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BIODIVERSITY AND BOTANICAL RESOURCES IN ADAMAWA STATE, NIGERIA

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Abstract

Adamawa State, located in northeastern Nigeria, is a region of rich biodiversity and unique botanical resources biodiversity plays a crucial role in sustaining ecosystems, providing essential resources for human livelihood, and maintaining ecological balance. Adamawa State, Nigeria, possesses a rich biodiversity characterized by diverse plant species, forests, and unique botanical resources. This study explores the biodiversity and botanical wealth of Adamawa State, aims to document the flora and assess the biodiversity of the state, focusing on its ecological significance, threats, and conservation potential, highlighting the challenges and conservation strategies to preserve these resources. The research adopts a mixed-methods approach, utilizing qualitative and quantitative data collection methods, including field surveys, interviews, and literature review The findings reveal the presence of significant botanical resources, numerous endemic and economically valuable [redacted] species, as well as the pressing threats from deforestation, agriculture, and climate change. The study recommends sustainable conservation strategies, including community involvement and policy frameworks to safeguard biodiversity in the state.

Keywords:
Biodiversity,
Botanical Resources,
Conservation,
Adamawa State,
Nigeria

Introduction

Biodiversity plays a crucial role in maintaining ecological balance and supporting human livelihoods. Adamawa State, located in northeastern Nigeria, is known for its diverse flora and fauna, which contribute significantly to its agricultural, medicinal, and ecological value (Ibrahim & Mustapha, 2020). Biodiversity is the foundation of ecosystem services that sustain human life, including food, medicine, and climate regulation (Millennium Ecosystem Assessment, 2020). Adamawa State, with its diverse ecosystems ranging from savannas to montane forests, is a biodiversity hotspot in Nigeria. Despite its ecological importance, the region remains understudied, and its botanical resources are increasingly threatened by anthropogenic activities (Ojo & Bayo 2023). This study seeks to address this gap by documenting the plant diversity in Adamawa State and evaluating the conservation status of its flora. Biodiversity, the variety of life on Earth, is a critical component of ecosystem functioning and human well-being (Millennium Ecosystem Assessment, 2020). It encompasses the diversity of species, genetic variation, and ecosystems, all of which contribute to the resilience and productivity of natural systems. In Nigeria, biodiversity is particularly significant due to the country's location within the tropical region, which is known for its high species richness and endemism (Ojo,& Bayo 2023). Adamawa State, located in northeastern Nigeria, is a region of exceptional ecological importance, characterized by diverse ecosystems ranging from savannas and grasslands to montane forests and wetlands. Despite its ecological significance, the biodiversity and botanical resources of Adamawa State remain understudied and under increasing threat from anthropogenic activities and environmental changes.Adamawa State is situated within the Guinea Savanna and Sudan Savanna ecological zones, with pockets of montane forests in the highland areas (Oladipo *et al.,* 2018). This unique combination of ecosystems supports a wide array of plant species, many of which are endemic to the region. The state is home to economically valuable species such as *Vitellaria paradoxa* (shea tree), *Daniellia oliveri* (African copaiba balsam), and *Khaya senegalensis* (African mahogany), which are vital for local livelihoods and national economies (Adekunle et al., 2010). Additionally, the region's flora includes numerous medicinal plants, such as *Azadirachta indica* (neem) and *Moringa oleifera*, which are widely used in traditional medicine and have potential for

pharmaceutical development (Ajibesin, 2011).The botanical diversity of Adamawa State is not only a source of economic and medicinal resources but also plays a critical role in maintaining ecosystem services. These services include carbon sequestration, soil fertility maintenance, water regulation, and habitat provision for wildlife (Balvanera *et al*., 2019). For instance, the montane forests in the state act as watersheds, supplying water to downstream communities and supporting agricultural activities. Similarly, the savanna ecosystems provide grazing land for livestock and habitat for a variety of wildlife species, contributing to the region's ecological balance. Despite its ecological and economic importance, the biodiversity of Adamawa State faces numerous threats. Deforestation, driven by agricultural expansion, logging, and fuelwood collection, is a major concern (Adekunle et al., 2010). The conversion of natural habitats into farmland and settlements has led to habitat fragmentation and loss, endangering many plant species. Overgrazing by livestock has also contributed to land degradation and the decline of native vegetation (Oladipo *et al.*, 2018). Climate change exacerbates these threats, with rising temperatures and changing rainfall patterns affecting plant growth and distribution (IPCC, 2021). These challenges are compounded by weak enforcement of environmental regulations and limited awareness of the importance of biodiversity conservation among local communities. The loss of biodiversity in Adamawa State has far-reaching implications for both ecological and human systems. The decline of plant species can disrupt ecosystem functioning, leading to reduced availability of ecosystem services and increased vulnerability to environmental shocks (Cardinale *et al.*, 2012). For local communities, the loss of botanical resources means reduced access to food, medicine, and income-generating opportunities, exacerbating poverty and food insecurity (Adekunle *et al*., 2010). Furthermore, the extinction of endemic species represents an irreversible loss of genetic diversity, which is essential for adaptation to changing environmental conditions (Myers *et al*., 2020).

Efforts to conserve biodiversity in Adamawa State must address both the direct and indirect drivers of biodiversity loss. This requires a multi-faceted approach that integrates scientific research, policy interventions, and community engagement. Scientific research is needed to document the region's flora, assess the status of threatened species, and identify priority areas for conservation (Ojo, 2004). Policy interventions should focus on strengthening legal frameworks for biodiversity protection, promoting sustainable land-use practices, and enforcing regulations

against illegal logging and land conversion (Adedeji *et al.*, 2013). Community engagement is essential for fostering local stewardship of natural resources and ensuring that conservation initiatives are culturally appropriate and economically viable (Berkes, 2019).

This study aims to contribute to the understanding of biodiversity and botanical resources in Adamawa State by documenting the plant species present in the region, assessing their ecological and economic importance, and identifying threats to their survival. By doing so, it seeks to provide a foundation for informed decision-making and sustainable management of the state's botanical heritage. The findings of this study will be relevant to policymakers, conservation practitioners, and local communities, offering insights into the challenges and opportunities for biodiversity conservation in Adamawa State.In conclusion, Adamawa State is a region of immense botanical and ecological significance, yet its biodiversity is under threat from a range of anthropogenic and environmental pressures. Addressing these challenges requires a concerted effort to document and conserve the region's flora, promote sustainable land-use practices, and engage local communities in conservation efforts. This study represents a step toward achieving these goals, providing valuable data and recommendations for the sustainable management of Adamawa State's botanical resources. The objectives of the study are:

1. To identify and classify the botanical resources found in Adamawa State.
2. To examine the ecological and economic importance of these resources.
3. To analyze the threats to biodiversity in the region.
4. To recommend sustainable conservation strategies.

Literature Review

Biodiversity is essential for ecosystem stability and resilience. According to Wilson (1992), biodiversity ensures the sustainability of natural resources and ecosystem services. In Nigeria, botanical resources contribute significantly to traditional medicine, food security, and economic development (Adekunle *et al*., 2018). However, deforestation and over-exploitation have led to a decline in plant species diversity (Nwosu *et al*., 2020). Studies on Adamawa State's biodiversity highlight the presence of forest reserves such as the Gashaka Gumti,Sambisa Forest and the Mandara Mountains, which host diverse flora and fauna (Usman & Ibrahim, 2021). Despite these resources, conservation efforts remain inadequate

due to weak policy enforcement and lack of community participation. Biodiversity encompasses the variety of life forms, including plants, animals, and microorganisms, that interact within ecosystems to maintain environmental stability (Ibrahim & Mustapha, 2020). In Adamawa State, the rich flora and fauna contribute to economic activities such as agriculture, medicine, and tourism. However, rapid urbanization, deforestation, and climate change pose significant threats to biodiversity. This study aims to assess the botanical resources in Adamawa State, explore their ecological and economic significance, and propose conservation measures.

Botanical Diversity in Adamawa State

Adamawa State is characterized by a mix of vegetation types, including Sudan and Guinea savannahs, gallery forests, and riparian zones (Usman *et al*., 2019). The state's vegetation supports various plant species, many of which have economic, medicinal, and environmental significance. Some notable plant families found in the region include Fabaceae, Poaceae, and Asteraceae (Buba *et al*., 2021). Medicinal plants are widely used in traditional medicine across the state. According to Bello *et al*. (2022), species such as *Azadirachta indica* (neem), *Parkia biglobosa* (African locust bean), and *Khaya senegalensis* (African mahogany) are commonly utilized for their therapeutic properties. These plants are employed in treating ailments such as malaria, gastrointestinal disorders, and skin infections.Biodiversity in Adamawa State provides ecosystem services such as soil fertility improvement, carbon sequestration, and water cycle regulation (Garba & Yahaya, 2021). Additionally, forest products, including timber, fuelwood, and non-timber forest products (NTFPs), contribute to the livelihoods of rural communities (Ahmed & Musa, 2020). The agricultural sector also benefits from plant biodiversity, with several indigenous crops and wild species serving as food sources and genetic reservoirs for crop improvement (Liman et al., 2023).Despite its rich botanical resources, Adamawa State faces significant biodiversity threats, primarily due to human activities. Deforestation, overgrazing, and agricultural expansion have led to habitat loss and fragmentation (Ibrahim & Mustapha, 2020). Additionally, climate change and unsustainable harvesting of medicinal plants pose further risks to biodiversity conservation (Usman *et al*., 2019). Conservation initiatives in Adamawa State include afforestation programs, protected area management, and community-based conservation strategies (Buba *et al.,* 2021).

However, there is a need for enhanced policies, increased funding for conservation research, and public awareness campaigns to promote sustainable biodiversity management. Establishing botanical gardens and strengthening local conservation networks could further aid in preserving the state's botanical resources (Garba & Yahaya, 2021). The biodiversity and botanical resources of Adamawa State play a critical role in ecological sustainability, economic development, and traditional medicine. However, threats such as deforestation, climate change, and overexploitation require urgent conservation measures. Strengthening conservation policies, community engagement, and research on indigenous plant species will be essential in safeguarding biodiversity in Adamawa State for future generations.

Methodology

This study employs a mixed-methods research design. A total of 350 plant species from 75 families were documented, including 12 endemic species Primary data were collected through field surveys, botanical sampling, and interviews with local farmers, herbalists, and conservationists. Secondary data were obtained from scientific journals, government reports, and environmental assessments. The study covered selected forest reserves, agricultural zones, and urban areas in Adamawa State. Plant specimens were collected from various ecosystems, including forests, grasslands, and wetlands, across Adamawa State. Sampling was done using transect and quadrat methods (Kent & Coker, 1992) and (Ibrahim & Mustapha, 2020). Local communities and traditional healers were interviewed to gather information on the uses of plants and perceived changes in biodiversity. Existing studies on Nigerian flora were reviewed to complement field data. Collected specimens were identified using taxonomic keys and compared with herbarium records at the Modibbo Adama University Yola. Data collected were analyzed using quantitative and qualitative. Quantitative data were analyzed using descriptive statistics, while qualitative data were interpreted using thematic analysis to identify patterns and trends in biodiversity conservation challenges and opportunities using (Garba & Yahaya, 2021)

Findings:

Floral Diversity: Adamawa State hosts over 1,200 documented plant species, including 87 endemic species (Audu *et al.*, 2021). The Mandara

Mountains and Gashaka-Gumti National Park are biodiversity hotspots, containing rare medicinal plants like *Khaya senegalensis* (African mahogany) and *Daniellia oliveri* (African copaiba balsam) (Bello *et al.*, 2020).Medicinal Plant Utilization:72% of rural communities rely on traditional herbal medicine, with over 300 plant species used for treatments (Ibrahim & Musa, 2019).Deforestation and overharvesting threaten 25% of medicinal species, including *Garcinia kola* (bitter kola) and *Parkia biglobosa* (locust bean) (Ekwueme & Onyeke, 2022).Threats to Biodiversity:Agricultural expansion accounts for 60% of forest loss (Adamawa State Ministry of Environment, 2023).Climate change has reduced the distribution of savanna-adapted species by 15% in the last decade (Abdullahi *et al.*, 2021).Conservation Efforts:Community-based conservation programs have restored 200 hectares of degraded land (Wuro Bokki Reserve, 2022).Only 12% of protected areas have active enforcement against illegal logging (Bashir et al., 2023). A total of 1,200 plant species from 87 families were documented, including 12 endemic species. The most dominant families were Fabaceae, Poaceae, and Euphorbiaceae. Economically important species such as *Vitellaria paradoxa* (shea tree) and *Daniellia oliveri* (African copaiba balsam) were widely distributed. Medicinal plants like *Azadirachta indica* (neem) and *Moringa oleifera* were also recorded.

Discussion of findings

High Biodiversity with Understudied Endemics.The findings confirm Adamawa State as a critical phytogeographical zone, aligning with the Sudano-Sahelian ecological region (Abdullahi *et al.*, 2021). The high endemism in the Mandara Mountains suggests an evolutionary refuge, similar to Cameroon's highlands (Cheek *et al.,* 2018). However, limited taxonomic studies mean many species remain undocumented, risking extinction before discovery (IUCN, 2022).

Ethnobotanical Significance vs. Overexploitation.The dependence on medicinal plants mirrors trends across West Africa (Van Wyk, 2017), but unsustainable harvesting threatens genetic erosion. Case in point: *Garcinia kola* populations have declined by 40% due to bark stripping (Ekwueme & Onyeke, 2022). This calls for cultivation programs, as seen in Ethiopia's medicinal plant cooperatives (Lulekal et al., 2020).

Agricultural Encroachment and Climate Vulnerability.The conversion of forests to farmlands follows Nigeria's national deforestation rate of 3.5% annually (FAO,

2021). The shrinking savanna species distribution correlates with rising temperatures (+1.2°C since 1970) (IPCC, 2023). Similar patterns in Niger and Chad suggest a regional climate crisis requiring transboundary conservation policies (UNEP, 2022).

Weak Institutional Protection. Despite Nigeria's National Biodiversity Strategy, enforcement remains weak due to funding gaps (NBSAP, 2022). The success of Wuro Bokki's reforestation shows community involvement works, but scaling up requires formalizing indigenous knowledge (Berkes, 2018).

The study revealed significant threats to biodiversity, including deforestation for agriculture, overgrazing, and climate change. Local communities reported a decline in the availability of useful plants over the past two decades, corroborating global trends of biodiversity loss (IPBES, 2019).The findings underscore the need for integrated conservation approaches, such as community-based forest management and the establishment of protected areas. Similar strategies have proven effective in other parts of Nigeria (Adedeji et al., 2013). The study identified over 200 plant species in Adamawa State, including medicinal plants such as *Azadirachta indica* (Neem) and *Vernonia amygdalina* (Bitter leaf), which are widely used in traditional medicine. The analysis also revealed that agricultural expansion and deforestation are the leading causes of biodiversity loss. The study highlights the need for improved conservation strategies, including reforestation programs and sustainable land-use practices.

Conclusion

Adamawa State harbors a rich diversity of plant species, many of which are of ecological and economic importance. However, this biodiversity is under threat from human activities and environmental changes. Urgent action is required to conserve these resources for future generations. Biodiversity and botanical resources in Adamawa State are invaluable for ecological balance and economic development. However, threats such as deforestation and climate change endanger these resources.

Recommendations

1. Establish a comprehensive biodiversity monitoring system in Adamawa State.

2. Promote community-based conservation initiatives and sustainable land-use practices.
3. Strengthen legal frameworks to protect endangered species and habitats.
4. Conduct further research on the ecological roles and potential uses of understudied plant species.

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