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Assessment of Tree and Shrub Species Diversity in The Federal Capital Territory, Abuja, Nigeria: Implications for Conservation and Land Use

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ABSTRACT

Tree and shrub diversity plays a crucial role in maintaining ecosystem stability, enhancing biodiversity, and providing essential ecological services. This study assesses the diversity, abundance, and distribution of tree and shrub species in the Federal Capital Territory (FCT), Nigeria, with a focus on understanding the implications for biodiversity conservation and land use management. Data were collected through systematic field surveys and analyzed to determine species richness, dominance, and ecological patterns across various land-use types. The results reveal significant variations in species composition and abundance, influenced by anthropogenic activities such as urban expansion, agriculture, and deforestation. Native species, including *Azadirachta indica, Parkia biglobosa,* and *Vitellaria paradoxa*, were observed in decline due to habitat fragmentation. In contrast, exotic species such as *Gmelina arborea* and *Tectona grandis* showed higher dominance in plantations and urban areas. The study emphasizes the urgent need for sustainable land-use policies and afforestation initiatives to conserve native biodiversity and mitigate the ecological impacts of urbanization. Findings from this research provide valuable insights for policymakers, conservationists, and urban planners to enhance biodiversity conservation efforts in rapidly developing regions like the FCT.

Keywords: Tree diversity, Shrub species, Biodiversity conservation, Land use changes.

INTRODUCTION

African countries, including Nigeria, are renowned for their rich diversity of plant species, many of which serve vital roles in traditional medicine, ornamental landscaping, fuel production, and other ethnobotanical applications (Dean *et al*., 2019). Plants play a fundamental role in ecosystems as autotrophic, multicellular organisms capable of synthesizing their food from atmospheric carbon dioxide. They form the foundation of food webs and food chains, supporting nearly all animal life.

Natural ecosystems in Africa provide habitats for a significant portion of the world's biodiversity. Nigeria, in particular, boasts a diverse range of ecosystems that support a vast array of life forms. The country is home to over 1,800 animal species and approximately 4,600 plant species (Mbaya and Malgwi, 2014). This biodiversity contributes significantly to the economy through agriculture and ecotourism, generating substantial foreign exchange. However, rapid deforestation is threatening these ecosystems (Inegbedon, 2008).

The loss of plant diversity is often driven by land development, agricultural expansion, deforestation, and habitat clearing for hunting. Such activities lead to the destruction of forest cover without fully understanding the ecological roles of the plant species present. Deforestation is regarded as one of the most pressing environmental and economic challenges globally. Human activities have been identified as the primary drivers of forest degradation, particularly in tropical regions. Forests play a crucial role in climate regulation, water management, air purification, and providing habitat and resources for wildlife. Additionally, they supply valuable materials such as timber and paper pulp (Ubom, 2010).

In Nigeria, approximately 133,234 hectares of forest have been lost to deforestation over the years, primarily for agricultural expansion (Richardson,

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2011). While tropical regions are known for their abundant biodiversity (Tanko *et al*., 2010; Ezealor, 2012), forested areas have significantly declined. A specific forest area was reported to have shrunk to 439,139 hectares, covering only about 23% of a state's total land area (Millennium, 2005). Moreover, the overexploitation of forest reserves has reached alarming levels, with tree and shrub densities dropping to less than one stand per hectare in some areas. This unprecedented rate of deforestation has led to the extinction of several plant species, while many others are now threatened (Omoregbe, 2004; Mahanta and Twari, 2004; Okoeguele, 2010;).

Given these concerns, this study aims to assess the stocking status of tree and shrub species in the Federal Capital Territory (FCT), Abuja, Nigeria. The FCT comprises six Area Councils, and for this research, three settlements were randomly selected from each council to provide a representative overview of tree and shrub distribution in the region.

MATERIALS AND METHODS

Study Sites

This study was conducted in Abuja, the Federal Capital Territory (FCT) of Nigeria, located between latitudes 9º03´ and 9º07´N and longitudes 7º26´ and 7º39´E in the north-central region of the country. Abuja experiences a tropical wet and dry climate, with a warm and humid rainy season and a dry season characterized by harmattan. The harmattan period is marked by dust haze, increased coldness, and aridity due to the influence of the northeast trade wind (Adejuwon, 2016). The FCT receives significant rainfall due to its proximity to the windward side of the Jos Plateau, where rising air masses contribute to precipitation (Odekunle, 2004).

The study sites, selected from the six area councils of the FCT, were chosen based on their biodiversity, which includes diverse plant and animal species, and the rapid developmental changes occurring in these locations. These sites lie within the Guinea savanna ecosystem, a characteristic feature of Nigeria's north-central region. According to Balogun *et al*. (2010), Abuja's mountainous terrain influences orographic rainfall, leading to frequent and substantial precipitation throughout the rainy season. The rainy season typically extends from March to November, with September being the peak month of rainfall. Annual rainfall in the region ranges between 1,000 mm and 1,600 mm, while the mean monthly temperature varies from 25.8ºC to 30.2ºC (NIMET, 2015).

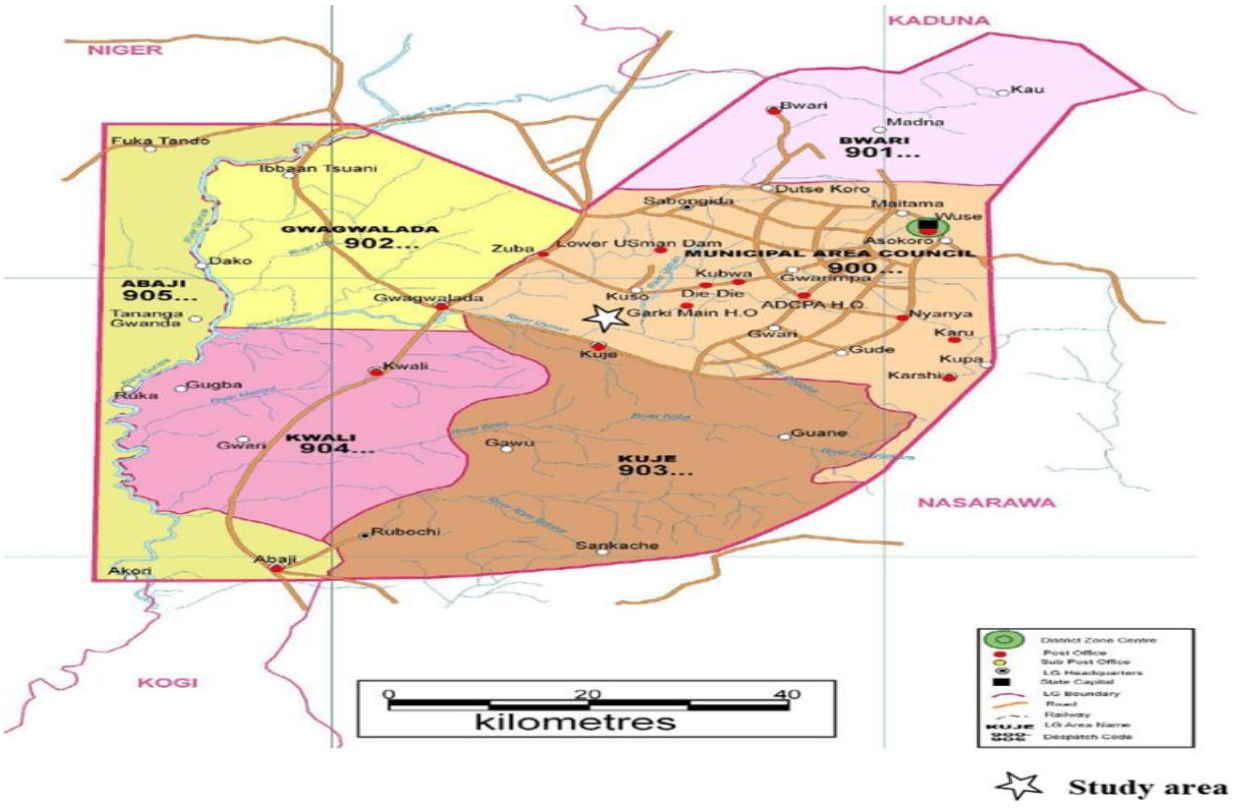

Figure 1: Map of the Federal Capital Territory, Abuja (Source: researchgate.net)

Data Collection

Data collection involved direct observation through field visits to assess plant species within the selected communities. These visits were conducted twice a month, during which all identified plant species were recorded. A mixed-methods approach, combining qualitative and quantitative research paradigms, was employed (Causton, 2003). This approach provided a comprehensive understanding of the research topic by integrating diverse research methodologies. Interviews were conducted with key stakeholders, including original inhabitants, settlers, hunters, farmers, and traditional medicine practitioners, to gather information on plant diversity and uses. The interview sessions, lasting approximately 20–30 minutes, allowed participants to share their perspectives on the subject matter. The reliability of this method is supported by Ezealor (2012) and Osemeobo (2014). To facilitate the selection of interviewees, a modified random sampling technique was used, ensuring broad representation across the six area councils.

In addition to interviews, visits to the area councils were undertaken to obtain maps and other relevant data that aided in generating a plant species inventory. A questionnaire-based survey employing a snowball sampling technique was also conducted, targeting specific stakeholders with valuable knowledge about local plant species. Both structured and semi-structured questions were used to capture a comprehensive understanding of the subject.

Quantitative data analysis was performed using the Statistical Package for Social Sciences (SPSS, version 23, because it provides a user-friendly interface for performing a wide range of statistical analyses without needing advanced programming skills. The results obtained from the fieldwork were systematically computed and analyzed, leading to the creation of a comprehensive database documenting the identified plant species.

RESULTS AND DISCUSSION

Species Distribution across Area Councils

The distribution of tree and shrub species across the Federal Capital Territory (FCT) area councils shows varying degrees of species similarity and uniqueness as highlighted in Table 1. Gwagwalada, Abaji, Kuje, Kwali, and Bwari share six common species: *Berlina grandiflora*, *Berlina grandifolia*, *Ficus exasperata*, *Khaya senegalensis*, *Lannea welwitschii*, and *Sterculia setigera.* This suggests that these councils have similar ecological conditions and habitat characteristics that support the coexistence of these species.

In contrast, Municipal and Kwali each had distinct species compositions, with two and one unique species, respectively. The low number of unique species in these areas might be linked to urbanization, deforestation, and other land-use changes (Soladoye *et al*., 2005). Additionally, councils such as Gwagwalada and Kuje, Gwagwalada and Kwali, and Abaji and Municipal had only one species in common, which may be due to localized environmental factors and anthropogenic influences shaping vegetation patterns (Ogunleye *et al*., 2004).

Among the councils, Gwagwalada and Bwari exhibited the highest species similarity, with 11 shared species. This strong floristic connection could be attributed to similar soil types and climatic conditions. In contrast, councils like Municipal and Kwali, which shared fewer species, may have undergone greater environmental modifications due to urban expansion. Notably, *Kigelia africana* was found exclusively in Gwagwalada, suggesting unique microhabitat preferences for this species (Burkill, 1985).

Taxonomic Representation and Species Richness

Table 2 shows that *Acacia* and *Terminalia* at the generic level were the most represented genera, each with three species. Other genera, including *Khaya, Cola, Ficus, Sterculia, Senna,* and *Berlina,* had two species, while most other genera were monospecific. The predominance of Fabaceae aligns with previous studies in Nigerian savanna regions, where this family dominates due to its nitrogen-fixing ability and adaptability to diverse soil types (Ogunleye *et al*., 2004; Soladoye *et al*., 2005).

Apart from Fabaceae, other highly represented families included Euphorbiaceae (8 species), Sterculiaceae (7 species), Rubiaceae (6 species), Palmae (5 species), and Combretaceae (5 species). Families such as Anacardiaceae, Moraceae, and Bombacaceae contained between three and four species each, while others had only one or two representatives. The high presence of Euphorbiaceae and Sterculiaceae in the study area aligns with the findings of Keay (1989), who documented their dominance in West African ecosystems.

The high number of monospecific genera suggests relatively low species diversity in the study area. This indicates that while some families are well-adapted to the environment, others have limited representation, which may be due to ecological constraints or overexploitation (Hutchinson & Dalziel, 1954). The predominance of a few families highlights the need for conservation strategies to prevent biodiversity loss.

Ethnobotanical Uses of Trees and Shrubs

Ethnobotanical analysis revealed that medicinal use was the most frequently reported function of the studied species, as presented in Figure 1. Many plants, such as *Khaya senegalensis, Afzelia africana,* and

Newbouldia laevis, are traditionally used for treating ailments like malaria, gastrointestinal disorders, and inflammation (Adekunle *et al*., 2013). This aligns with Sofowora (1993), who emphasized the importance of medicinal plants in traditional healthcare systems in Africa.

Food-related uses ranked second, with species like *Treculia africana, Detarium microcarpum,* and *Tamarindus indica* serving as important nutritional resources, particularly for rural communities (Keay, 1989). The consumption of these species highlights their role in food security and their contribution to the local economy. Timber-producing species, including *Khaya senegalensis* and *Afzelia africana*, are highly valued for their durable wood, widely used in construction, furniture making, and crafts (Hutchinson & Dalziel, 1954). The economic importance of these species has, however, led to overexploitation, raising concerns about sustainable harvesting practices.

While medicinal and food uses dominated, some species also had ornamental, spiritual, and cultural significance. Species like *Spondias mombin* and *Newbouldia laevis* are commonly used in traditional ceremonies and religious practices (Adekunle *et al*., 2013). The relatively lower frequency of these uses suggests that economic and subsistence-driven applications take precedence over cultural applications in the study area.

Conclusion

The study reveals notable variations in species distribution throughout the FCT, with some species being widely distributed while others are highly localized. The prevalence of Fabaceae, Euphorbiaceae, and Sterculiaceae corroborates findings from earlier research. Additionally, the existence of numerous monospecific genera indicates a relatively low diversity within certain families. Ethnobotanical analysis emphasizes the significance of these species in medicine, food, and timber production, thereby highlighting their socio-economic value.

Given the increasing threats posed by deforestation, habitat loss, and overexploitation, conservation efforts should be prioritized to maintain biodiversity and ensure the sustainable use of these resources. Future research should explore the impact of land-use changes on species distribution and the potential for domestication of economically valuable species.

Table 1: Taxonomic Distribution of Identified Shrub and Tree Species in the Study Area

Family	Frequency	Species (Scientific Name)	Common Name
Anacardiaceae	4	*Anacardium occidentale L.*	Cashew tree
		Lannea welwitschii	False marula
		Mangifera indica	Mango tree
		Spondias mombin	Hog plum
Annonaceae	2	*Annona senegalensis*	Wild custard apple
		Uvaria chamae	Bush banana
Balanitaceae	1	*Balanites aegyptiaca*	Desert date
Bignoniaceae	2	*Spathodea campanulata*	African tulip tree
		Stereospermum kunthianum	Pink jacaranda
Bombacaceae	3	*Adansonia digitata*	Baobab tree
		Bombax buonopozense	Red silk-cotton tree
		Ceiba pentandra	Kapok tree
Cannabaceae	1	*Trema orientalis*	Charcoal tree
Caricaceae	1	*Carica papaya*	Papaya tree
Casuarinaceae	1	*Casuarina equisetifolia*	Australian pine
Celastraceae	1	*Maytenus senegalensis*	Confetti tree
Chrysobalanaceae	1	*Maranthes polyandra*	N/A
Combretaceae	5	*Anogeissus leiocarpa*	African birch
		Combretum molle	Velvet bushwillow
		Terminalia catappa	Indian almond
		Terminalia mantaly	Madagascar almond
		Terminalia glaucescens	N/A

Family	Frequency	Species (Scientific Name)	Common Name
Euphorbiaceae	8	*Alchornea cordifolia*	Christmas bush
		Bridelia ferruginea	Ironwood
		Calotropis procera	Apple of Sodom
		Hura crepitans	Sandbox tree
		Macaranga rose	N/A
		Neoguillauminia virosa	N/A
		Phyllanthus muellerianus	N/A
		Thevetia peruviana	Yellow oleander
Fabaceae	24	*Acacia nilotica*	Gum arabic tree
		Acacia seyal	Red acacia
		Acacia sieberiana	Paperbark thorn
		Afzelia africana	African mahogany
		Albizia lebbeck	Woman's tongue tree
		Bauhinia rufescens	Red Bauhinia
		Berlinia grandiflora	N/A
		Berlinia grandifolia	N/A
		Dalium guineense	Velvet tamarind
		Daniellia oliveri	African copaiba balsam tree
		Delonix regia	Flame tree
		Detarium microcarpum	Tallow tree
		Dichrostachys cinerea	Sickle bush
		Entada africana	African flame creeper
		Erythrina senegalensis	Senegal coral tree
		Erythrophleum suaveolens	Ordeal tree
		Leucaena lanceolata	N/A
		Lonchocarpus laxiflorus	N/A
		Parkia biglobosa	African locust bean tree
		Piliostigma thonningii	Monkey bread tree
		Prosopis africana	Iron tree
		Senna alata	Candle bush
		Senna siamea	Siamese cassia
		Tamarindus indica	Tamarind tree
Hypericaceae	1	*Harungana madagascariensis*	Orange-milk tree
Lamiaceae	1	*Tectona grandis*	Teak tree
Lecythidaceae	1	*Napoleonaea vogelii*	N/A
Loganiaceae	2	*Anthocleista djalonensis*	Cabbage tree
		Strychnos spinosa	Spiny monkey orange
Meliaceae	3	*Azadirachta indica*	Neem tree
		Khaya grandifolia	Big-leaf mahogany
		Khaya senegalensis	African mahogany
Meliazer	1	*Pseudocedrela kotschyi*	N/A
Moraceae	4	*Ficus platyphylla*	Balsam fig
		Ficus asperifolia	Sandpaper fig

Family	Frequency	Species (Scientific Name)	Common Name
		Musanga cecropioides	Parasol tree
		Treculia africana	African breadfruit
Moringaceae	1	*Moringa oleifera*	Drumstick tree
Myrtaceae	1	*Eucalyptus camaldulensis*	River red gum
Ochnaceae	1	*Lophira lanceolata*	N/A
Olacaceae	1	*Ximenia americana*	Wild plum
Palmae	5	*Borassus aethiopum*	African fan palm
		Elaeis guineensis	Oil palm
		Hyphaene thebaica	Doum palm
		Phoenix dactylifera	Date palm
		Raphia sp	Raphia palm
Polygalaceae	1	*Securidaca longipedunculata*	Violet tree
Proteaceae	1	*Protea elliottii*	N/A
Rhamnaceae	1	*Ziziphus spina-christi*	Christ's thorn jujube
Rosaceae	1	*Parinari curatellifolia*	Mobola plum
Rubiaceae	6	*Crossopteryx febrifuga*	Fever tree
		Gardenia erubescens	Red-stemmed gardenia
		Maclura latifolia	N/A
		Mitragyna inermis	African abura
		Morinda lucida	Brimstone tree
		Nauclea latifolia	African peach
Sapindaceae	1	*Blighia sapida*	Ackee tree
Sapotaceae	1	*Vitellaria paradoxa*	Shea tree
Sterculiaceae	7	*Cola gigantean*	Giant cola tree
		Cola millenii	Monkey cola
		Hildegardia barteri	N/A
		Kigelia africana	Sausage tree
		Newbouldia laevis	African border tree
		Sterculia setigera	Sheanut tree
		Sterculia tragacantha	Gum karaya tree
Tiliaceae	1	*Corchorus mollis*	N/A
Umbelliferae	2	*Cussonia arborea*	Cabbage tree
		Steganotaenia araliacea	N/A
Verbenaceae	3	*Gmelina arborea*	Beechwood
		Tectona grandis	Teak tree
		Vitex doniana	Black plum

Table 2: Distribution of Common and Peculiar Tree Species Across Federal Capital Area Councils

Area Council(s)	Common or Peculiar Species
Gwagwalada, Abaji, Kuje, Kwali, and Bwari (N=6)	*Berlinia grandiflora, Berlinia grandifolia (Vahl) Hutch & Dalz, Ficus asperifolia, Khaya senegalensis A. Juss, Lannea welwitschii, Sterculia setigera*
Municipal (N=2)	*Treculia africana, Detarium microcarpum*
Gwagwalada and Kuje (N=1)	*Kigelia africana*
Kwali (N=1)	*Ximenia americana*
Gwagwalada and Kwali (N=1)	*Corchorus mollis*
Abaji and Municipal (N=1)	*Dialium guineense*
Gwagwalada, Abaji, Kwali (N=1)	*Mitragyna inermis*
Bwari and Municipal (N=2)	*Phoenix dactylifera, Acacia sieberiana*
Gwagwalada, Abaji, Bwari (N=2)	*Bombax buonopozense, Newbouldia laevis*
Gwagwalada and Municipal (N=5)	*Afzelia africana Smith ex Pers, Hura crepitans, Morinda lucida, Raphia sp., Tamarindus indica L.*
Gwagwalada, Kwali, and Bwari (N=5)	*Cussonia arborea, Gardenia erubescens Stapf, Pseudocedrela kotschyi, Spondias mombin, Ziziphus spina-christi*
Gwagwalada and Bwari (N=11)	*Anthocleista djalonensis, Bauhinia rufescens, Borassus aethiopum, Bridelia ferruginea, Crossopteryx febrifuga, Hyphaene thebaica, Khaya grandifolia, Lophira lanceolata, Musanga cecropioides, Uvaria chamae, Securidaca longipedunculata*
Gwagwalada, Kuje, Kwali, Bwari (N=3)	*Acacia seyal, Combretum molle, Strychnos spinosa*

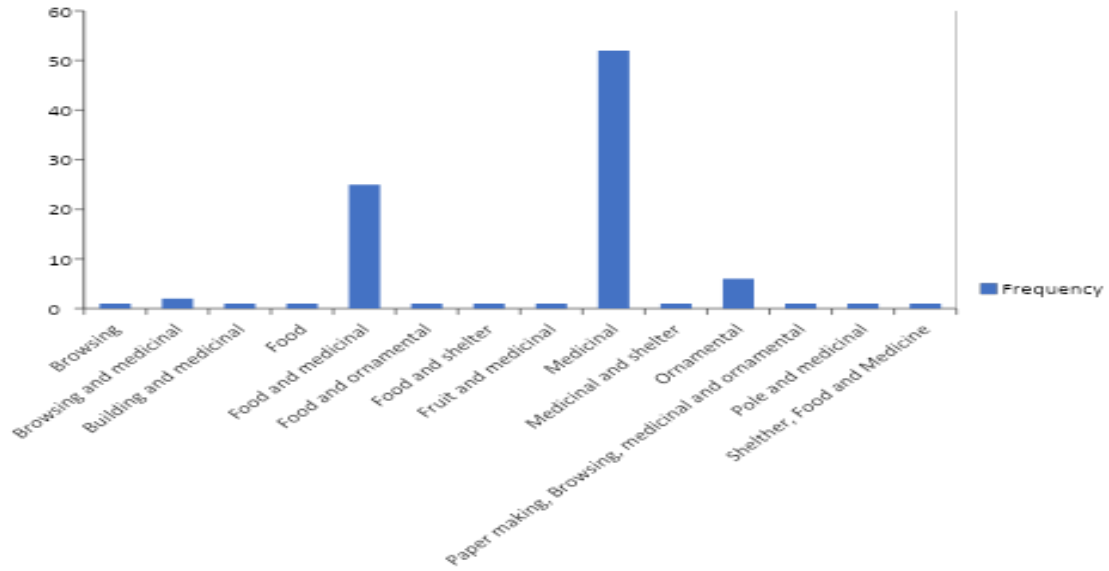

Figure 1: Ethnobotanical Uses of Studied Trees and Shrubs

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