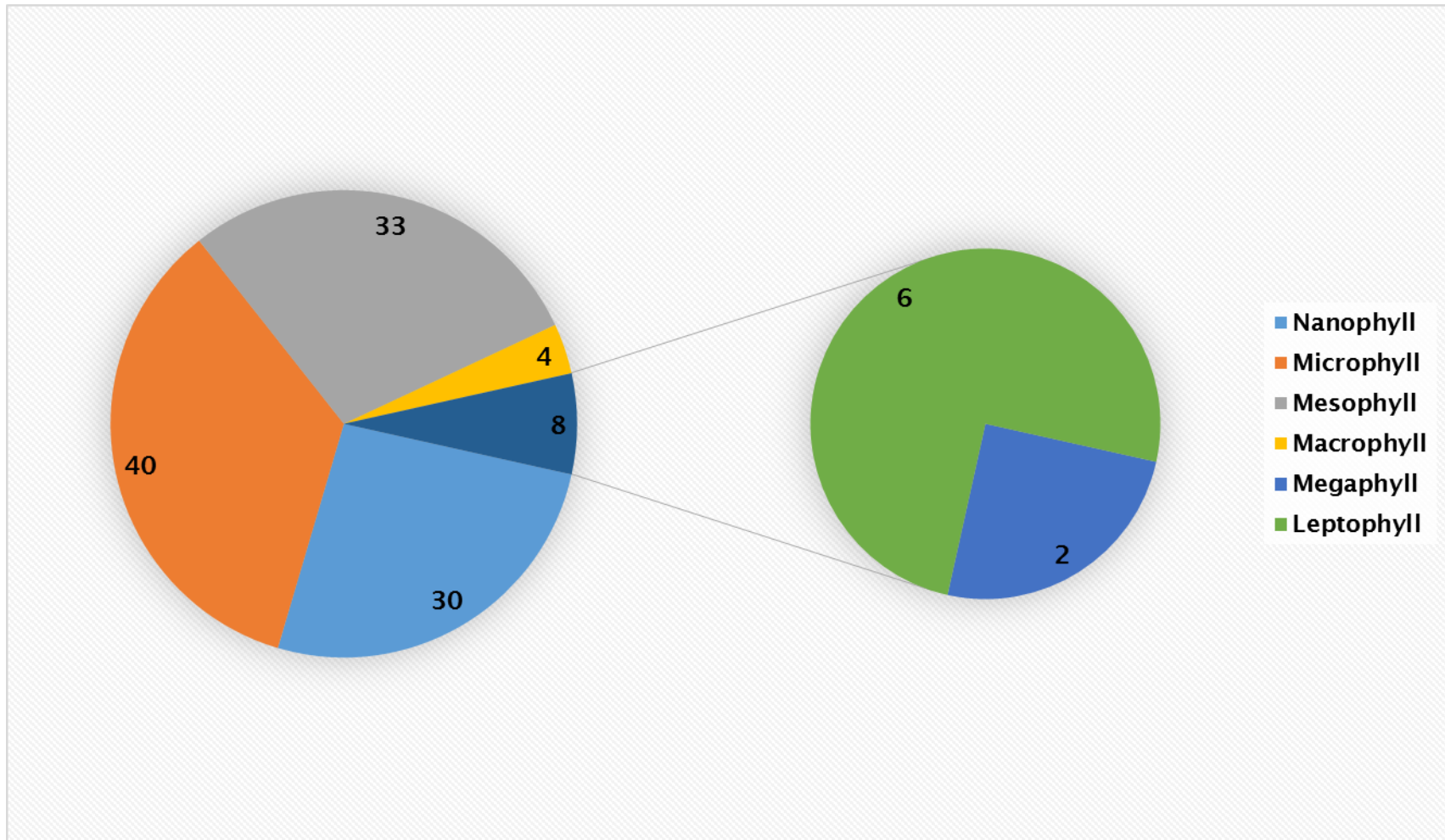
In applying the Raunkiaer biological spectrum classification, our analysis revealed that a substantial portion of the plant species, accounting for 34.78 %, fell into the category of therophytes, followed closely were nano-phanerophytes which constituted 17.39 % of the total species, while as hemicryptophytes contributed 11.30 % and meso-phanerophytes made up 9.57 %. Micro-phanerophytes and mega-phanerophytes showed equal prevalence at 8.70 % each, whereas, geophytes represented 6.96 % of the total. The least represented category were chamaephytes, at 2.61 % (Fig 10). The high prevalence of therophytes in these habitats is closely associated with the elevated level of disturbance caused by various anthropogenic activities, a pattern supported by research, such as Barbero *et al.* (1990). This aligns with the findings of Knapp *et al.* (2008), who noted that therophytes tend to be more abundant in highly urbanized environments subject to frequent disturbances compared to less urbanized regions. This positive relationship between increased disturbance and therophyte prevalence has been observed consistently in similar studies (Solinska *et al.*, 1997; Grime, 2006; Naqinezhad and Saeidi Mehrvaez, 2007; Ravanbakhsh *et al.*, 2007; Reddy and Pattanaik, 2009). Furthermore, the prevalence of therophytes can be attributed to various factors, including the introduction of annual weeds and biotic influences, indicators of a disturbed environmental condition (Al-Yemeni and Sher, 2010). Notably, the increasing developmental activities and urban sprawl expansion have likely been significant contributors to heightened biotic interferences in the area. This prevalence of therophytes can also be explained by the prevailing microclimate of the region, combined with various anthropogenic activities like grazing, logging and deforestation, as supported by the findings of Sher and Khan (2007) and Khan *et al.* (2011). Additionally, limited moisture availability in the form of rainfall may play a role, a pattern consistent with the results reported by Qureshi *et al.* (2011) in their study conducted in Koont. In conclusion, the



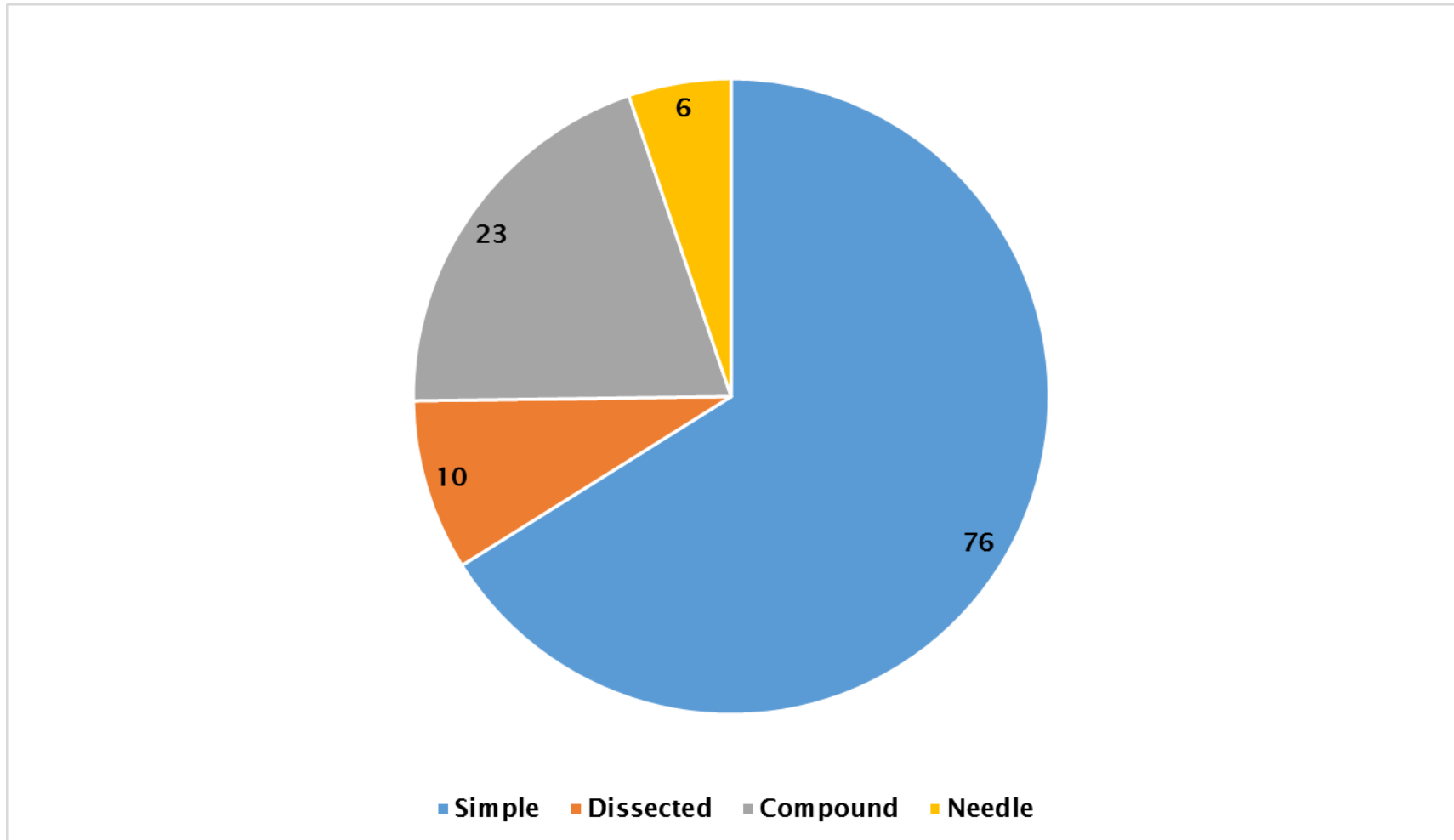
**Fig. 10: Distribution of the Raunkiaer's lifeforms in the Urban and Peri-urban areas of Ganderbal**

substantial presence of therophytes suggests increased aridity during the summer and autumn seasons, along with significant human disturbance, particularly in the form of livestock overgrazing, within this Himalayan region. Therophytes are known for their ability to synchronize their life cycles with suitable seasons and survive in the form of seeds due to water scarcity, a characteristic that aligns with the observations of our study. These plants are well-suited to occupy vacant niches resulting from disturbances like deforestation and overgrazing, as supported by previous research (Pysek *et al.*, 2005). The results of the present study when compared with that of Raunkiaer's (1934) normal spectrum, revealed a significant increase in therophytes, surpassing the normal spectrum and suggested that the phytoclimate of the area can be categorized as thero-phanerophytic (Fig 14). Studies exploring phytoclimatic associations have been carried out by various researchers in Jammu and Kashmir state, including Sapru (1975); Kaul and Sarin (1976); Kapur (1982); Dhar and Koul (1986); Kumar (1987); Singh and Kachroo (1994); Kumar (1997); Kour (2001); Singh (2002); Kesar (2002); Jhangir (2004) and Dutt (2005). Therophytes typically thrive in warm and dry climates, while phanerophytes are more suited for warm and moist conditions. The climate in the study area is characterized by warm and dry summers, which aligns with the dominance of therophytes.

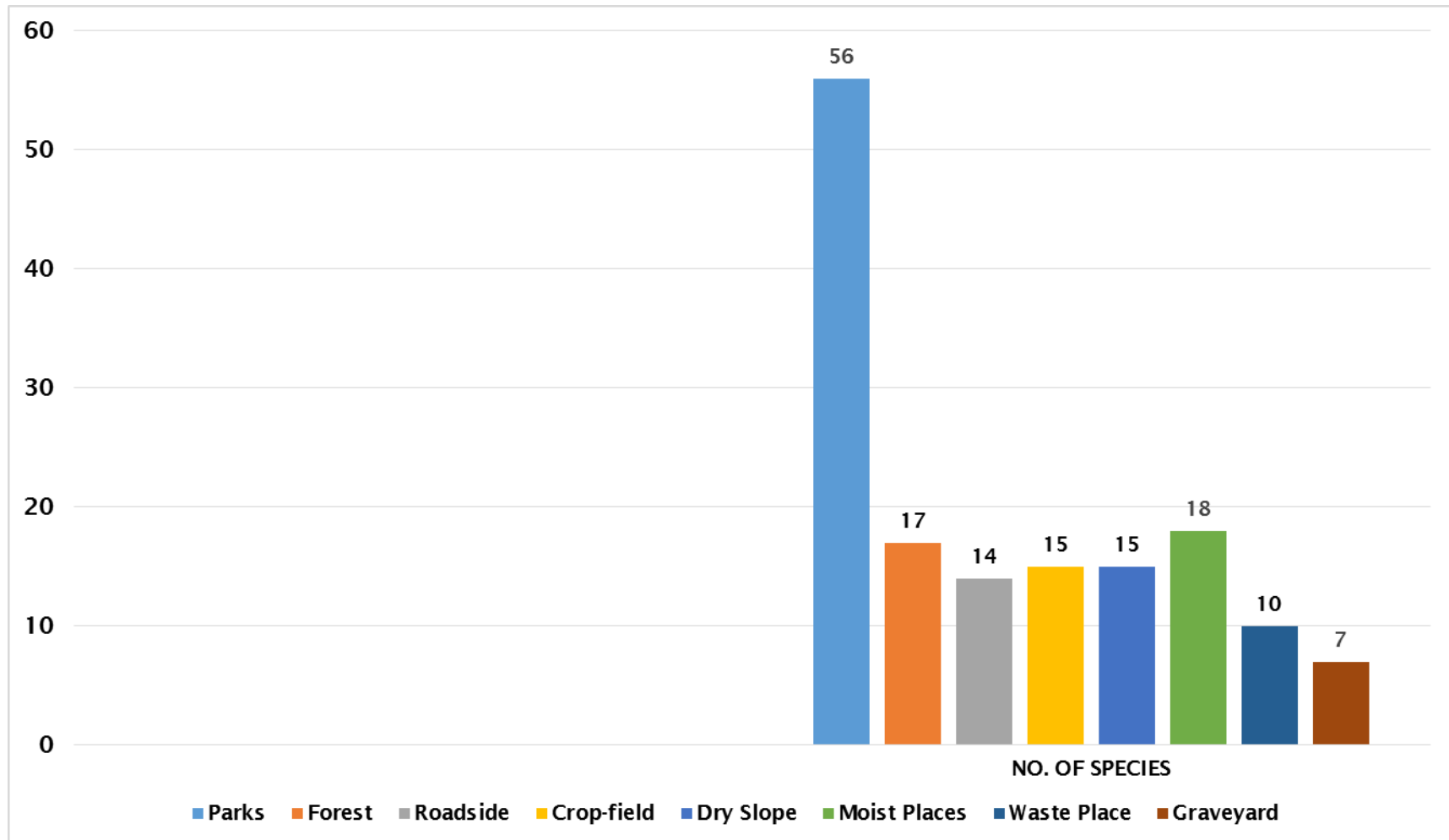
Although the leaf spectra were distributed in six different types, it was mostly dominated (89.57 %) by microphyll, mesophyll, nanophyll leaf types while as the remaining three leaf size types were least represented (10.43 %) in the total species pool (Fig 11). Leaf-size spectra, along with other factors like the biological spectrum, leaf persistence and various plant features, are valuable tools for classifying plant communities and associations. Additionally, understanding leaf size provides insights into the physiological processes of plants and plant communities (Batalha and Martins, 2004). The dominance of small leaved species, i.e., microphylls (40 species), mesophylls (33 species) and nanophylls (30 species) is well in coordination arid climate with severe cold freezing winters.



**Fig. 11: Representation of leaf size in the Urban and Peri-urban areas of Ganderbal**



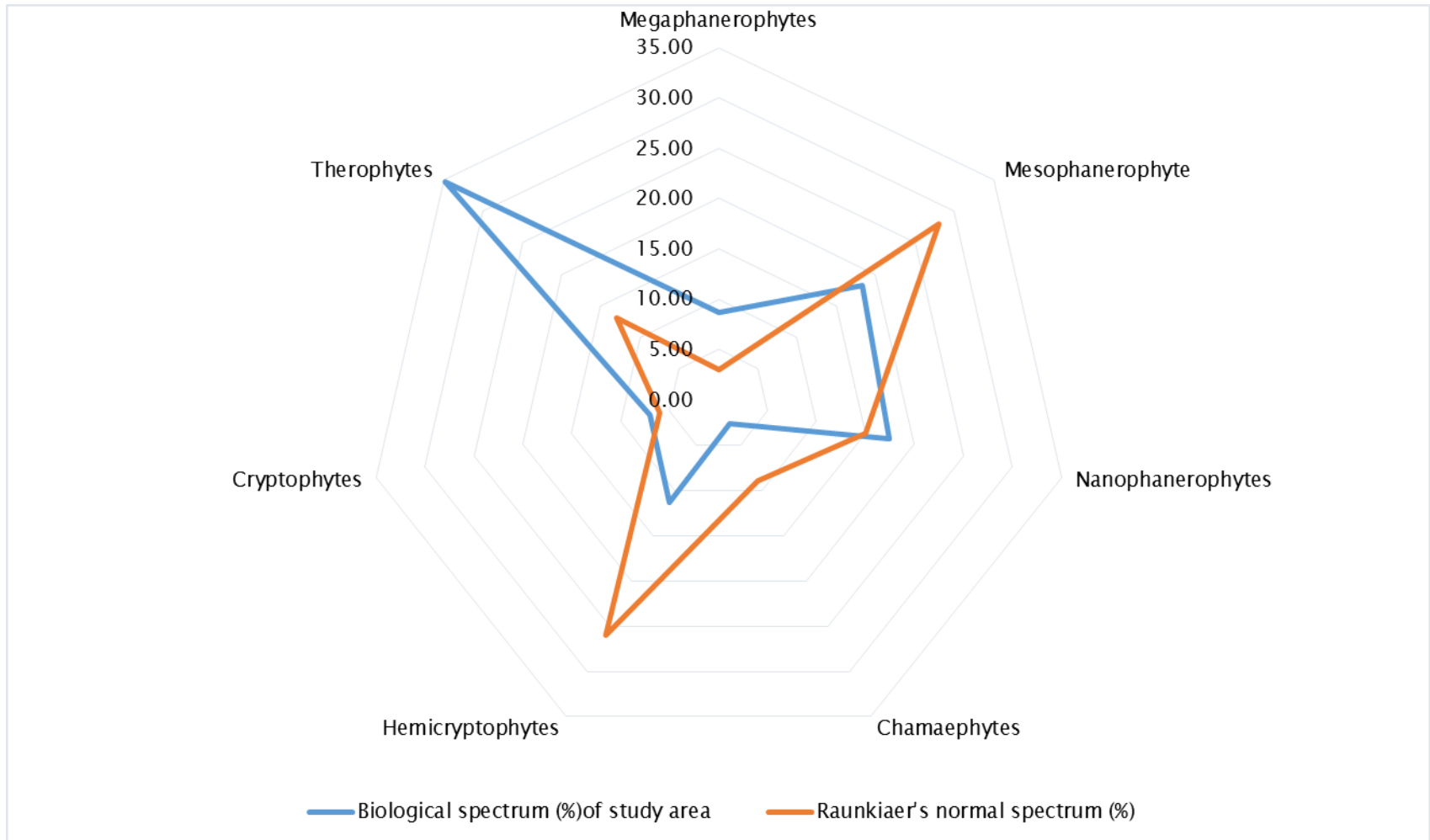
**Fig. 12: Representation of Leaf lamina types in the Urban and Peri-urban areas of Ganderbal**



**Fig. 13: Distribution of plant species in the various habitats in the Urban and Peri-urban areas of Ganderbal**

Consistent findings regarding leaf size classes were observed in previous studies by different workers while working in different regions of Indian Himalayan Region (IHR) like Khan *et al.* (2013) while working on vegetation of Sheikh Maltoon Town in District Mardan, Pakistan reported similar results. Likewise, Tareen and Qadir (1993) and Malik *et al.* (2007) also noted a high percentage of microphylls in the flora of District Quetta and in the Ganga Chotti, Bedori Hills respectively. Moreover, the majority of the plant species featured simple leaf lamina, accounting for 76 of the total species present, followed by those with compound leaf lamina at 23 species, dissected leaf lamina at 10 species and needle leaf lamina at 6 species (Fig 12). The shape of leaves plays a crucial role in helping plants maximize their efficiency in capturing light and managing water loss, which, in turn, minimizes unnecessary energy expenditure in leaf production, as suggested by Malhado *et al.* (2009). This theory gains further support from the distribution of leaf sizes observed in various resource-deficient environments, as demonstrated by Manzoni *et al.* (2013). The findings of this study align with Ihsan *et al.* (2016) who while investigating the Biological Spectrum of District Bannu, Pakistan, reported that the majority of plants had simple leaves (76.16 %). Further, Salma (2023) while working in urban green spaces of Srinagar also noted the predominance of simple leaved species which accounted for 68 % of the total species.

On comparing the floristic diversity in urban and peri-urban areas, noticeable patterns became apparent (Figure 5). Urban locations revealed a higher diversity in tree species, boasting a total of 27 species, while peri-urban areas documented 17 species. Similarly, in the shrub category, urban areas exhibited 21 species, surpassing the 16 species identified in peri-urban areas. The variation extended to herbaceous growth-form, where urban areas showcased a rich assortment of 59 species, in contrast to the 43 species noted in peri-urban areas. Moreover, when exploring sub-shrub species, urban areas exhibited increased diversity with the identification of 02 species, whereas, peri-urban areas included



**Fig. 14: Comparison of Biological spectrum with Raunkiaer's normal spectra**

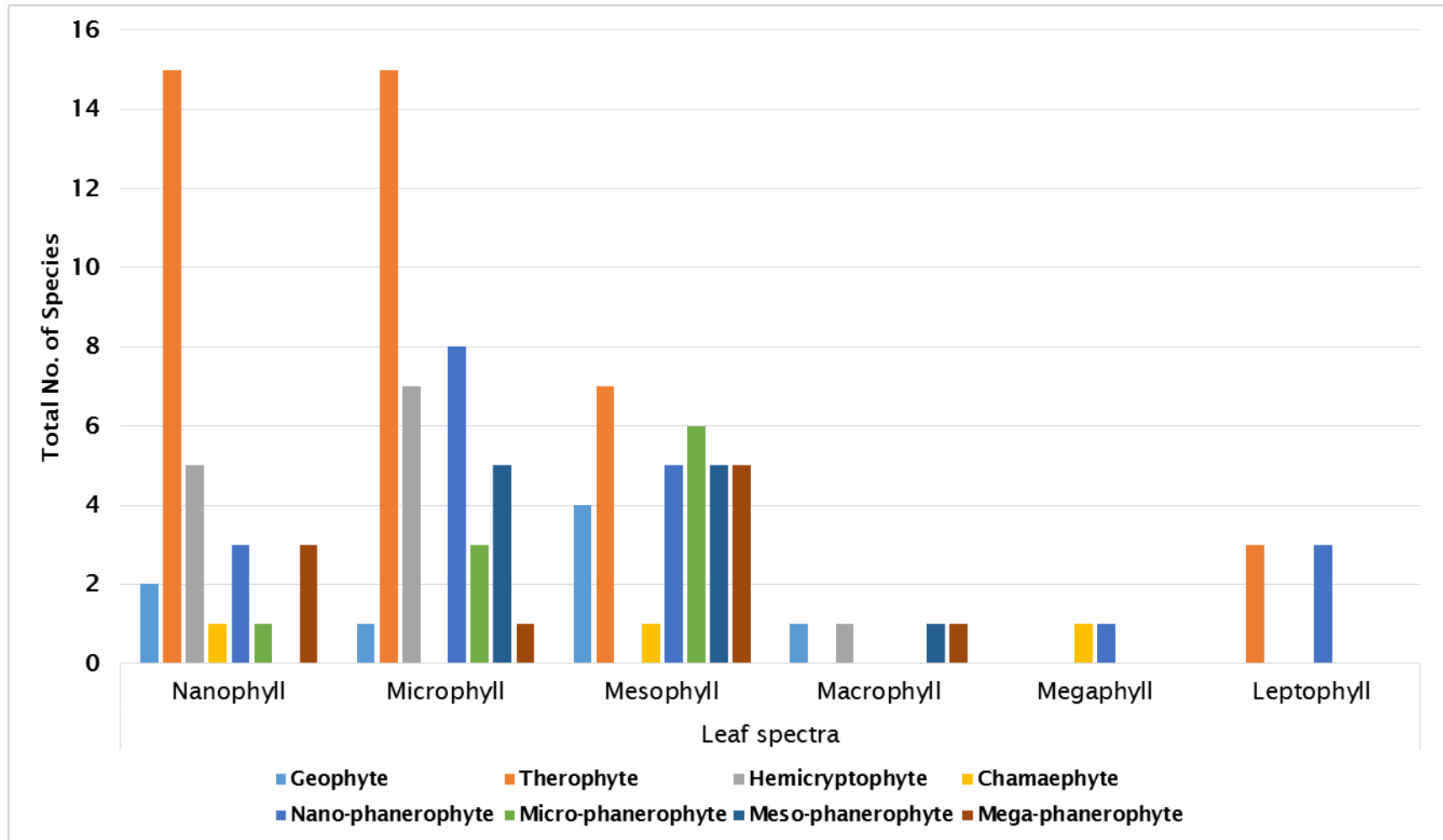


Fig. 15: Analysis of life form with different leaf sizes

only 01 species. Further, the difference extended to climber species, with urban areas hosting 2 species. These findings underscore the subtle distinctions in plant species composition between urban and peri-urban environments. Moreover, the utilization of the Shannon-Wiener Index to assess species richness underscored variations in plant species diversity between urban and peri-urban environments in Ganderbal. And it was revealed that urban areas had the highest Shannon-Wiener diversity index at 1.53 recorded for Duderhama site as compared to peri-urban areas, where the highest diversity index, recorded was 1.49 for Tulumulla site. However, it is important to note that the highest similarity index, calculated at 93 %, was observed between the Gangerhama (urban) and Sarich Chodri Bagh (peri-urban) areas specifically in the tree and shrub category. The variations observed across different plant categories provide valuable insights into the ecological dynamics of these areas.

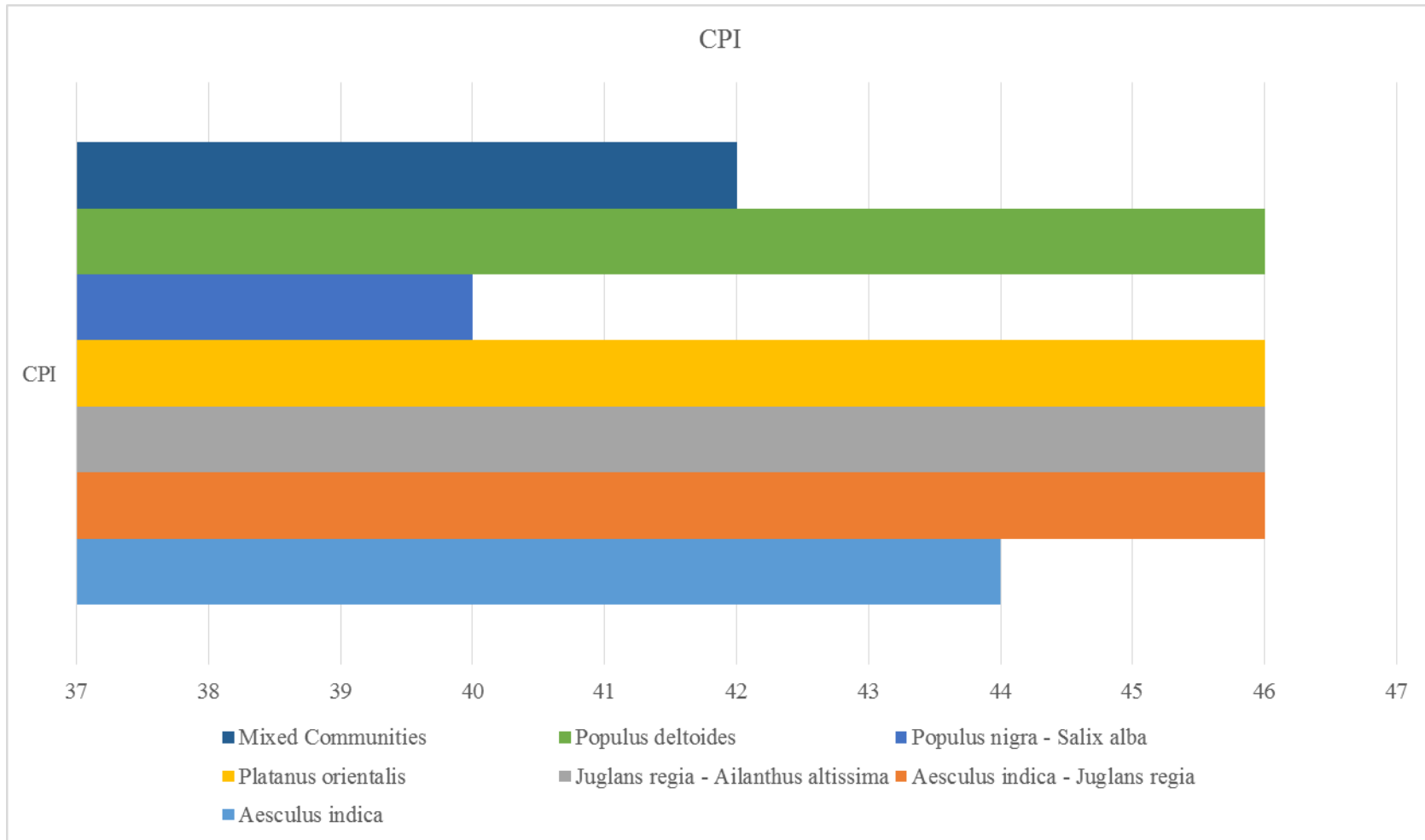
## **5.2 Conservation prioritization of plant communities and habitats**

Quantitative assessments, as highlighted by Uniyal *et al.* (2002), have a pivotal role within the field of species ecology. They serve to evaluate how populations perform under diverse conditions and offer valuable insights into the specific ecological needs of a particular taxon, as emphasized by Kaul and Handa (2001). The data generated through these assessments holds immense promise for its potential contribution to the conservation and management of plant species that are rare and at risk, as noted by Synge (1981). When we observe a low population density across the surveyed regions, it suggests limited availability of the species within the study area. However, the presence of a random distribution in certain sites and a higher frequency of occurrence in others indicates that these specific habitats within the region hold promise for the species to thrive more successfully. Conservation prioritization of the habitats, species and communities is prerequisite for the management planning of the biodiversity in protected and unprotected areas (Joshi and Samant, 2004). Habit refers to the environmental conditions that encompass a species, a population of species or a community of

species, as described by Clements and Shelford (1939). In the contemporary context, the destruction of these habitats stands out as a primary factor contributing to the decline of species populations, eventually placing them at risk of endangerment or even extinction. Therefore, the present attempt has been made to prioritize the habitats and communities of the urban and peri-urban areas of Ganderbal. In the study conducted a total of 07 unique plant communities were identified and they were classified as follows: *Aesculus indica*, *Aesculus indica* - *Juglans regia*, *Juglans regia* - *Ailanthus altissima*, *Platanus orientalis*, *Populus nigra* - *Salix alba*, *Populus deltoides* and Mixed Communities (Table 29). The results align with those of Farooq (2023), who in a study on plant communities and habitats in the urban green spaces of Srinagar, also identified a total of six distinct plant communities. However, the sparse distribution of vegetation in the urban and peri-urban areas of Ganderbal resulted in the identification of a smaller number of plant communities (07), in contrast to other areas within the Indian Himalayan Region (IHR), as observed by Samant *et al.* (2002) who identified a total of 13 distinct plant communities while working on compositional diversity at Nanda Devi Biosphere Reserve. This difference could be attributed to the area's harsh and extremely cold climatic conditions. While comparing the plant communities in urban and peri-urban areas of Ganderbal it was noted that the *Aesculus indica* plant community exclusively thrived in peri-urban sites of Ganderbal entirely absent from all nine urban areas. Additionally, the prevalence of the *Aesculus indica* - *Juglans regia* community was dominant in peri-urban areas, with only one occurrence in urban sites. In contrast, the *Platanus orientalis* community exhibited equal representation in both urban and peri-urban sites. However, the *Populus deltoides* community and Mixed Communities were predominantly found in urban sites of Ganderbal. Notably, the two communities viz: *Juglans regia* - *Ailanthus altissima* and *Populus nigra* - *Salix alba* community were exclusively present in urban areas. The notable differences in the distribution of plant communities between urban and peri-urban areas in Ganderbal suggest distinct ecological preferences and adaptations to varied environmental conditions

across these regions. Overall, these findings highlight the nuanced distribution of plant communities, emphasizing the impact of urbanization on local biodiversity patterns in Ganderbal.

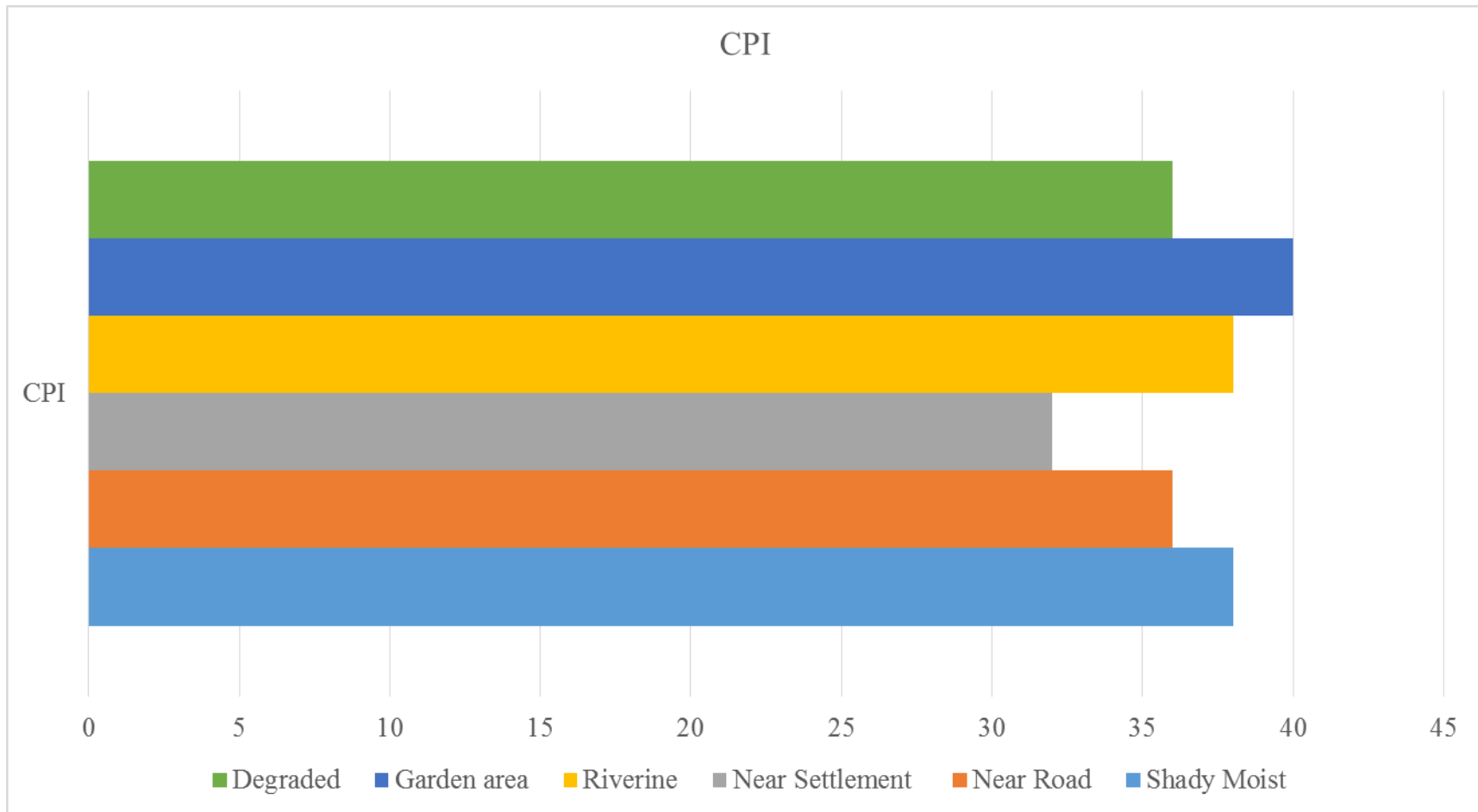
Additionally, the study revealed the existence of six separate habitat types (Table 30). These habitats were categorized as Shady moist, Riverine, Near Road, Near Settlement, Garden Area and Degraded habitats. The findings align with the work of Singh and Samant (2010) which was conducted in Lahaul valley, where they identified a total of fifteen different habitats, including Rocky, Bouldary, Shady moist, Forest, Parasite, Degraded, Dry, Riverine, Water courses, Grassland, Marshy, Shrubberies, Near-settlements, Camping sites and Roadsides. Likewise, Rana and Samant (2009) while working in Manali wildlife sanctuary also yielded comparable results, unveiling the existence of thirteen distinct habitats. These encompassed shady moist forest, dry forest, riverine areas, rocky terrains, bouldary regions, degraded habitats, camping sites, slopes, alpine dry slopes, glacial moraine, shrubbery, water courses and landslide areas. Furthermore, Farooq (2023), focused on urban green spaces in Srinagar city, identified a total of six distinct habitats, including garden areas, near settlements, shady locations, plantations, riverine zones and degraded habitats. In the comparative analysis of habitat types between urban and peri-urban areas in Ganderbal, distinct patterns emerged. Notably, Near Road and Riverine habitats exhibited dominance in urban areas highlighting the influence of human infrastructure and water bodies, contrasting with the prevalence of Shady Moist and Near Settlement habitat types in peri-urban sites indicating a different ecological context, possibly influenced by proximity to human settlements. Furthermore, the exclusive presence of Garden Area habitat characterized urban areas, underscoring their distinctive ecological profile. The exclusive presence of Garden Area habitat in urban regions emphasizes the deliberate cultivation or landscaping in these areas. This suggests a distinct human impact on the ecological makeup of urban spaces, likely for recreational or aesthetic purposes. Conversely, Degraded habitats were found



**Fig. 16: Conservation Prioritization Index of plant communities in Urban and Peri-urban areas of Ganderbal**

exclusively in peri-urban areas, emphasizing the environmental challenges faced by these regions. This could be attributed to factors such as land-use changes, pollution or other forms of degradation associated with human activities on the outskirts of urban centers. This detailed observation of habitat distribution contributes valuable insights to the ecological dynamics in both urban and peri-urban landscapes in Ganderbal shedding light on the interplay between human activities and the natural environment in these distinct settings.

In light of the urgent need to address the rapid loss of biodiversity, it has become crucial to prioritize the protection of sensitive biodiversity elements, with a focus on conserving habitats and communities that support high species diversity, native and endemic species, economically valuable species as well as those facing threats. This prioritization approach is instrumental in contributing to the conservation of biodiversity to some extent. Among these communities, the Mixed Communities had the highest species richness, totaling 97 species, followed by the *Aesculus indica* Community with 65 species. Notably, the *Juglans regia* - *Ailanthus altissima* Community had the highest percentage of native species at 18.18 % and the highest percentage of economically important species at 40.90 %. *Populus deltoides* exhibited the highest percentage of endemic species at 3.27 % and *Populus nigra* - *Salix alba* had the highest percentage of threatened species at 9.09 % (Table 29). According to Ashok *et al.* 2009 study, within the various communities, *Juniperus polycarpos*, *Pinus wallichiana*, *Cedrus deodara*, *Picea smithiana*, *Betula utilis* and *Abies pindrow* exhibited substantial species richness, including a significant presence of native, endemic, near-endemic, economically important and threatened species. Among habitats, the near settlement habitat had the highest species richness, totaling 67 species, closely trailed by the near road habitat with 65 species. Conversely, the degraded habitat had the lowest species richness, comprising 43 species. The degraded habitat stood out for having the highest percentage of threatened species, at 6.97 %. The near road habitat had the highest percentage of native species, reaching



**Fig. 17: Conservation Prioritization Index of habitats in Urban and Peri-urban areas of Ganderbal.**

18.46 %, while the riverine habitat held the most endemic species, at 3.27 %. The garden habitat was notable for containing 39.34 % of economically important species (Table 30). As per Singh and Samant (2010) research, it was evident that within the recognized habitats, the forest, shady moist, rocky, grassland and dry habitats showcased substantial species richness, encompassing native, endemic, near-endemic, economically significant and threatened species. Similarly, Rana and Samant (2009) while working at Manali wildlife sanctuary also revealed that the forest, shady moist, riverine and dry habitats displayed high species richness, featuring native, endemic, near-endemic, economically valuable and threatened species.

In the Indian Himalayan Region (IHR), a majority of studies focused on prioritizing species for conservation have primarily relied on qualitative attributes and observations. However, a few researchers, such as Joshi and Samant (2004), as well as Samant *et al.* (2001) have recommended incorporating both qualitative and quantitative attributes when assessing the status of species for prioritization. Additionally, there is a pressing need to evaluate the status and significance of communities for conservation purposes, as emphasized by Joshi and Samant (2004). Within the various communities analyzed, *Juglans regia* - *Ailanthus altissima*, *Aesculus indica* - *Juglans regia*, *Platanus orientalis* and *Populus deltoides* stood out by obtaining the highest Conservation Priority Index (CPI), each scoring 46 (Figure 16). As a result, these communities were identified as the top priorities for conservation efforts. Among the different habitats considered, the Garden Area habitat secured the highest Conservation Priority Index (CPI) at 40, followed closely by the Shady Moist and Riverine habitats, both with a CPI of 38. The Near Road and Degraded habitats had a CPI of 36 (Figure 17) and were subsequently earmarked as priorities for conservation efforts. Singh and Samant (2010) while studying the conservation prioritization of habitats and forest communities within the Lahaul Valley identified specific habitats and communities with elevated Conservation Priority Index (CPI) scores. Notably,

forests and shady moist habitats received CPI scores of 44 and 38, respectively, indicating their high conservation priority. Further, Wani and Pant (2023) while working on the Status of Biodiversity in the Gulmarg Wildlife Sanctuary observed that among the habitat categories, the dry habitats had the maximum CPI of 50, closely followed by shady moist habitats with a CPI of 48 and bouldary habitats with a CPI of 46. Regarding forest communities, the *Aesculus indica*–*Pinus wallichiana* mixed community displayed the highest CPI value of 62.

The sustainable conservation of these communities and habitats necessitates ongoing monitoring to enable timely and effective management. Unfortunately, the challenging topography, severe climatic conditions and substantial anthropogenic pressures such as road traffic and urbanization have led to significant damage to the biodiversity within these areas. These results echo the observations made by Singh and Samant (2010) who identified similar threats causing substantial harm to the biodiversity of recognized communities in their study on the prioritization of habitats and forest communities in the Lahaul Valley.

## Chapter-6

### SUMMARY AND CONCLUSION

The study titled “Assessment of floristic diversity, biological spectrum and conservation prioritization of forest communities in Urban and Peri-urban areas of Ganderbal, Kashmir”. was carried out in the Ganderbal, Kashmir, spanning the period from 2022 to 2023. The findings of this research are presented and summarized below, organized under the following headings:

- 6.1 Assessment of floristic diversity and biological spectrum in Urban and Peri-urban areas of Ganderbal.
- 6.2 To study the conservation prioritization of forest communities and habitats in Urban and Peri-urban areas of Ganderbal.

#### **6.1 Assessment of floristic diversity and biological spectrum in Urban and Peri-urban areas of Ganderbal**

The comprehensive investigation unveiled 115 distinct plant species, among these, 8 were classified as monocotyledons, 6 as gymnosperms, while the majority, totaling 101 species, belonged to the dicotyledon category. Among the 50 plant families, Asteraceae emerged as the most diverse, with 13 species, followed by Rosaceae with 11 species. Furthermore, it's worth noting the significance of Leguminosae and Amaranthaceae, which encompassed 7 and 6 species, respectively. In the comparison between urban and peri-urban areas, distinct variations in plant species composition were observed. Urban areas displayed higher diversity in several categories: they hosted 27 tree species compared to peri-urban areas 17; had 21 shrub species as opposed to 16 in peri-urban areas and exhibited 59 herbaceous plant species while peri-urban areas had 43. Additionally, urban areas supported 2 sub-shrub species, whereas, peri-urban areas had 1 and urban areas had 2 climber species.

The Raunkiaer biological spectrum classification of plant species in the study area showed that therophytes were the most dominant category at 34.78 %, followed by nano-phanerophytes at 17.39 %. Hemicryptophytes, meso-phanerophytes, micro-phanerophytes and mega-phanerophytes each made up around 8-11 % of the species, while geophytes accounted for 6.96 % and chamaephytes were the least common at 2.61 %. In the leaf spectra classification, the study identified the following distribution of leaf forms: microphylls were the most prevalent, making up 40 % of the total, followed by mesophylls at 33 %, nanophylls at 30 %, leptophylls at 6 %, macrophylls at 4 % and megaphylls at 2 %.

## **6.2 To study the conservation prioritization of forest communities and habitats in Urban and Peri-urban areas of Ganderbal.**

Among the seven different plant communities studied, *Juglans regia* - *Ailanthus altissima*, *Aesculus indica* - *Juglans regia*, *Platanus orientalis* and *Populus deltoides* exhibited the highest Conservation Priority Index (CPI), each scoring 46. In contrast, the *Populus nigra* - *Salix alba* community had the lowest CPI, with a value of 40. The Mixed Community displayed the highest biodiversity, with a total of 97 species. Notably, the *Juglans regia* - *Ailanthus altissima* Community had the highest percentage of native species at 18.18 % and the highest percentage of economically important species at 40.90 %. *Populus deltoides* Community exhibited the highest percentage of endemic species at 3.27 %, while the *Populus nigra* - *Salix alba* Community had the highest percentage of threatened species, with 9.09 % of its species falling into this category.

The study area encompassed a total of six distinct habitats, each with its unique characteristics. Notably, the Garden area habitat exhibited the highest Conservation Priority Index (CPI) value of 40, signifying its elevated importance and priority for conservation efforts. Conversely, the Near Settlement habitat recorded the lowest CPI value at 32. This habitat category was the most prevalent, occupying the maximum number of sites, totaling five. Moreover, the Near

Settlement habitat also boasted the highest species richness, with 67 species identified within it.

## **CONCLUSION**

The study titled “Assessment of floristic diversity, biological spectrum and conservation prioritization of forest communities in Urban and Peri-urban areas of Ganderbal, can be concluded as:

- This present study provides valuable insights for the first time into the floristic diversity, biological spectrum and conservation priorities of plant communities and habitats in urban and peri-urban areas of Ganderbal, Kashmir, highlighting variations in species composition and ecological significance among different communities and habitats.
- The phytosociological analysis conducted in the study area revealed the existence of 115 plant species, comprising 29 tree species, 22 shrub species, 2 sub-shrubs, 2 climbers, 1 palm species and 59 herb species.
- Among the plant families identified in the study, Asteraceae exhibited the highest diversity with 13 species, closely followed by Rosaceae, which comprised 11 species.
- Urban areas showed higher diversity than peri-urban areas in terms of tree, shrub, herbaceous, sub-shrub and climber species.
- Raunkiaer biological spectrum classification revealed a dominance of therophytes (34.78 %) and nano-phanerophytes (17.39 %).
- Leaf spectra classification highlighted microphylls (40 %) as the most prevalent leaf form.
- The majority of the species had simple leaf lamina, accounting for 76 %.
- The distribution of plant species across different habitats showed that the majority were concentrated in park habitats (56 %), followed by moist

places (18 %), forests (17 %), crop-fields and dry slopes (15 %), roadsides (14 %), waste places (10 %) and graveyards (7 %).

- The highest similarity index for trees and shrubs was found between two sites, Sarich Chodri Bagh and Gangerhama, with an impressive 93 % similarity. While the highest similarity index for herbs was identified between Rangil and Harran with a value of 78 %.
- Within urban areas, Duderhama displayed the highest Shannon-Wiener diversity index, registering at 1.53. In contrast, among peri-urban areas, Tulmulla recorded the highest Shannon-Wiener diversity index, which reached 1.49.
- Among the plant communities studied, *Juglans regia* - *Ailanthus altissima*, *Aesculus indica* - *Juglans regia*, *Platanus orientalis* and *Populus deltoides* had the highest Conservation Priority Index (CPI) at 46.
- Among six distinct habitats identified, with the Garden area habitat having the highest CPI at 40.
- The importance of this study extends to the fact that the data on life forms of plants can offer insights into the prevailing phytoclimatic conditions, which, in turn, can be valuable for deducing the microclimatic conditions within a particular area.
- Regular monitoring of communities and habitats with high CPI values is crucial for their effective management.
- In summary, it is recommended that a well-defined strategy and policy for conservation management of prioritized communities and habitats be developed to ensure the efficient management of area.

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**Appendix 1****Selected Urban areas of Ganderbal.**

<b>Name</b>	<b>Co-ordinates</b>	<b>Altitude</b>
Beehama	N 34° 12'44.86" E074° 46'05.34"	1590 m
Ganderbal	N 34° 21'14.34" E 074° 76'27.96"	1619 m
Arampora	N 34° 13'01.93" E 074° 46'27.97"	1599 m
Duderhama	N 34° 13'10.45" E 074° 46'19.31"	1607 m
Fathepora	N 34° 12'28.81"E 074° 46'16.82"	1597 m
Gangerhama	N 34° 12'56.27" E 074° 45'48.09"	1563 m
Wanipora	N 34° 13'21.11" E 074° 45'39.87"	1595m
Bamloora	N 34° 12'03.35" E 074° 46'01.13"	1602m
Saloor	N 34° 12'27.62" E 074° 46'07.73"	1589m

**Appendix 2****Selected Peri-urban areas of Ganderbal.**

<b>Name</b>	<b>Co-ordinates</b>	<b>Altitude</b>
Arch	N 34° 14'05.19" E 074° 46'04.17"	1581 m
Tulmulla	N 34° 13'46.24" E 074° 43'37.50"	1586m
Seh Pora	N 34° 11'06.58" E 074° 43'13.39"	1584m
Harran	N 34° 10'39.41" E 074° 45'47.33"	1583 m
Rakh Kujjar	N 34° 19'12.71" E 074° 77'74.38"	1623m
Wahid Pora	N 34° 13'56.58" E074° 45'48.4"	1587m
Badhra Kund	N 34° 23'32.49" E 074° 79'19.01"	1537m
Sarich Chodri Bagh	N 34° 24'16.99" E 074° 78'64.58"	1522m
Rangil	N 34° 20'42.68" E 074° 56'04.54"	1699m

Appendix III

Some important native, endemic, economically important and threatened species of the main prioritized communities

Prioritised communities	Native	Endemic	Economically important species	Threatened
<p><i>Aesculus indica</i></p>	<p><i>Aesculus indica</i>  <i>Berberis lycium</i>  <i>Carpesium abrotanoides</i>  <i>Cedrus deodara</i>  <i>Indigofera heteratha</i>  <i>Juglans regia</i>  <i>Myosotis arvensis</i>  <i>Nerium indicum</i>  <i>Picea smithiana</i>  <i>Rubus niveus</i>  <i>Populus nigra</i>  <i>Setaria viridis</i></p>	<p><i>Aesculus indica</i>  <i>Cedrus deodara</i></p>	<p><i>Ailanthus altissima</i>  <i>Brassica rapa</i>  <i>Cannabis sativa</i>  <i>Cedrus deodara</i>  <i>Celtis australis</i>  <i>Chenopodium album</i>  <i>Cupressus sempervirens</i>  <i>Daucus carota</i>  <i>Juglans regia</i>  <i>Ficus carica</i>  <i>Eschscholzia californica</i>  <i>Foeniculum vulgare</i>  <i>Galinsoga parviflora</i>  <i>Morus alba</i>  <i>Picea smithiana</i>  <i>Populus nigra</i>  <i>Populus deltoides</i>  <i>Robinia pseudoacacia</i>  <i>Rosa × damascena</i>  <i>Rosa multiflora</i>  <i>Rubus niveus</i>  <i>Rumex dentatus</i>  <i>Salix alba</i></p>	<p><i>Berberis lycium</i>  <i>Marrubium vulgare</i>  <i>Mentha arvensis</i>  <i>Rubus ulmifolius</i></p>

<p><b><i>Aesculus indica - Juglans regia</i></b></p>	<p><i>Aesculus indica Berberis lycium Carpesium abrotanoides Fragaria nubicola Indigofera heterantha Juglans regia Myosotis arvensis Nerium indicum Populus nigra Rubus niveus</i></p>	<p><i>Aesculus indica</i></p>	<p><i>Aesculus indica Ailanthus altissima Cannabis sativa Celtis australis Chenopodium album Daucus carota Ficus carica Foeniculum vulgare Fragaria nubicola Galinsoga parviflora Juglans regia Mentha arvensis Morus alba Populus nigra Populus deltoides Robinia psuedoacacia Rosa × damascena Rosa multiflora Rubus niveus Salix alba Rumex dentatus</i></p>	<p><i>Berberis lycium Marrubium vulgare Rubus ulmifolius</i></p>
<p><b><i>Juglans regia - Ailanthus altissima</i></b></p>	<p><i>Juglans regia Berberis lycium Indigofera heterantha Nerium indicum</i></p>		<p><i>Ailanthus altissima Celtis australis Ficus carica Juglans regia Morus alba Brassica rapa Cannabis sativa</i></p>	<p><i>Berberis lycium</i></p>

			<i>Daucus carota</i> <i>Hedera helix</i>	
<i>Platanus orientalis</i>	<i>Aesculus indica</i> <i>Indigofera heterantha</i> <i>Juglans regia</i> <i>Myosotis arvensis</i> <i>Papaver dubium</i> <i>Picea smithiana</i> <i>Populus nigra</i> <i>Rubus niveus</i> <i>Setaria viridis</i>	<i>Aesculus indica</i>	<i>Aesculus indica</i> <i>Ailanthus altissima</i> <i>Foeniculum vulgare</i> <i>Juglans regia</i> <i>Melia azedarach</i> <i>Mentha arvensis</i> <i>Morus alba</i> <i>Picea smithiana</i> <i>Platanus orientalis</i> <i>Populus nigra</i> <i>Populus deltoides</i> <i>Rosa × damascena</i> <i>Rosa multiflora</i> <i>Rubus niveus</i> <i>Rumex dentatus</i> <i>Tagetes patula</i>	<i>Rubus ulmifolius</i>

**Appendix 4: Some important native, endemic, economically important and threatened species of the main prioritized habitats**

<b>Prioritised habitats</b>	<b>Native</b>	<b>Endemic</b>	<b>Economically important species</b>	<b>Threatened</b>
<b>Garden area</b>	<p><i>Nerium indicum</i> <i>Rubus niveus</i></p>		<p><i>Ailanthus altissima</i> <i>Brassica rapa</i> <i>Cannabis sativa</i> <i>Catalpa bignoniodes</i> <i>Celosia argentea</i> <i>Cryptomeria japonica</i> <i>Cupressus sempervirens</i> <i>Dahlia pinnata</i> <i>Daucus carota</i> <i>Eschscholzia californica</i> <i>Ficus carica</i> <i>Foeniculum vulgare</i> <i>Galinsoga parviflora</i> <i>Gomphrena globose</i> <i>Halianthus annus</i> <i>Ligustrum lucidum</i> <i>Platanus orientalis</i> <i>Populus deltoides</i> <i>Prunus cerasifera</i> <i>Prunus persica</i> <i>Rosa × damascena</i> <i>Rubus niveus</i></p>	<p><i>Cryptomeria japonica</i></p>

			<i>Salix babylonica</i> <i>Tagetes patula</i> <i>Viola tricolor</i>	
<b>Shady Moist</b>	<i>Aesculus indica</i> <i>Berberis lycium</i> <i>Cedrus deodara</i> <i>Juglans regia</i> <i>Nerium indicum</i> <i>Picea smithiana</i> <i>Setaria viridis</i>	<i>Aesculus indica</i> <i>Cedrus deodara</i>	<i>Aesculus indica</i> <i>Ailanthus altissima</i> <i>Brassica rapa</i> <i>Cannabis sativa</i> <i>Cedrus deodara</i> <i>Celtis australis</i> <i>Chenopodium album</i> <i>Daucus carota</i> <i>Eschscholzia californica</i> <i>Ficus carica</i> <i>Foeniculum vulgare</i> <i>Hedera helix</i> <i>Indigofera heterantha</i> <i>Juglans regia</i> <i>Mentha arvensis</i> <i>Morus alba</i> <i>Picea smithiana</i> <i>Populus deltoides</i> <i>Robinia psuedoacacia</i> <i>Rosa multiflora</i> <i>Rumex dentatus</i> <i>Salix alba</i>	<i>Berberis lycium</i> <i>Marrubium vulgare</i> <i>Rubus ulmifolius</i>

<p style="text-align: center;"><b>Riverine</b></p>	<p style="text-align: center;"> <i>Aesculus indica</i>  <i>Carpesium abrotanoides</i>  <i>Cedrus deodara</i>  <i>Fragaria nubicola</i>  <i>Indigofera heterantha</i>  <i>Juglans regia</i>  <i>Myosotis arvensis</i>  <i>Nerium indicum</i>  <i>Paparver dubium</i>  <i>Rubus niveus</i>  <i>Populus nigra</i>  <i>Setaria viridis</i> </p>	<p style="text-align: center;"> <i>Aesculus indica</i>  <i>Cedrus deodara</i> </p>	<p style="text-align: center;"> <i>Aesculus indica</i>  <i>Ailanthus altissima</i>  <i>Brassica rapa</i>  <i>Cannabis sativa</i>  <i>Cedrus deodara</i>  <i>Celtis australis</i>  <i>Chenopodium album</i>  <i>Daucus carota</i>  <i>Ficus carica</i>  <i>Foeniculum vulgare</i>  <i>Fragaria nubicola</i>  <i>Galinsoga parviflora</i>  <i>Juglans regia</i>  <i>Morus alba</i>  <i>Platanus orientalis</i>  <i>Populus nigra</i>  <i>Populus deltoides</i>  <i>Robinia psuedoacacia</i>  <i>Rosa × damascena</i>  <i>Rosa multiflora</i>  <i>Rubus niveus</i>  <i>Rumex dentatus</i>  <i>Salix alba</i> </p>	<p style="text-align: center;"><i>Rubus ulmifolius</i></p>
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**Sher-e-Kashmir**  
**University of Agricultural Sciences and Technology of Kashmir**  
**Division of Natural Resources Management,**  
**Faculty of Forestry, Benhama, Ganderbal**

**CERTIFICATE**

Certified that all the corrections/amendments as suggested by External Examiner **Dr. Sandeep Singh**, Professor and Head, Division of Silviculture and Agroforestry, Faculty of Horticulture and Forestry, SKUAST-Jammu during Viva-Voce examination held on **11-03-2024** have been incorporated in the manuscript entitled “**Assessment of floristic diversity, biological spectrum and conservation prioritization of plant communities in Urban and Peri-urban areas of Ganderbal, Kashmir**” submitted by **Ms. Baria Ashraf** (Regd. No. MSF-2021-139).

**Dr. Aasif Ali Gattoo**  
Chairman  
Advisory Committee