

Floristic Composition and Vegetation Analysis of the Plant Communities in North Kordofan State, Sudan: A Comprehensive Survey

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ABSTRACT

This study presents a comprehensive floristic and vegetation analysis of plant communities in North Kordofan State, Sudan, a semi-arid region undergoing increasing climatic and anthropogenic pressures. Field surveys conducted in March 2023 documented 137 plant species belonging to 61 genera and 37 families, dominated by dicotyledons. Fabaceae, Poaceae, Malvaceae, Asteraceae, and Euphorbiaceae were the most species-rich families. Vegetation structure was characterized by a high proportion of herbs, with annual species (56.9%) slightly exceeding perennials (43.1%). Life-form analysis following Raunkiaer's classification revealed the dominance of therophytes (47%), reflecting adaptation to seasonal drought, grazing pressure, and recurrent disturbance, while phanerophytes (17%) and geophytes–helophytes (15%) indicated the presence of relatively stable habitats. Chorological analysis showed a predominance of Saharo-Arabian and cosmopolitan elements, alongside Sudano-Zambezian and palaeotropical species, highlighting North Kordofan as a biogeographical transition zone. The observed floristic patterns underscore the combined influence of climate variability, soil conditions, and land-use practices on vegetation composition. These findings provide a baseline for biodiversity assessment and emphasize the need for targeted conservation strategies that protect perennial-rich habitats, regulate land use, and integrate long-term ecological monitoring to enhance ecosystem resilience in semi-arid Sudan.

Keywords: Floristic diversity; Life forms; Semi-arid ecosystems; Chorology; Sudan.

INTRODUCTION

Examining floristic composition and ecological dynamics is fundamental for conserving biodiversity, especially in regions grappling with environmental pressures such as climate change, habitat loss, and land-use changes (Hinderson, 2004; UNDP, 2024). Plant diversity plays a key role in sustaining ecosystem services, including soil stabilization, water regulation, and the provision of vital resources such as food, fodder, and medicinal plants (Eltom, 2022; Forest Biodiversity in Kordofan Region, 2024). In arid and semi-arid environments like North Kordofan State, Sudan, plant communities are not only crucial for biodiversity but also serve as a foundation for local livelihoods (UNICEF, 2024; ACAPS, 2023). However, the scarcity of comprehensive research on the region's flora and ecological structure limits the formulation of effective conservation and management strategies (Obeid, 1970; Ahmed, 2023). To address this knowledge gap, this study aims to systematically document the plant species of North Kordofan, evaluate plant community structures, and analyze their survival strategies in response to environmental conditions.

Previous studies have emphasized the significance of plant community assessments in biodiversity conservation and ecosystem service provision. (Hua *et al.*, 2022) explored the impact of forest restoration on biodiversity and ecosystem functions, while (Qian *et al.*, 2021) investigated the drivers of phylogenetic beta diversity in European plant communities, underscoring the role of evolutionary history in shaping vegetation

patterns. In North Kordofan, environmental degradation increasingly threatens plant communities, necessitating immediate conservation actions (Eltom, 2022; UNDP, 2024). Studies on ecological changes in semi-arid regions, such as Hinderson (2004), have highlighted the extensive depletion of natural resources due to both climatic variability and human activities. Similarly, the "Assessment Report for North Kordofan State" (UNDP, 2024) identifies the region's susceptibility to land cover degradation and calls for strategic biodiversity conservation and sustainable land management efforts.

Research on similar ecosystems highlights the critical role of plant diversity in maintaining ecological stability. Investigations into forest biodiversity in the Kordofan region indicate that native flora contribute significantly to ecosystem resilience and support a wide range of terrestrial and aquatic organisms (Forest Biodiversity in Kordofan Region, 2024). Likewise, Obeid's (1970) work on Acacia vegetation in Sudan provides valuable insights into plant adaptation mechanisms and their ecological significance. Functional trait-based approaches, such as Raunkiaer's life form classification system, are particularly useful in evaluating plant survival strategies, offering an understanding of how vegetation responds to factors like water availability, soil composition, and temperature fluctuations. Moreover, research on plant tolerance to salinity (Ahmed, 2023) has demonstrated the ability of certain species, such as Acacia, to thrive in arid conditions.

Beyond floristic composition, assessing the human impact on landscapes is essential for effective conservation planning. The "Environmental and Social Management Plan" (African Development Bank, 2024) highlights the need to integrate conservation efforts with sustainable development, ensuring the responsible use of natural resources. Additionally, ecological research on fauna, such as "Ecological Studies on Ticks of Kordofan" (2024), emphasizes the interconnections between plant communities and broader ecological systems, reinforcing the importance of holistic conservation approaches.

Objectives of the Study

This research aims to bridge the knowledge gap in North Kordofan's floristic composition through the following objectives:

Flora Identification – Systematically document and classify plant species within North Kordofan, contributing to the development of a comprehensive floristic database.

Analysis of Floristic Composition, Vegetation Types, and Life Forms – Examine plant life forms, including trees, shrubs, and herbs, using Raunkiaer's classification system to assess their adaptations to the region's environmental conditions.

Investigation of Floristic Structure – Evaluate the distribution, organization, and structural characteristics of plant populations to understand survival strategies influenced by factors such as water availability, soil properties, and climate variations.

By addressing these objectives, this study will provide valuable insights for the development of effective conservation strategies and sustainable land management practices tailored to the unique ecological and socio-economic conditions of North Kordofan.

MATERIALS AND METHODS

Study Area

The study was conducted in North Kordofan State, central Sudan (11°–16° N, 27.15°–32° E), covering approximately 244,700 km². The region lies within the semi-arid savannah belt and is characterized by low and highly variable rainfall, frequent droughts, and advancing desertification. Vegetation ranges from sparse woodland and grassland to degraded agricultural and grazing landscapes. Mean annual rainfall decreases northward, while temperatures remain high throughout the year. Land use is dominated by rain-fed agriculture and pastoralism, which exert substantial pressure on natural vegetation.

Field Sampling Design

Field surveys were conducted in March 2023 during the peak flowering and fruiting period to maximize species detectability. Sampling sites were selected to represent the major habitat types across North Kordofan, including rangelands, agricultural fallows, woodland remnants, and disturbed areas. Site selection followed a

stratified approach based on habitat heterogeneity and accessibility. At each site, floristic inventories were compiled through direct observation and systematic walking surveys.

Plant Identification and Data Collection

All vascular plant species encountered were recorded in situ. Representative specimens were collected for taxonomic verification and deposited in reference collections. Species identification was conducted using regional floras and taxonomic keys, and nomenclature was verified using the International Plant Names Index (IPNI) and The Plant List. For each species, information on growth form (tree, shrub, herb), life cycle (annual or perennial), life form, and chorological affinity was recorded.

Life-Form and Floristic Classification

Life forms were classified according to Raunkiaer's system based on the position of perennating buds during unfavorable seasons. Species were categorized as phanerophytes, chamaephytes, hemicryptophytes, geophytes–helophytes, or therophytes. Chorological classification followed Takhtajan, Good, and White, assigning species to recognized floristic regions (e.g., Saharo-Arabian, Sudano-Zambezian, Palaeotropical).

Data Analysis

Floristic data were analyzed using IBM SPSS Statistics. Descriptive statistics were applied to quantify species richness, family representation, life-form spectra, vegetation types, and floristic categories. Percentages were calculated to compare functional and biogeographical groups and to interpret vegetation structure in relation to environmental conditions.

RESULTS AND DISCUSSION

Floristic Composition

The floristic composition of North Kordofan State, as outlined in the survey, provides significant insights into the region's plant diversity and ecological dynamics. The survey revealed a total of 137 species, with dicotyledons being the dominant group, comprising 102 species, as opposed to 35 species of monocotyledons (see **Figure 3. Appendix. Table 1**). This dominance of dicotyledons is consistent with global trends seen in many terrestrial ecosystems. Dicotyledons, due to their greater morphological diversity and adaptive strategies, are often more successful in a wide variety of habitats. Their ability to engage in secondary growth, develop complex vascular tissues, and adapt to fluctuating environmental conditions makes them a prominent feature in many ecosystems (Gentry, 1993; Takhtajan, 1986).

The identification of 29 dicotyledon families and 8 monocotyledon families further underscores the taxonomic richness of the region. Dominant families such as *Fabaceae*, *Poaceae*, *Malvaceae*, *Asteraceae*, and *Euphorbiaceae* are ecologically significant and play vital roles in ecosystem processes. For instance, the *Fabaceae* family, known for its nitrogen-fixing capabilities, contributes to soil fertility, particularly in nutrient-poor environments. The *Asteraceae* family, which is also abundant, provides essential resources for pollinators, including bees and butterflies, playing a key role in maintaining pollinator populations and supporting biodiversity (Zanzottera *et al.*, 2020). These families are adaptive to a variety of environmental conditions, indicating the ecological resilience of the region's flora.

The life-form analysis based on Raunkiaer's classification reveals a high prevalence of therophytes (47%), which are annual plants that complete their life cycle in a single growing season. This life-form is highly advantageous in the semi-arid climate of North Kordofan, where seasonal rainfall and drought conditions pose significant challenges to plant survival. Therophytes are well adapted to such conditions by taking advantage of the brief rainy seasons to complete their reproductive cycle rapidly. Other life forms, such as phanerophytes (17%), geophytes, and helophytes (15%), also contribute to the region's biodiversity and survival strategies. These life-forms further reflect the complex adaptive mechanisms employed by the plants to thrive in this challenging environment, where water availability and temperature fluctuations are major limiting factors for growth (Raunkiaer, 1934; Evert, 2006).

The biogeographical distribution of the species is equally noteworthy. The floristic elements present in North Kordofan—cosmopolitan, Saharo-Arabian, Sudano-Zambezian, Palaeotropical, Mediterranean, Irano-

Turanian, and Pantropical—highlight the region’s role as a convergence zone for various floristic groups. This diverse distribution pattern suggests a complex interplay of historical biogeographical processes, including the movement of species over time due to climatic shifts and the region's geographic position at the crossroads of multiple biomes (White, 1983; Takhtajan, 1986). The convergence of these floristic elements also underscores the ecological importance of North Kordofan as a biodiversity hotspot, making it a critical area for conservation efforts aimed at maintaining regional and global biodiversity (UNDP, 2024).

This comprehensive survey of North Kordofan’s flora not only emphasizes the region's rich plant diversity but also provides valuable insights into the ecological strategies that enable plants to thrive in a semi-arid environment. The region’s plant communities, shaped by historical and ecological processes, are integral to the local and regional ecosystems and warrant continued attention for conservation and sustainable management (Santos *et al.*, 2022).

Floristic (Vegetation) Analyses

Vegetation Type:

The study on vegetation type distribution revealed significant insights into the ecological dynamics of the region. The data showed that annual species dominate the vegetation, with 78 species accounting for 56.9% of the total **See Figure 4**. This high percentage of annuals suggests a dynamic environment where species with shorter life cycles thrive, possibly due to seasonal changes or frequent disturbances. Annuals contribute to the rapid turnover of biomass and can quickly colonize disturbed areas, indicating a resilient ecosystem capable of adapting to changes (Richardson & Whittaker, 2010; Poppenwimmer *et al.*, 2023). This pattern of dominance by annuals aligns with global trends where annuals are often favored in environments subject to frequent disturbances, such as fire or grazing, and can quickly exploit temporary ecological windows (Tilman *et al.*, 2006).

In contrast, perennial species were also well-represented, with 59 species making up 43.1% of the total **See Figure 4**. The presence of a substantial number of perennials indicates areas of stability within the ecosystem where long-lived species can establish and maintain populations. Perennials play a crucial role in soil stabilization and long-term ecosystem health, providing continuous cover and resources for other organisms. Such species tend to dominate in more stable environments where conditions are less variable, thus supporting long-term ecological succession and contributing to ecosystem resilience (Prochazka *et al.*, 2024; Grime, 1977). Perennials also serve to maintain nutrient cycling and provide habitat for wildlife, thereby supporting broader ecosystem functions (Huston, 1994).

The study also noted a much smaller number of biannual species, suggesting that the environmental conditions or ecological niches in the study area do not favor species with a two-year life cycle. This low presence of biannuals might be due to specific climatic or soil conditions that do not support their growth and reproduction. Environmental factors such as temperature variability, soil fertility, and moisture availability are known to influence plant life cycles, with biannuals often requiring more consistent conditions to thrive (Grime, 1977; Poppenwimmer *et al.*, 2023).

Ecological Balance and Environmental Factors:

The balance between annuals and perennials highlights the mixed nature of the ecosystem, combining elements of both stability and dynamism. This balance is essential for maintaining biodiversity and ecosystem services. Environmental factors such as climate, soil type, and disturbance regimes likely influence the dominance of annuals and perennials. For instance, frequent disturbances like grazing or fire might favor annuals, while stable conditions might support perennials (Richardson & Whittaker, 2010; Prochazka *et al.*, 2024). The dynamic interplay between these two plant types is crucial for maintaining ecological equilibrium, where both fast-growing species and long-lived species can coexist, contributing to the overall resilience of the ecosystem (Tilman *et al.*, 2006; Huston, 1994).

Life form :

The life forms of the species were classified using the Raunkiaer scheme [Raunkiaer, 1934], which includes the following categories: Ch: chamaephytes, H: hemicryptophytes, GH: geophytes-helophytes, and Th: therophytes.

As shown in **Figure 5** and Appendix Table 1, **therophytes** dominated the flora, representing 65 species (47% of the total species). This dominance suggests that the environment favors annual plants, which complete their life cycle within a single growing season. Therophytes are well-adapted to the dynamic nature of the ecosystem, capable of quickly colonizing disturbed areas and responding to seasonal fluctuations. The prevalence of therophytes indicates a system with frequent disturbances such as grazing, fire, or seasonal droughts, which are typical of semi-arid ecosystems like North Kordofan. Annual plants can exploit these disturbances, ensuring their survival by rapidly completing their life cycles during the more favorable seasons [Grime, 1977; Santos *et al.*, 2022]. This highlights the resilience and adaptability of the region's flora to its harsh environmental conditions.

Phanerophytes, representing 17% of the species, thrive in stable environments with moderate resource availability and low disturbance, aligning with [Prochazka *et al.*, 2023], who highlight their evolutionary adaptation to such conditions. Their role in maintaining ecosystem integrity is crucial, as [He *et al.*, 2023] emphasize the importance of perennial plants in sustaining ecosystem stability. Additionally, [Ford *et al.*, 2016] underscore the contribution of woody species to soil stabilization, preventing erosion and enhancing long-term ecological resilience. Collectively, these studies highlight the significance of phanerophytes in promoting biodiversity, maintaining habitat stability, and supporting ecosystem sustainability.

Geophytes-helophytes, comprising 21 species (15%), Geophytes-helophytes play a critical role in semi-arid ecosystems by utilizing underground storage organs, such as bulbs, tubers, and rhizomes, to survive periods of environmental stress. Their presence suggests that these ecosystems experience seasonal droughts, necessitating adaptation mechanisms that allow plants to retreat underground to conserve resources [Dafni & Cohen, 1981]. This ability to persist through underground dormancy is vital in regions with limited surface water and nutrient availability [Baskin & Baskin, 2014]. Functional traits associated with geophytes contribute to ecosystem resilience by ensuring plant survival and regeneration in challenging climates [De Bello *et al.*, 2010]. Additionally, water storage strategies, such as those seen in plants employing CAM and C4 mechanisms, further enhance their ability to withstand prolonged dry periods [Rundel & Keeley, 2013]. The role of underground storage organs in mitigating environmental stress highlights their importance in maintaining biodiversity and ecosystem stability in semi-arid regions [Grace *et al.*, 2016].

Hemicryptophytes, comprising 14 species (10%), have perennating buds at the soil surface, allowing them to thrive in moderately disturbed environments like grazing or mowing. This bud positioning provides protection, enabling them to regenerate after disturbances. Their adaptive strategies are well-studied in plant ecology. [Grime, 2001] highlights hemicryptophytes as key functional plants in disturbed settings. [Díaz *et al.*, 1999] explore their responses to grazing and mowing, while [Pierce *et al.*, 2014] examine their ecological strategies, including seed production and regeneration. [Tüxen and Ellenberg, 1972] discuss their role in plant community dynamics, and [Klimeš and Klimešová, 1999] investigate their recovery mechanisms after environmental stress.

Finally, **chamaephytes**, with 13 species (9.5%), are small shrubs or herbs that have perennating buds close to the ground. Their presence suggests that parts of the ecosystem are characterized by microhabitats that offer protection to low-lying plants, such as leaf litter or dense vegetation. Chamaephytes are often found in areas with lower disturbance, where the protective cover of the ground can shield them from environmental stressors. These plants contribute to the stability of the ecosystem by enhancing ground cover and providing habitats for other organisms [White, 1983].

Ecological Implications:

The distribution of life forms in the ecosystem highlights its diverse nature, balancing stability and dynamism. The prevalence of therophytes indicates a resilient system that quickly recovers from disturbances like grazing, fire, or drought [Grime, 2001; Lavorel & Garnier, 2002; Bond & Keeley, 2005]. In contrast, phanerophytes and geophytes-helophytes signify more stable areas where long-lived species thrive [Díaz & Cabido, 2001; Cornelissen *et al.*, 2003; Chapin *et al.*, 2011]. This interplay between dynamic and stable habitats is vital for biodiversity and ecosystem services, as various plant traits enhance resilience and productivity [Westoby *et al.*, 2002]. Understanding these life forms and their ecological roles is crucial for effective conservation and management, ensuring the preservation of both dynamic (therophytes) and stable (phanerophytes, geophytes-helophytes) components for long-term sustainability [Grime, 2001; Chapin *et al.*, 2011].

Floristic Category - Chorological Analysis and Climatic Belts in North Kordofan:

The chorological analysis of North Kordofan, as depicted in **Figure 6 and Appendix Table 1**, reveals a strong correlation between plant species distribution and the region’s climatic belts. This relationship aligns with previous studies on land cover dynamics and environmental change in the region (Dafalla *et al.*, 2014; Hinderson, 2004; Adam *et al.*, 2023).

The Saharo-Arabian category exhibits the highest representation, which is consistent with the prevailing arid and semi-arid conditions of North Kordofan. The dominance of species adapted to arid environments highlights the significant impact of climatic factors, such as low precipitation and high temperatures, on vegetation composition (Hinderson, 2004). These species have evolved drought-resistant mechanisms, allowing them to thrive in the harsh desert and semi-desert conditions typical of the region.

Cosmopolitan species, comprising 20.4% of the total flora, indicate a wide ecological tolerance. Their ability to grow across various climatic conditions suggests resilience and adaptability to fluctuating environmental variables, including shifts in temperature, soil moisture, and human-induced disturbances. This finding aligns with remote sensing studies that have documented significant land use changes, which may contribute to the spread of generalist species in North Kordofan (Dafalla *et al.*, 2014).

The presence of Sudano-Zambezian, Palaeotropical, and Pantropical species indicates regions within North Kordofan that receive slightly more moisture, supporting a more diverse range of plant life. These species reflect transitional zones between arid and sub-humid climates, where vegetation composition is influenced by seasonal rainfall patterns (Adam *et al.*, 2023). Such areas serve as important biodiversity hotspots, supporting a mix of life forms that contribute to ecosystem stability.

The occurrence of Mediterranean and Irano-Turanian species, though less dominant, suggests that microhabitats within North Kordofan provide suitable ecological conditions for these plants. These species may be restricted to specific niches, such as rocky outcrops, depressions, or areas with slightly higher soil moisture retention. Their presence further underscores the heterogeneous nature of the region’s landscape and climatic gradients (Hinderson, 2004).

Overall, the analysis effectively illustrates how plant species distribution aligns with the climatic belts of North Kordofan. The findings emphasize the adaptability of different species to the region’s environmental conditions, reflecting both historical biogeographic patterns and ongoing ecological shifts driven by climate variability and land use changes. Understanding these dynamics is essential for conservation planning and sustainable land management strategies in arid and semi-arid ecosystems (Dafalla *et al.*, 2014; Adam *et al.*, 2023).



Figure 1. Illustrates the geographical location and layout of North Kordofan in Sudan.

Source: North Kurdufan in Sudan (Kafia Kingi disputed) - North Kordofan - Wikipedia.

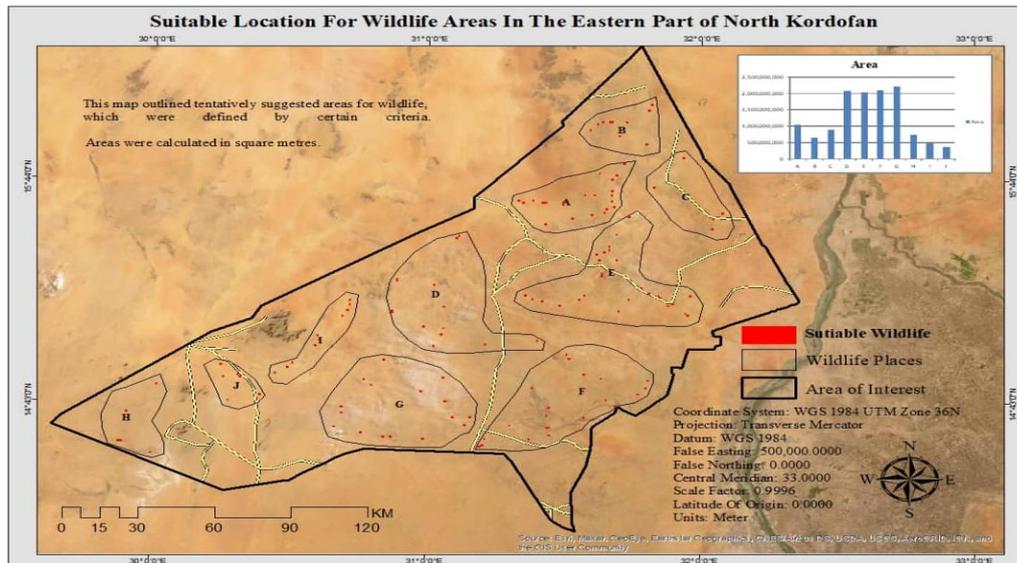


Figure 2. Suitable Location for Wildlife Areas in the Eastern Part of North Kordofan, Sudan.

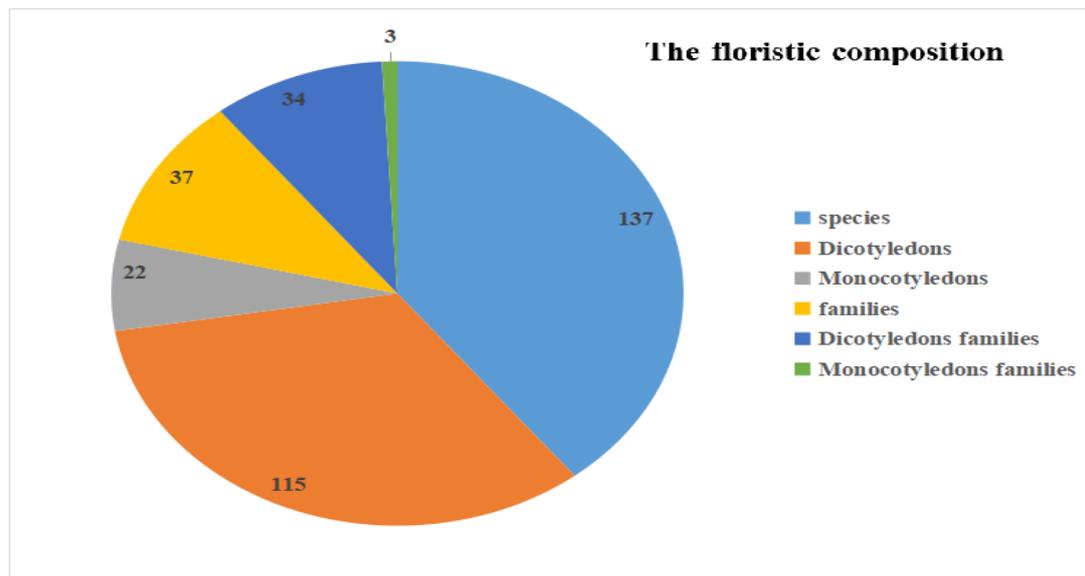


Figure 3. Shows that floristic composition relates to the plant analysis and prevalence of plant species in North Kordofan.

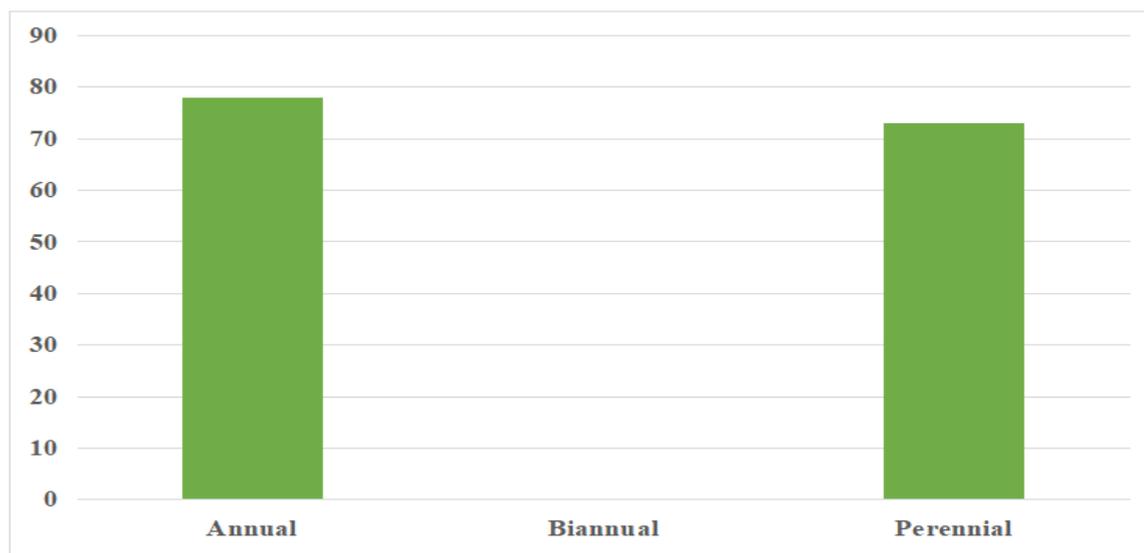


Figure 4. Shows the diverse vegetation types among the plant species in in North Kordofan

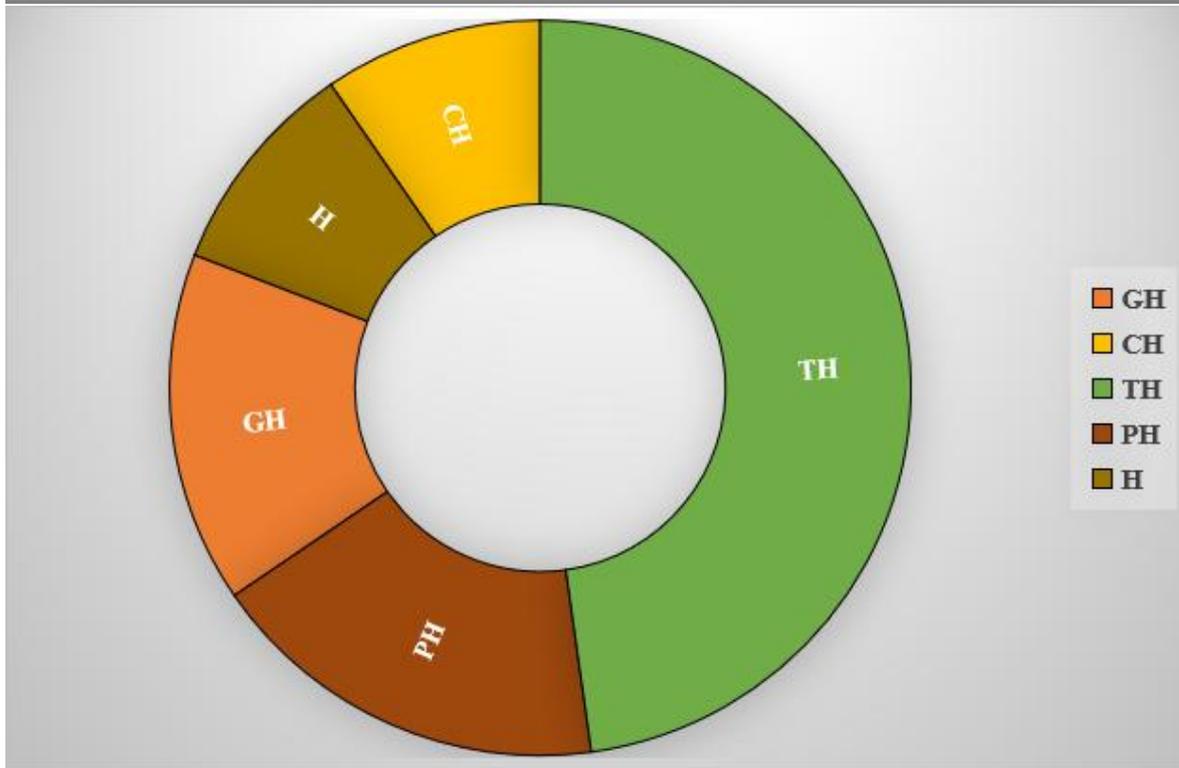


Figure 5. Illustrates that therophytes constituted the predominant life form in North Kordofan.

Ch: chamaephytes, H: hemicryptophytes, GH: geophytes-helophytes, and Th: therophytes.

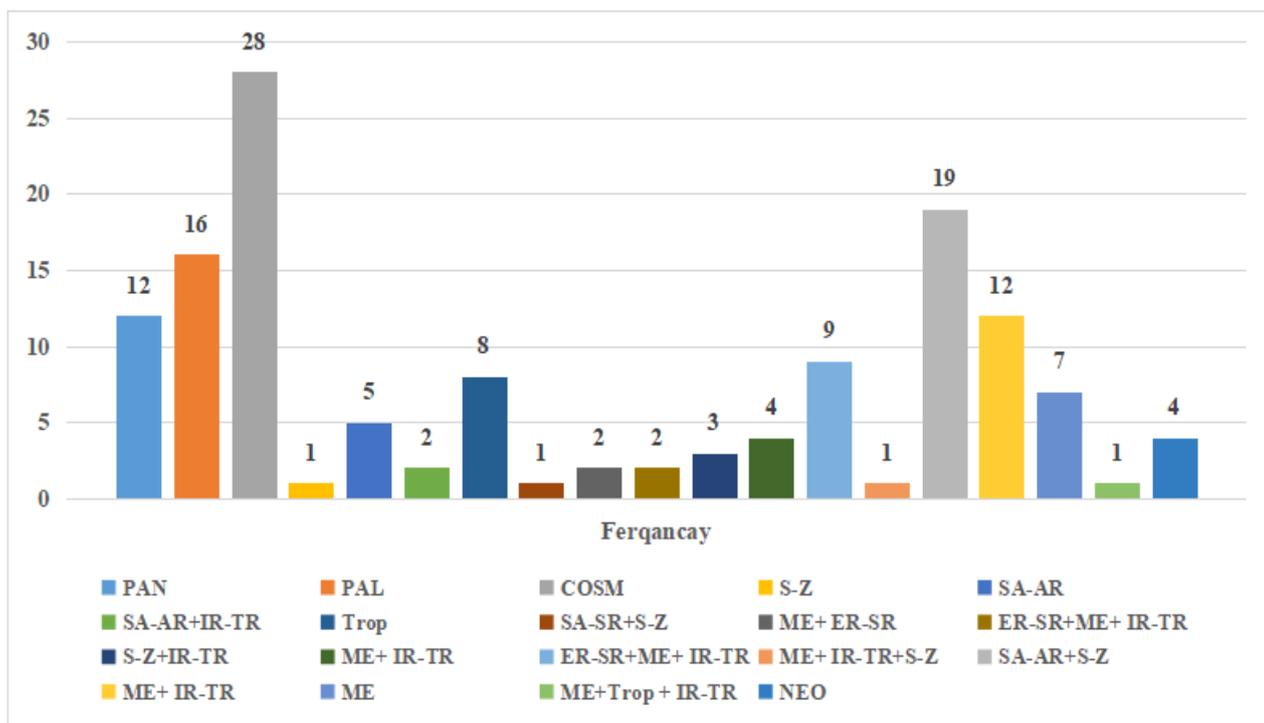


Figure 6. Shows the floristic classification of plant species in North Kordofan.

RECOMMANDIONS

To improve biodiversity conservation and ecosystem management in North Kordofan:

Safeguard Perennial Species and Ecosystem Integrity: It is essential to protect areas rich in perennial species, as they play a crucial role in maintaining ecosystem integrity, enhancing soil quality, and providing habitats. Conservation initiatives should focus on phanerophytes and geophytes-helophytes, which serve as indicators of environmental stability and resilience.

Adopt Sustainable Land Management Techniques: Implementing controlled grazing and effective fire management practices is vital for sustaining ecosystem equilibrium. Given the prevalence of therophytes in disturbed regions, it is important to manage rotational grazing and periodic disturbances to encourage rapid biomass turnover while avoiding significant degradation.

Promote Habitat Diversity and Support Indigenous Species: Conservation strategies should aim to preserve and restore a variety of habitats, which will benefit a wide array of plant species, especially those from less common floristic groups. Emphasis should be placed on native species that are well-suited to the local climate in afforestation and restoration efforts.

Invest in Long-Term Ecological Studies: The application of advanced technologies such as remote sensing and GIS can enhance the monitoring of species composition and distribution, facilitating adaptive conservation approaches. This will enable the tracking of floristic changes over time and the identification of critical habitats that require intervention.

Involve Local Communities in Conservation Efforts: Merging traditional ecological knowledge with scientific research can yield effective conservation strategies. Community-driven monitoring programs, educational initiatives, and awareness campaigns will foster local engagement and ensure the sustainability of conservation efforts over the long term.

By implementing these strategies, North Kordofan can achieve a balance between ecological stability and sustainable land use, thereby ensuring the resilience of its biodiversity against climatic and human-induced changes.

CONCLUSION

The floristic evaluation of North Kordofan State indicates a notable level of botanical diversity, with a total of 137 identified plant species, primarily consisting of dicotyledons. These species are distributed across 61 genera and 37 families, with 115 dicotyledonous species classified into 29 families and 22 monocotyledonous species grouped into 8 families. The Fabaceae family is the most prevalent, encompassing 19 genera and 30 species, followed closely by Poaceae, which includes 15 species. Other significant families are Malvaceae (9 species), Asteraceae (7 species), Euphorbiaceae (7 species), and Cyperaceae (6 species). The vegetation is predominantly composed of herbs (75.9%), with trees making up 18.2% and shrubs accounting for 5.8%.

The high occurrence of therophytes illustrates their adaptation to the semi-arid climate, showcasing their capacity to thrive in disturbed habitats. The interplay between annual and perennial species underscores the mixed nature of the ecosystem, which is crucial for maintaining biodiversity and ecosystem functions. Frequent disturbances tend to favor annual species, while stable environments support perennial growth, highlighting the importance of focused conservation efforts. Safeguarding areas rich in perennials is essential for ensuring long-term ecological health, while adaptive management in regions dominated by annuals can bolster biodiversity and resilience.

Chorological analysis reveals a significant relationship between species distribution and climatic zones. The predominance of the Saharo-Arabian category reflects the arid characteristics of the region, while the presence of cosmopolitan species (20.4%) suggests a capacity for adaptation to various climatic conditions. The occurrence of Sudano-Zambezian, Palaeotropical, and Pantropical species indicates transitional areas with increased moisture availability, which supports a wider array of plant species. Although Mediterranean and Irano-Turanian species are less frequent, they point to the presence of specialized ecological niches, highlighting the diverse microhabitats found in North Kordofan.

This research contributes significantly to our comprehension of the floristic composition in North Kordofan, underscoring the necessity for sustainable land management and conservation approaches. The integration of ecological monitoring with adaptive management practices is essential for preserving the resilience of both annual and perennial species, thereby promoting long-term biodiversity and ecosystem stability amid environmental changes.

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Conflict of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

Author Contributions

- MABA: Performed data analysis and drafted the manuscript.
- LMAH: Responsible for the experimental design, manuscript review, coordination of the project, and made significant contributions to the manuscript.
- OMM, NYG, HHM, and AMM**: Conducted the fieldwork and curated the data.

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APPENDIX

Table 1: Plant Species, Taxonomic Families, Growth Forms, Floristic Classification, and Vegetation Types in North Kordofan.

Family	Species	Life form	V. Type	Floristic category
Acanthaceae	Blepharis ciliaris (L.) B.L.Burt.	Annual	Th	PAN
Aizaceae	Glinus lotoides L.	Annual	Th	PAL
	Trianthema portulacastrum L.	Annual	Th	PAL
	Zaleya pentandra (L.) Jeffrey	Annual	Th	PAL
Amaranthaceae	Aerva javanica (Burm. f.) Juss. ex Schult.	Perennial	H	COSM
	Alternanthera nodiflora R. Br.	Annual	Th	COSM
	Amaranthus graecizan L.	Annual	Th	ME+IR-TR
	Amaranthus hybridus L	Annual	Th	PAL
	Amaranthus spinosus L.	Annual	Th	COSM
	Amaranthus viridis L.	Annual	Th	PAL
Aristolochiaceae	Aristolochia bracteolata Lam.	Annual	Th	S-Z
Asteraceae	Echinops longifolius A.Rich.	Annual	Th	SA-AR
	Eclipta prostrata (L.) L.	Annual	H	SA-AR
	Ethulia conyzoides L. f.	Perennial	H	SA-AR+IR-TR
	Pulicaria grantii Oliver & Hiern ex Oliver	Perennial	H	SA-AR+IR-TR
	Sonchus cornutus Hochst. ex Oliv. & Hiern.	Annual	Th	COSM
	Sonchus oleraceus L.	Annual	Th	COSM
	Xanthium strumarium L.	Annual	Th	COSM
Apocynaceae	Calotropis procera (Ait.) Ait. f.	Perennial	Ph	Trop
	Leptadenia arborea (Forssk.) Schweinf.	Perennial	Ph	Trop
	Leptadenia pyrotechnica (Forssk.) Decne.	Perennial	Ph	Trop
	Nerium oleander L.	Perennial	Ph	Trop
Bombacaceae	Adansonia digitata L.	Perennial	H	SA-SR+S-Z
Boraginaceae	Echium arenarium Guss.	Annual	Th	COSM
	Heliotropium aegyptiacum Lehm.	Annual	Th	COSM
	Heliotropium indicum L.	Annual	Th	COSM
	Heliotropium sudanicum F.W.Andrews	Annual	Th	COSM
	Heliotropium supinum L	Annual	Th	COSM
Burseraceae	Boswellia papyrifera (Del. ex Caill.) Hochst	Perennial	H	ME+ IR-TR
Brassicaceae	Farsetia aegyptiaTurra.	Annual	Th	ME ER-SR
	Rorippa indica (L.) Hiern	Annual	Th	ME+ ER-SR+IR-TR
	Lepidium sativum L	Annual	Th	ME+ ER-SR
Capparaceae	Boscia salicifolia Oliv.	Annual	Th	COSM
	Capparis decidua (Forssk.) Edgew	Perennial	H	ME+ IR-TR
	Cleome gynandra L.	Annual	Th	S-Z+IR-TR
Celastraceae	Gymnosporia senegalensis (Lam.) Loes.	Perennial	Th	ER-SR+ME+ IR-TR
Combretaceae	Combretum cordofanum Engl. & Diels.	Perennial	Th	S-Z+IR-TR
	Combretum glutinosum Perr. ex DC.	Perennial	Th	S-Z+IR-TR
Convolvulaceae	Ipomoea cordofana Choisy.	Perennial	H	Trop
	Ipomoea obscura (L.) Ker Gawl.	Perennial	H	Pan
	Momordica balsamina L.	Perennial	H	Trop
Cucurbitaceae	Citrullus colocynthis (L.) Schrad.	Perennial	H	PAL
	Momordica charantia L.	Perennial	H	ME+ IR-TR

Cyperaceae	<i>Bulbostylis hispidula</i> (Vahl) R. W. Haines	Perennial	Gh	COSM
	<i>Cyperus alopecuroides</i> Rottb.	Perennial	Gh	Pan
	<i>Cyperus difformis</i> L	Perennial	Gh	Pan
	<i>Cyperus rotundus</i> L.	Perennial	Gh	Pan
	<i>Cyperus squarrosus</i> L.	Perennial	Gh	Pan
	<i>Fimbristylis complanata</i> (Retz.) Link.	Perennial	Gh	PAL
Euphorbiaceae	<i>Chrozophora plicata</i> (Vahl) A. Juss. ex Spreng.	Annual	Th	SA-AR
	<i>Euphorbia abyssinica</i> J. F. Gmel.	Annual	Th	Trop
	<i>Euphorbia acalyphoides</i> Hochst. ex Boiss.	Annual	Th	ER-SR+ME+ IR-TR
	<i>Euphorbia aegyptiaca</i> Boiss.	Annual	Th	ER-SR+ME+ IR-TR
	<i>Euphorbia indica</i> Lam.	Annual	Th	ME+ IR-TR+S-Z
	<i>Phyllanthus niruri</i> L.	Annual	Th	ME+IR-TR
	<i>Ricinus communis</i> L	Perennial	Ph	PAN
	Fabaceae	<i>Acacia mellifera</i> subsp. <i>mellifera</i> (Vahl)Benth	Perennial	Th
<i>Acacia nilotica</i> (L.)Del.		Perennial	Th	SA-SI+S-Z
<i>Acacia nilotica</i> subsp. <i>tomentosa</i> (Benth.)Brenan		Perennial	Th	SA-SI+S-Z
<i>Acacia oerfota</i> (Forssk.)Schweinf		Perennial	Th	ME+ IR-TR
<i>Acacia roemeriana</i> Scheele		Perennial	Th	COSM
<i>Acacia senegal</i> (L.) Willd.var <i>senegal</i> Brenan		Perennial	Ph	SA-SI+S-Z
<i>Acacia seyal</i> Del.		Perennial	Ph	SA-SI+S-Z
<i>Acacia sieberiana</i> DC.		Perennial	Ph	SA-SI+S-Z
<i>Acacia tortilis</i> subsp <i>raddiana</i> (Savi)Brenan.		Perennial	Ph	SA-SI+S-Z
<i>Albizia lebbek</i> (L.)Benth		Perennial	Ph	SA-SI+S-Z
<i>Alysicarpus monilifer</i> (L.)DC		Perennial	Ph	SA-SI+S-Z
<i>Bauhinia rufescens</i> Lam.		Perennial	Ph	SA-SI+S-Z
<i>Chamaecrista nigricans</i> (Vahl) Greene		Perennial	Ph	SA-SI+S-Z
<i>Crotalaria senegalensis</i> (Pers.) Bacle ex DC		Perennial	Th	SA-SI+S-Z
<i>Erythrina comosa</i> Hua		Perennial	Th	SA-SI+S-Z
<i>Entada africana</i> Guill. & Perr.		Perennial	Th	SA-SI+S-Z
<i>Faidherbia albida</i> (Del.)A.Chev.		Perennial	Th	SA-SI+S-Z
<i>Erythrina comosa</i> Hua		Perennial	Th	SA-SI+S-Z
<i>Indigofera oblongifolia</i> Forssk.		Perennial	Th	ME
<i>Indigofera spicata</i> Forssk.		Perennial	Th	COSM
<i>Tamarindus indica</i> L.		Perennial	Th	ME+ IR-TR
<i>Mimosa pigra</i> L.		Perennial	Th	COSM
<i>Parkinsonia aculeata</i> L.		Perennial	Th	COSM
<i>Prosopis juliflora</i> (Sw.) DC.		Perennial	Th	COSM
<i>Senna alata</i> (L.) Roxb.)		Perennial	Ph	COSM
<i>Senna alexandrina</i> Mill.		Perennial	Ph	COSM
<i>Senna italica</i> Mill.		Perennial	Ph	COSM
<i>Senna obtusifolia</i> (L.) H. S. Irwin & Barneby	Perennial	Ph	COSM	
<i>Sesbania sesban</i> (L.) Merr. subsp. <i>sesban</i> var. <i>sesban</i>	Perennial	Ph	PAL	
<i>Tephrosia apollina</i> (Delile) Link	Perennial	Ph	PAL	
<i>Tephrosia bracteolata</i> Guill. & Perr.	Perennial	Ph	PAL	
Lamiaceae	<i>Ocimum basilicum</i> L.	Perennial	GH	ME+SA-AR+IR-TR

Loranthaceae	Plicosepalus acaciae (Zucc.) Wiens & Polhill	Perennial	GH	ME+SA-AR+IR-TR
Malvaceae	Abutilon pannosum Schltldl.	Annual	Th	PAL
	Corchorus rilocularis	Annual	Th	NEO
	Corchorus fascicularis	Annual	Th	ME+ IR-TR
	Grewia tenax (Forssk.) Fiori.	Annual	Th	ME+ IR-TR
	Hibiscus obtusilobus Garcke	Annual	Th	ME+ IR-TR
	Hibiscus sabdariffa L.	Annual	Th	ME+ IR-TR
	Hibiscus trionum L.	Annual	Th	ME+ IR-TR
	Pavonia burchellii (DC.) R.A.Dyer	Annual	Th	ME+ IR-TR
	Sida spinosa L.	Annual	Th	ME+ IR-TR
Meliaceae	Azadirachta indica Adr. Juss.	Perennial	H	ME
	Khaya senegalensis (Desr.) A. Juss.	Perennial	H	ME
Moraceae	Ficus capreifolia Del.	Perennial	H	ME
Moringaceae	Moringa oleifera Lam.	Perennial	H	ME
Myretaceae	Eucalyptus camaldulensis	Perennial	H	ME
Nyctaginaceae	Boerhavia erecta L.	Perennial	H	ME
Rhamnaceae	Ziziphus spina-christi (L.) Desf.	Perennial	Gh	COSM
Pedaliaceae	Ceratotheca sesamoides Endl.	Annual	Th	ME+SA-AR+IR-TR
	Rogeria adenophylla J. Gay	Annual	Th	ME+SA-AR+IR-TR
	Sesamum indicum L.	Annual	Th	ME+SA-AR+IR-TR
Poaceae	Andropogon gayanus Kunth.	Perennial	GH	Pan
	Aristida stipoides Lam.	Perennial	GH	Pan
	Brachiaria obtusiflora (Hochst.) Stapf.	Perennial	GH	Pan
	Cenchrus ciliaris L.	Perennial	GH	PAL
	Cenchrus priouri (Kunth) Maire	Annual	Th	NEO
	Chloris virgata Sw.	Perennial	GH	SA-AR+S-Z
	Cymbopogon schoenanthus spp.proximus(A.Rich.) Maire & Weille.	Perennial	GH	PAL
	Cynodon dactylon	Perennial	Th	PAN
	Dactyloctenium aegyptium (L.) Willd.	Perennial	GH	COSM
	Digitaria ciliaris (Retz.) Koeler.	Annual	Th	COSM
	Echinochloa obtusiflora Stapf.	Annual	Th	PAL
	Eragrostis ciliaris (L.) R. Br.	Annual	Th	PAL
	Panicum turgidum Forssk.	Annual	Th	PAL
	Tragus berteronianus	Annual	Th	ME+Trop + IR-TR
	Tetrapogon cenchriformis (A.Rich.) Clayton	Annual	Th	ME+SA-AR+IR-TR
	Urochloa deflexa (Schumach) H. Scholz.	Annual	Th	ME+SA-AR+IR-TR
Polygalaceae	Polygala erioptera DC.	Annual	Th	ME+IR-TR
Portulacaceae	Portulaca oleracea L.	Annual	Th	COSM
Salvadoraceae	Salvadora persica L.	Perennial	GH	ME+IR-TR
Scrophulariaceae	Striga hermonthica (Delile) Benth.	Annual	Ch	Trop
Solanaceae	Datura innoxia Miller	Perennial	Th	NEO
	Datura stramonium L.	Perennial	Th	NEO
	Physalis minma L.	Perennial	Th	COSM
	Solanum incanum L.	Perennial	Ch	COSM
	Solanum nigrum L.	Perennial	Ch	COSM

Tamaricaceae	Tamarix aphylla (L.) Karst.	Perennial	Ph	SA-AR
	Tamarix nilotica (Ehrenb.) Bunge	Perennial	Ph	SA-AR+S-Z
Typhaceae	Typha angustata	Perennial	GH	Pan
Zygophallaceae	Balanites aegyptiaca(L.) Del.	Perennial	Ch	SA-AR+S-Z
	Fagonia cretica L.	Perennial	Ch	SA-AR