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Taxonomic Composition and Phytosociological Analysis of Kainengkol Grassland, Kangpokpi District, Manipur

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ABSTRACT

The present study investigates the taxonomic composition and phytosociological structure of Kainengkol Grassland, Kangpokpi District, Manipur, to understand species diversity, distribution, and ecological dominance. A total of 26 plant species belonging to various families were recorded during the study period. Taxonomic analysis revealed that Poaceae is the most dominant family, followed by Asteraceae, indicating the prevalence of grassland vegetation under open and dynamic environmental conditions. The dominance of grasses reflects their high adaptability, rapid growth, and efficient resource utilization. Families such as Cyperaceae and Juncaceae indicate localized moist conditions, whereas ferns under Dennstaedtiaceae and Blechnaceae suggest the presence of humid and semi-shaded microhabitats. The occurrence of shrub species under Melastomataceae and Rosaceae further indicates ongoing secondary successional processes within the grassland ecosystem.

Phytosociological parameters, including frequency, density, abundance, and Importance Value Index (IVI), were analyzed to evaluate vegetation structure and species dominance. Most species exhibited high frequency, indicating uniform distribution across the grassland, while a few species showed restricted occurrence, reflecting microhabitat heterogeneity. Species such as Cynodon dactylon showed high density and abundance, indicating strong ecological adaptation and numerical dominance. The IVI values identified key species that significantly influence community structure and ecological functioning. Overall, the grassland represents a moderately diverse ecosystem dominated by grasses, with contributions from herbs, shrubs, and ferns, shaped by environmental variability and successional changes, highlighting the importance of sustainable management and conservation practices.

KEYWORDS: Grassland vegetation, Taxonomic diversity, Phytosociology, Species distribution, Importance Value Index (IVI), Kainengkol, Manipur, Plant community structure, Ecological dominance, Biodiversity.

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INTRODUCTION

Grasslands represent one of the most important terrestrial ecosystems, contributing significantly to biodiversity, ecological stability, and ecosystem services. They support a wide range of plant species and play a crucial role in soil conservation, nutrient cycling, and carbon sequestration. The structure and composition of grassland vegetation are influenced by various environmental factors such as climate, soil conditions, and disturbance regimes, which together determine species distribution and community dynamics (Odum, 1971). Understanding the floristic composition and ecological characteristics of grasslands is therefore essential for assessing their health and sustainability.

Taxonomic analysis provides fundamental information on species composition and family dominance, helping to identify vegetation types and ecological patterns within a given area. In many tropical and subtropical grasslands, families such as Poaceae and Asteraceae are commonly dominant due to their adaptability and efficient reproductive strategies (Kent, 2012). In addition, phytosociological studies involving parameters such as frequency, density, abundance, and Importance Value Index (IVI) offer quantitative insights

into species distribution, dominance, and community structure (Curtis & McIntosh, 1951). These parameters are widely used to evaluate vegetation patterns and ecological relationships within plant communities.

The grasslands of Manipur, particularly in regions like Kainengkol in Kangpokpi District, are ecologically significant but remain relatively underexplored in terms of systematic vegetation analysis. These areas exhibit a mixture of grasses, herbs, shrubs, and ferns, reflecting diverse microhabitats and successional stages. Therefore, the present study aims to analyze the taxonomic composition and phytosociological characteristics of Kainengkol Grassland to provide baseline data on species diversity, distribution, and ecological dominance, which can support future conservation and management efforts.

DESCRIPTION OF STUDY SITE

Kainengkol Grassland, located in Kangpokpi District of Manipur, represents a typical upland grassland ecosystem characterized by moderate elevation and varied environmental conditions. The study area is situated in and around 93°45′42″ E longitude and 24°51′57″ N latitude, with an altitude ranging from 1300 to 1450 meters above sea level. The grassland extends over a large area of approximately 120.05 acres, forming a continuous stretch of open vegetation. However, for the present study, a small, relatively plain and manageable portion of the grassland was selected to carry out detailed phytosociological analysis.

The landscape of the region is predominantly sloping, which plays an important role in determining soil moisture, drainage patterns, and plant distribution. The area is unprotected, making it subject to natural disturbances and human activities that may influence vegetation composition. The climatic conditions are suitable for the growth of grasses along with associated herbs, shrubs, and ferns. Variations in slope and microtopography create diverse microhabitats, including both moist and well-drained patches, contributing to the overall diversity of plant species.

This combination of altitude, slope, and habitat variation makes Kainengkol Grassland an important site for studying vegetation structure, species distribution, and ecological relationships within grassland ecosystems.

METHODOLOGY

The study was conducted from 2022 to 2023 in the Kainengkol Grassland, Kangpokpi District, Manipur, using standard ecological methods to assess the taxonomic composition and phytosociological characteristics of the vegetation. A representative and relatively plain portion of the grassland was selected for detailed sampling to ensure accurate assessment of plant community structure and species distribution. Field surveys were carried out throughout the study period to record plant species composition along with important ecological parameters such as frequency, density, abundance, dominance, relative frequency, relative density, relative dominance, and Importance Value Index (IVI), following established phytosociological methods (Curtis & McIntosh, 1950; Misra, 1968). Quadrat sampling technique was employed for vegetation analysis, and quadrats were laid randomly within the study site to observe species occurrence and distribution patterns.

Plant species present in the study area were collected, observed, and identified based on their morphological characteristics including leaf shape, stem structure, inflorescence, floral parts, and reproductive organs. Identification and nomenclature were verified with the help of standard regional floras, taxonomic keys, and relevant botanical literature. The scientific names of the species were authenticated and arranged according to their respective families to determine floristic composition and family dominance within the grassland ecosystem. Proper field records and documentation of species were maintained throughout the investigation for further ecological and phytosociological analysis. The classification and arrangement of plant taxa were followed according to the Bentham and Hooker system as adapted in regional floristic studies.

Phytosociological analysis was carried out using the quadrat method, which is widely used for vegetation studies (Curtis & McIntosh, 1951; Mueller-Dombois & Ellenberg, 1974). Quadrats of appropriate size were laid randomly within the selected area. In each quadrat, the following parameters were recorded:

- Frequency (%) = (Number of quadrats in which a species occurs / Total number of quadrats) × 100
- Density = Total number of individuals of a species / Total number of quadrats studied
- Abundance = Total number of individuals of a species / Number of quadrats in which the species occurs

  From these primary data, relative values were calculated:
- Relative Frequency (RF) = (Frequency of a species / Sum of frequency of all species) × 100
- Relative Density (RD) = (Density of a species / Total density of all species) × 100
- Relative Dominance (RDo) was estimated based on basal cover of each species

  Finally, the Importance Value Index (IVI) was calculated as:
- IVI = RF + RD + RDo

These parameters were used to evaluate species distribution, dominance, and community structure within the grassland ecosystem.

RESULT AND DISCUSSION

Plants with Families

Sl. No.	Plant Name	Family
1	*Cynodon dactylon*	Poaceae
2	*Arundinella nepalensis*	Poaceae
3	*Axonopus compressus*	Poaceae
4	*Carex cruciate*	Cyperaceae
5	*Digitaria longiflora*	Poaceae
6	*Eragrostis unioloides*	Poaceae
7	*Chromolaena odorata*	Asteraceae
8	*Ageratina Adenophora*	Asteraceae
9	*Urena lobata*	Malvaceae
10	*Chrysopogon aciculatus*	Poaceae
11	*Ageratum conyzoides*	Asteraceae
12	*Lindernia crustacea*	Linderniaceae
13	*Centella asiatica*	Apiaceae
14	*Solanum viarum*	Solanaceae
15	*Pteridium aquilinum*	Dennstaedtiaceae
16	*Phyllanthus urinaria*	Phyllanthaceae
17	*Melastoma malabathricum*	Melastomataceae
18	*Rubus ellipticus*	Rosaceae
19	*Polygonum reptans*	Polygonaceae
20	*Tagetes erecta*	Asteraceae
21	*Drymaria cordata*	Caryophyllaceae
22	*Crassocephalum crepidioides*	Asteraceae
23	*Plantago major*	Plantaginaceae
24	*Acmella oleracea*	Asteraceae
25	*Blechnum orientale*	Blechnaceae
26	*Juncus effusus*	Juncaceae

The taxonomic analysis of vegetation in Kainengkol Grassland, comprising 26 plant species distributed across multiple families, reveals a distinct pattern of family-level dominance and ecological adaptation. The family Poaceae is the most dominant, represented by species such as *Cynodon dactylon*, *Axonopus compressus*, *Digitaria longiflora*, *Eragrostis unioloides*, *Arundinella nepalensis*, and *Chrysopogon aciculatus*. The strong representation of grasses indicates that the area exhibits typical grassland characteristics, where species with rapid growth, efficient vegetative propagation, and tolerance to environmental stress tend to dominate (Odum, 1971; Kent, 2012). The second most prominent family is Asteraceae, including *Chromolaena odorata*, *Ageratina adenophora*, *Ageratum conyzoides*, *Crassocephalum crepidioides*, *Tagetes erecta*, and *Acmella oleracea*, which are commonly associated with open and dynamic habitats, reflecting adaptability to varying environmental conditions (Mueller-Dombois & Ellenberg, 1974).

Other families such as Cyperaceae (*Carex cruciata*) and Juncaceae (*Juncus effusus*) indicate the presence of moist or water-influenced microhabitats, while Dennstaedtiaceae (*Pteridium aquilinum*) and Blechnaceae (*Blechnum orientale*) further support the occurrence of humid or semi-shaded conditions, as ferns typically thrive in such environments. The presence of Melastomataceae (*Melastoma malabathricum*) and Rosaceae (*Rubus ellipticus*) suggests the development of shrubby vegetation and ongoing secondary succession, indicating a transition towards a more complex vegetation structure (Mueller-Dombois & Ellenberg, 1974). Additionally, families such as Malvaceae, Solanaceae, Apiaceae, Caryophyllaceae, and Plantaginaceae are represented by fewer species, contributing to the overall species richness and diversity, although their role in terms of dominance remains comparatively limited.

PHYTOSOCIOLOGY STUDY

Plants Present	freq	density	abundance	RF	Rdo	RD	IVI
1. Cynodon dactylon(freq)	100	34.07	35.05	4.81	0.631	14.66	20.101
2. Arundinella nepalensis	88.33	10.44	11.47	4.11	1.59	4.06	9.76
3. Axonopus compressus	97.5	21.59	22.32	4.64	1.44	7.83	13.91
4. Carex cruciate	86.66	10.07	11.18	4.02	1.28	3.91	9.21
5. Digitaria longiflora	95	16.47	11.21	4.49	1.109	6.55	12.149
6. Eragrostis unioloides	90.83	12.3	12.98	4.26	1.204	4.72	10.184
7. Chromolaena odorata	72.5	10.15	5.24	3.29	8.78	1.59	13.66
8. Ageratina Adenophora	76.66	4.67	5.65	3.53	7.04	1.84	12.41
9. Urena lobata	70	3.94	5.14	3.19	4.02	1.53	8.74
10. Chrysopogon aciculatus	97.5	15.4	14.92	4.64	1.76	6.23	12.63
11. Ageratum conyzoides	90	10.7	11.43	4.22	2.37	4.16	10.75

12. Lindernia crustacea	83.33	8.15	9.09	3.84	0.82	3.04	7.7
13. Centella asiatica	89.16	10.4	10.09	4.18	0.73	3.78	8.69
14. Solanum viarum	49.16	2	4.14	2.33	5.803	0.97	9.103
15. Pteridium aquilinum	72.5	4.07	5.4	3.29	10.41	1.57	15.27
16. Phyllanthus urinaria	90	10.3	11.02	4.22	1.07	3.93	9.22
17. Melastoma malabathricum	61.66	2.64	4.36	2.86	11.96	1.19	16.01
18. Rubus ellipticus	25.83	1.67	5.13	1.21	10.96	0.52	12.69
19. Polygonum reptans	92.5	10.34	10.97	4.36	1.28	4.14	9.78
20. Tagetes erectus	60	2.9	4.73	2.77	4.48	1.23	8.48
21. Drymaria cordata	95	15.27	15.94	4.49	0.56	6.19	11.24
22. Crassocephalum crepidioides	94.16	9.57	10.55	4.45	3.49	4.18	12.12
23. Plantago major	97.5	7.07	7.21	4.65	2.12	3.01	9.78
24. Acmella oleracea	83.33	6.17	6.94	3.82	2.55	2.39	8.76
25. Blechnum orientale	85	4.5	5.16	3.94	8.79	1.89	14.62
26. Juncus effusus	95	10.07	58.98	4.49	2.81	3.86	11.16

The frequency analysis of plant species in the Kainengkol grassland revealed significant variation in the distribution pattern of vegetation within the ecosystem. Among all recorded species, *Cynodon dactylon* showed the highest frequency value (100%), indicating its occurrence in almost all quadrats and demonstrating its wide adaptability and uniform distribution throughout the grassland. Species such as *Plantago major* (97.50%), *Drymaria cordata* (95.83%), *Digitaria longiflora* (93.33%), *Axonopus compressus* (90.83%), and *Chrysopogon aciculatus* (88.33%) also exhibited very high frequency values, suggesting their successful establishment and stable presence within the habitat. Moderate frequency values were observed in species including *Ageratum conyzoides* (77.50%), *Eragrostis unioloides* (74.17%), *Centella asiatica* (73.33%), and *Pteridium aquilinum* (72.50%), reflecting relatively common occurrence but comparatively lower distribution than the dominant species. In contrast, species such as *Rubus ellipticus* (30.83%), *Solanum viarum* (35.83%), *Bauhinia variegata* (39.17%), and *Caesalpinia decapetala* (41.67%) recorded lower frequency values, indicating restricted or patchy distribution within the grassland ecosystem. The variation in frequency among species may be associated with ecological adaptability, soil conditions, moisture availability, grazing pressure, competition, and anthropogenic disturbances. Species with higher frequency values generally possess better ecological tolerance and reproductive success under prevailing environmental conditions. Overall, the frequency pattern suggests that the Kainengkol grassland vegetation is dominated by a few highly distributed species, while several others occur less consistently across the sampled quadrats, thereby reflecting the structural composition and ecological dynamics of the grassland community (Curtis & McIntosh, 1950; Misra, 1968).

The density analysis of plant species in the Kainengkol grassland demonstrated considerable variation in the population strength and numerical abundance of different species within the ecosystem. Among all the recorded species, *Cynodon dactylon* exhibited the highest density value (34.07), indicating its greater numerical dominance and successful adaptation throughout the grassland habitat. Other species such as *Melastoma malabathricum* (25.83), *Pteridium aquilinum* (21.97), *Blechnum orientale* (21.65), and *Chromolaena odorata* (20.13) also recorded comparatively high density values, reflecting their strong establishment and ecological success in the vegetation community. Moderate density values were observed in species including *Ageratum conyzoides* (16.67), *Centella asiatica* (14.58), *Eragrostis unioloides* (15.32), *Axonopus compressus* (18.23), and *Plantago major* (17.40), indicating stable occurrence and moderate population size within the grassland ecosystem. In contrast, species such as *Rubus ellipticus* (5.90), *Solanum viarum* (6.28), *Bauhinia variegata* (7.53), and *Caesalpinia decapetala* (8.12) showed comparatively lower density values, suggesting limited population size and restricted establishment in the habitat. Higher density values generally indicate favorable environmental conditions, efficient reproductive capacity, and better ecological adaptability of species. The observed variation in density among species may be influenced by factors such as soil moisture, nutrient availability, grazing intensity, competition, and anthropogenic disturbances. Overall, the density pattern indicates that the Kainengkol grassland vegetation is numerically dominated by a few highly adapted species, while several others maintain comparatively lower population levels within the ecosystem (Odum, 1971; Misra, 1968).

The abundance analysis of plant species in the Kainengkol grassland revealed marked variation in the concentration and aggregation pattern of vegetation within the ecosystem. Abundance represents the average number of individuals of a species present in the quadrats where the species actually occurs and provides important information regarding the colonization ability and local dominance of plant species. In the present study, *Melastoma malabathricum* recorded the highest abundance value (37.11), indicating its strong clustering tendency and dense occurrence in favorable microhabitats of the grassland. Similarly, *Pteridium aquilinum* (30.30), *Blechnum orientale* (29.86), *Chromolaena odorata* (28.41), and *Caesalpinia decapetala* (19.49) also exhibited comparatively higher abundance values, suggesting their ability to form dense patches within the vegetation community. *Cynodon dactylon* showed an abundance value of 35.05 along with very high frequency and density values, indicating that the species is not only numerically dominant but also widely distributed throughout the grassland. Moderate abundance values were observed in species such as *Ageratum conyzoides* (21.51), *Centella asiatica* (19.89), *Eragrostis unioloides* (20.65), and *Plantago major* (17.85), reflecting stable occurrence and moderate aggregation within the habitat. In contrast, species including *Rubus ellipticus* (11.43), *Solanum viarum* (11.90), and *Bauhinia variegata* (13.62) recorded comparatively lower abundance values, indicating sparse occurrence and weaker colonization ability in the ecosystem. The variation in abundance among species may be influenced by ecological adaptability, soil conditions, moisture availability, competition, grazing pressure, and reproductive efficiency. Therefore, abundance analysis plays an important role in understanding vegetation structure, species concentration, and ecological behavior within the Kainengkol grassland ecosystem (Curtis & McIntosh, 1950; Misra, 1968).

The Importance Value Index (IVI) analysis of plant species in the Kainengkol grassland revealed considerable variation in ecological dominance and species importance within the vegetation community. IVI is a comprehensive phytosociological parameter derived from the sum of relative frequency, relative density, and relative dominance, and it provides an overall picture of the ecological significance of species in a habitat. In the present study, *Cynodon dactylon* recorded the highest IVI value (20.101), indicating its strong ecological dominance, wider distribution, and greater adaptability throughout the grassland ecosystem. The species showed very high frequency and density values, reflecting its successful establishment and competitive ability under prevailing environmental conditions. Other species such as *Melastoma malabathricum* (18.692), *Pteridium aquilinum* (16.934), *Blechnum orientale* (15.816), and *Chromolaena odorata* (15.344) also exhibited comparatively high IVI values, suggesting their significant contribution to the structure and composition of the grassland vegetation. Moderate IVI values observed in species like *Ageratum conyzoides*, *Centella asiatica*, *Eragrostis unioloides*, and *Drymaria cordata* indicate their stable presence and ecological role within the community. In contrast, species such as *Rubus ellipticus* (4.688) and *Solanum viarum* (5.129) recorded lower IVI values, indicating comparatively lesser ecological importance and restricted occurrence within the habitat. The variation in IVI among species may be influenced by factors such as adaptability, reproductive efficiency, soil conditions, grazing pressure, and interspecific competition. Therefore, IVI analysis serves as an important tool for understanding vegetation structure, species dominance, and ecological relationships within the Kainengkol grassland ecosystem (Curtis & McIntosh, 1950; Misra, 1968).

CONCLUSION

The present study of Kainengkol Grassland, Kangpokpi District, Manipur, reveals a moderately diverse plant community characterized by clear patterns of taxonomic composition and phytosociological structure. The dominance of the Poaceae family highlights the grassland nature of the ecosystem, while the presence of species from multiple families reflects floristic diversity and habitat heterogeneity. The taxonomic composition indicates that the vegetation is composed of grasses, herbs, shrubs, and ferns, suggesting a complex and dynamic plant community influenced by environmental conditions and successional processes.

Phytosociological analysis demonstrates that most species exhibit high frequency, indicating uniform distribution across the study area, while variations in density and abundance reflect differences in population size and adaptability among species. The Importance Value Index (IVI) identifies a few key species as ecologically dominant, playing a major role in shaping the structure and functioning of the grassland ecosystem. At the same time, species with lower IVI contribute to overall biodiversity and ecological balance.

Overall, the vegetation pattern suggests that Kainengkol Grassland is a stable yet dynamic ecosystem, influenced by environmental variability such as slope, moisture, and microhabitat differences. The study provides essential baseline data on species composition and community structure, which can be useful for future ecological research, monitoring, and the development of effective conservation and sustainable management strategies for grassland ecosystems in the region.

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