

# Tree Species Composition, Distribution and Important Value Index in Open Mining Sites in Selected Local Governments of Zamfara State, Nigeria

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## ARTICLE INFO

*Received: December, 2019*

*Accepted: April, 2020*

*Published: April, 2020*

### **Keywords:**

Deforestation

Conservation

Anthropogenic activities

Zamfara state.

## ABSTRACT

*Assessment of tree species composition, distribution and Important Value Index (IVI) was carried out in open mining sites of Anka, Bukkuyum and Maru local government areas of Zamfara state, Nigeria due to the presence of abundant mineral resources and an outbreak of diseases that killed thousands of both young and old in 2010, and to develop conservation guidelines in the area. Random sampling technique using quadrats was employed for the study. All woody species were systematically identified and measured in Fifty (50) quadrats of 50 x 50 m size. Relative density, abundance, frequency, species and family importance value index were computed to characterize the species composition. A variety of diversity measures were calculated to examine the heterogeneity of each community. A total of 33 species in 29 genera, representing 19 families were found. Fabaceae and Combretaceae were the most abundant families. The vegetation cover in these communities could best be described by the following shrub types Guiera senegalensis, Piliostigma thonningii, and Combretum macronthum complex. The dominant woody species were all shrubs therefore the species composition of Zamfara State could best be characterised by shrubs and by the trees being sufficiently widely spaced. An excessive depletion of vegetation resources is in vogue currently due to mining, deforestation and other anthropogenic interferences over the years. The research recommends a periodic and vigilant monitoring of the mining sites and proper legal measures be taken on the people that violate the law to avoid total extinction of the tree species.*

## 1. INTRODUCTION

Habitat destruction is proceeding at such an alarming rate and the continued growth of population in Nigeria, especially the Northern part brought about an increased demand for shelter, food and fibre, coupled with increase in the cost of domestic energy have caused recourse to fuel wood as an alternative source of energy for domestic uses (FGN, 2009). Poverty that is associated with increase in population has intensified dependence on natural resources leading to overexploitation and consequent environmental challenges in

developing countries especially Nigeria (Omofonmwan and Osa-edoh, 2008). This is worsened by the high poverty rate in Northern Nigeria which has necessitated over reliance on primary products and the use of forest resources as sources of food and livelihood (USAID, 2008).

Most households in *Zamfara* State depend on the scanty woody species for energy sources, construction poles and other uses (Dangulla, 2013). Unfortunately, the stock and diversity of such vital resources has continued to dwindle due to unfriendly anthropogenic activities in the state. *Zamfara* state is within the savannah woodlands that are looked upon as one of the less species-diverse terrestrial ecosystems compared to the tropical rain forests (Usman and Adefalu, 2011; *Zamfara* Forestry Dept., 2015). Though many tree species can adapt to the high rate of evapo-transpiration, stress and low rainfall, mature faster, they usually remain with a less fruiting population (Eilu *et al.*, 2007). This is why woodlands are distinguished from all other terrestrial ecosystems by very low tree diversity at many levels (species, life forms, etc.). However, the biodiversity in the savannah woodlands generates a variety of good resources which help to sustain livelihoods of both local and urban communities (Kumar *et al.*, 2006).

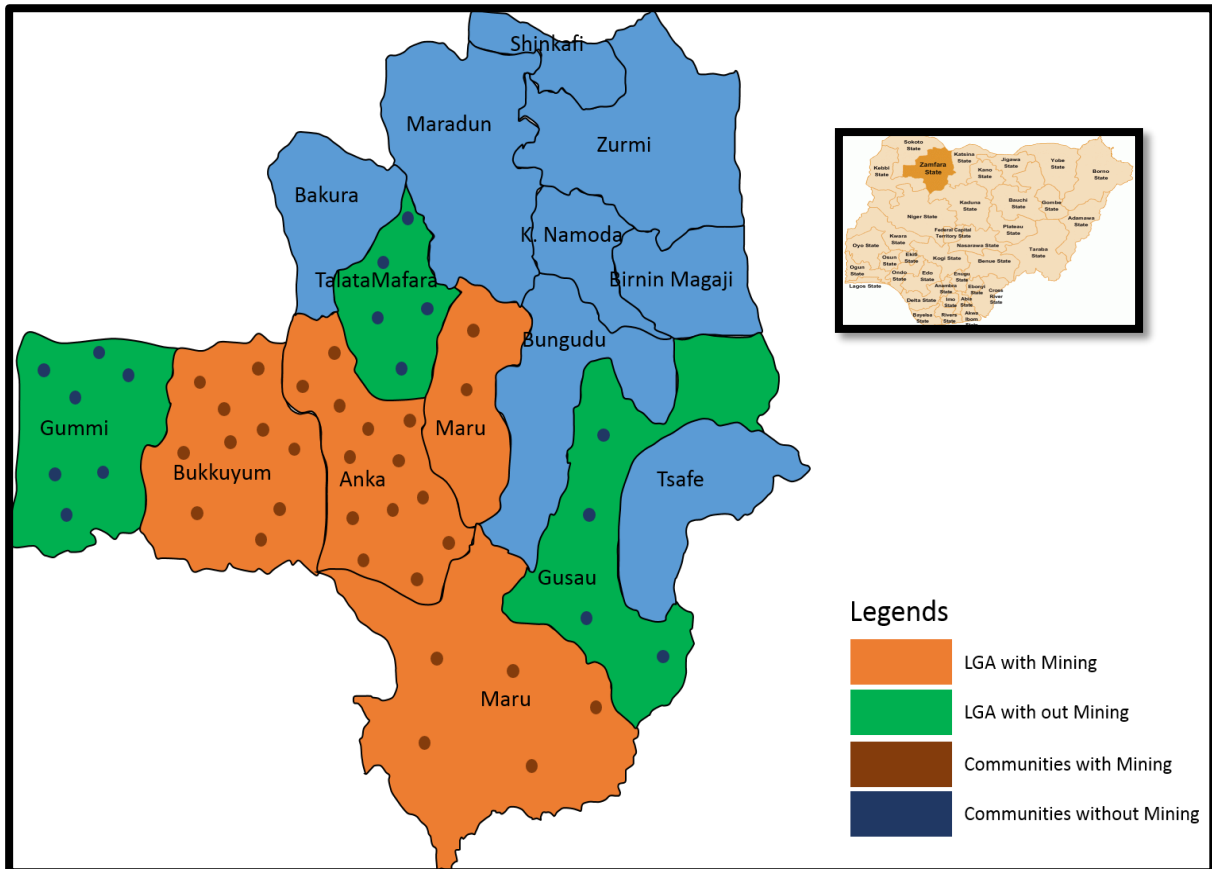
To enhance conservation processes, it is pertinent to train more people on savannah forestry and its biodiversity. Knowledge of the distribution and of the factors potentially undermining its maintenance is a critical step towards the adequate long-term in situ conservation of endangered endemic species (Ati *et al.*, 2010). More so, baseline raw data on the floral structure of woody trees in *Zamfara* state are not readily available, unpublished, scanty and where available difficult to access. This research work was conducted to ascertain the woody species composition, distribution and Important Value Index (IVI) in three Local Government Areas: *Anka*, *Bukkuyum* and *Maru* all of *Zamfara* state, Nigeria to create an important baseline data for present and future research works on impact of farming on biodiversity in *Zamfara* state and Nigeria as a whole.

## 2. MATERIALS AND METHODS

*Zamfara* state is a state in north western Nigeria. Its GPS coordinates are: Elevation: 1485.98 feet. 12°10'0" N, and 6°15'0" E. Its capital is Gusau. It is situated along Zaria and Sokoto federal government road (*Zamfara* Forestry Dept. 2015). It has a land mass of about 38, 418 square kilometres with a population of about 3,278,873. (NPC, 2006). It is surrounded in the south by *Kaduna* state, to the north by Niger Republic. In the west by *Sokoto* and *Niger* states and to the east by *Katsina* state (*Zamfara* Forestry Dept 2015.). The climatic condition of *Zamfara* state is tropically warm with temperature up to 38°C and above between March to May. The landscape of the state is generally undulating with few rocks here and there. This research work was conducted in *Anka*, *Bukkuyum* and *Maru* local government areas because of abundant deposit of mineral resources and mining related activities in the areas.

*Anka* local government area is located in the town of *Anka* as the council headquarter. It is located in the western part of *Zamfara* state. Restricted to the north by *Bakura*, *Talata Mafara* L.G.A to the east, by *Maru* L.G .A to the south and to the west by *Bukkuyum* L.G.A and *Sokoto* state. Its coordinates are 11°59'N, 6°02'E, with a total land area 2,864.20 km<sup>2</sup> (1, 060sq m) and a population of 143,637 (NPC, 2006). The study communities in *Anka* L.G.A are: *Abare*, *Bagega*, *Kwali*, *Tungan Daji*, *Kirsa*, *Dusa*, *Barayan Zaki*, *Malgalma*, *Kurukuru*, *Jarkuka*, *Dan Kamfani*, *Bawa Daji*, and *Sunke*, (13 No communities). This is because they once had cases of lead poisoning and recorded hundreds of casualties especially children. *Bukkuyum* is a local government area located in *Bukkuyum* town as the council headquarters. It is located in the north west of the state, with a land mass of about 3,350.01 Km<sup>2</sup>. It is restricted by *Anka* and *Gummi* L.G.As. Its coordinates are 12°00'N, 5°37'E, with a population of 216,348 (NPC, 2006).

The following mining communities were studied under Bukkuyum: *Dan-Gurumfa, Gaude, Yargalma, Kyaram, Dogon-Daji (mai-baka), Fura-Girke, Kairu, Godai, Kwali and Tungan-Guru* (10 No Communities). Maru local government area is located in the far north of the area. It has Maru town as the council headquarter. Its coordinates are  $11^{\circ}36'N$   $6^{\circ}17' E.$ , with a land mass of about  $6,921.86 \text{ Km}^2$  and a population of 291, 900 (NPC, 2006). The following communities in Maru were studied: *Malele, Dan-Jikko, Dukki, Tushe, Bindin, Zaman-Gira Tushe, and Kanoma central*. (8 No communities).



**Fig. 1:** Map of Zamfara State Showing the Study areas (Source: Field Survey 2019)

### Tree Species Composition, Distribution and Density in Mining Communities

This particular aspect of the study was restricted to the three local government areas with mining related activities: Anka, Bukkuyum and Maru. The rapid disappearance of vegetal cover through long term anthropogenic activities has endangered many tree species and vegetation communities in the forest. Today, many tree species have become extinct; many others are in short supply and at the verge of total extinction. Many economic trees with commercial, historical, medicinal, agricultural and environmental value have disappeared from the forest. It is against this backdrop that this paper assessed what is left of the vegetation communities as well as the tree species in the forest.

### Tree Species Sampling Frame and Techniques

The quadrat vegetation sampling method was used in this study. Fifty (50) quadrats of 50 m x 50 m size were used (Ati *et al.*, 2010). The choice of the size was to allow for optimum inclusion of species in the inventory due to the sparse nature of vegetation in the study areas. All the woody species in the quadrats were enumerated and identified on fields to species level using flora books and taxonomic keys (Blench and Dendo, 2007) and those that could not be identified were collected and kept for future identification.

Purposive sampling technique was adopted for this study, this was because of the insecurity situation in the study area and Zamfara state in general which is harboured by armed robbers and cattle rustlers in the state as at the time of data collection. As such, only areas that are safe and devoid of any insecurity threat were considered for the placement of the quadrats. Across the fifty (50) sampled quadrats in the study area only 23 tree species were identified, which are all indigenous. Quite a lot of tree species were destroyed by deforestation (Zamfara Forestry Dept. 2015)

### Data collection and Analysis

Data collection included identification of tree species and classification into families. Three aged men (botanists) assisted in tree identification. Trees identified were listed and classified. Species and family dominance were determined by the Importance Value Index (IVI) which is given as the sum of Relative Frequency (RF) + Relative Density (RD) + Relative Abundance (RA) (Savadogo *et al.*, 2007). While the dominant species was determined as the species with the highest IVI value, the dominant family was determined as the sum of IVI values of all the species belonging to a particular family (Demisse *et al.*, 2006). Diameters at breast height, tree total height were measured in each quadrat and other data generated from this study were rummage-sale to calculate Relative Frequency, Relative Density, Relative abundance and Importance Value Index (IVI) using:

IVI was given as:

$$RF \left( \frac{a}{b} \times 100 \right) + RD \left( \frac{c}{d} \times 100 \right) + RA \left( \frac{a}{q} \times 100 \right)$$

Where:

a=species frequency

b=sum of all species frequencies

c=number of individuals of a species

d= total number of individual's species

q= total quadrats in which the species occur

### 3. RESULTS AND DISCUSSION

In these communities, the floristic assembly of woody species revealed a wider variation (Table 1) with IVI values ranging from 48.07 to 7.99. Based on the IVI values, species *Azadirachta indica* (48.07), *Moringaceae* (24.44) and *Ziziphus mauritainia* (16.93) could be the most important elements of these communities in Zamfara State. This affirmed the work of (Dangulla, 2013), who reported that 67.2% of woody species in Zamfara State was made up of *Azadirachta indica*, *Balanites Aegyptiaca*, *Senna Sieberiana*, *Combretum micranthum*, *Guiera senegalensis*, *Mimosa pigra*, *Parkia biglobosa* and *Piliostigma reticulatum* with *Azadirachta indica*, *Gueira senegalensis*, *Mimosa pigma* and *Combretum macronthum* been the dominant woody species. However, Combreceae and Fabeceae families were found to have the highest the number of occurrences in the three study communities (Figure 1), which could be because of their regeneration ability, less economic value and their use to hinder mustering by livestock.

Alternatively, their abundance in the communities could indicate that they may be neither good as sources of fuel wood nor are they good as animal fodder, thus reducing human and animal pressures on these species. To support this, Eilu *et al.* (2007) had previously reported that the focal communities are selective in their plant exploitation. The dominant woody species were all shrubs therefore the species composition of the three focal communities could best be characterised by shrubs and woody trees being sufficiently spaced that the canopy does not close. The open canopy allows sufficient light to influence the ground to support the growth of shrubs and herbaceous plants. On the other hand, the other dominant species from the previous studies are threatened and require conservation effort. Although, the variability in the frequency and dominance of species in the study area may not be unconnected with the species level of malleability to the environment, their relative tolerance to disturbance, as well as water, nutrient and/or other environmental requirements as supported by (Dangulla, 2013).

**Table 1:** Woody Plant Species in the Mining Areas

S/No	FAMILY	SCIENTIFIC NAMES	COMMON NAME	HAUSA NAME
1.	<i>Anacardaceae</i>	<i>Lannea acida</i>	<i>Lannea</i>	<i>Faru</i>
2.	<i>Arecaceae</i>	<i>Borassus aethopium</i>	<i>Fan palm</i>	<i>Gigiya</i>
		<i>Hyapphaene thebaica</i>	<i>Dum palm</i>	<i>Goriba</i>
3.	<i>Bombaceae</i>	<i>Adansonia digitate</i>	<i>Boabab</i>	<i>Kuka</i>
4.	<i>Combretaceae</i>	<i>Anogeisus leicarpus</i>	<i>Axle wood</i>	<i>Marke</i>
		<i>Combretum micranthum</i>	<i>Combretum</i>	<i>Geza</i>
		<i>Combretum nigricans</i>	<i>Combretum</i>	<i>Tsiriri</i>
		<i>Guiera senegalensis</i>	<i>Moshi medicine</i>	<i>Sabara</i>
5.	<i>Convolvulaceae</i>	<i>Ipomea ascarifolia</i>	<i>Morning glory</i>	<i>Duman kada</i>
6.	<i>Ebanaceae</i>	<i>Diospyres mespiliformis</i>	<i>Ebonyi tree</i>	<i>Kaiwa</i>
7.	<i>Fabeceae</i>	<i>Acacia nilotica</i>	<i>Acacia</i>	<i>Bagaruwa</i>
		<i>Acacia senegalensis</i>	<i>Acacia</i>	<i>Farar kaya</i>
		<i>Bautinia rufescens</i>	<i>Bautinia</i>	<i>Jirga</i>
		<i>Cassia fistula</i>	<i>Golden shower</i>	<i>Malga</i>
		<i>Cassia singueceae</i>	<i>Winter cassia</i>	<i>Runfu</i>
		<i>Mimosa pigra</i>	<i>Sensitive plant</i>	<i>Gumbi</i>
		<i>Piliostigma thanningii</i>	<i>Camel's foot</i>	<i>Kalgo</i>
		<i>Tamarindus indica</i>	<i>Tamarin tree</i>	<i>Tsamiya</i>
8.	<i>Meliaceae</i>	<i>Meliaceae</i>	<i>Neem</i>	<i>Dogon Yaro</i>
9.	<i>Moringaceae</i>	<i>Moringaceae</i>	<i>Medicine tree</i>	<i>Zogale</i>
10.	<i>Myrtaceae</i>	<i>Psidium guajava</i>	<i>Guava</i>	<i>Gwaiba</i>
11.	<i>Rhamnaceae</i>	<i>Ziziphus mauritaina</i>	<i>Jujub tree</i>	<i>Magarya</i>
12.	<i>Zygphyllaceae</i>	<i>Balanites aegyptiaca</i>	<i>Desert date</i>	<i>Aduwa</i>
	12 Families	23 species		

According to (Dangulla, 2013), seeds of species such as *Guiera senegalensis*, *Combretum micranthum*, *Ficus vallis-choudae*, *Ximenia americana* and *Ziziphus abyssinica* become dormant when moisture levels are low to adapt to dry seasons. This is why plant ecologists in the Northern parts of Nigeria should be focusing on research on inter-annual variability in plants as well as soil seed bank studies. Similarly, *Acacia macrostachya*, *Lannea microcarpa*, *Acacia nilotica*, *Detarium microcarpum*, *Lannea microcarpa*, *Rogeria adenophylla* and a host of others shed their leaves to cope with the condition of moisture deficit. (Dalling *et al.*, 2002) stated that Zamfara State is known for grazing and overgrazing also influences biodiversity by

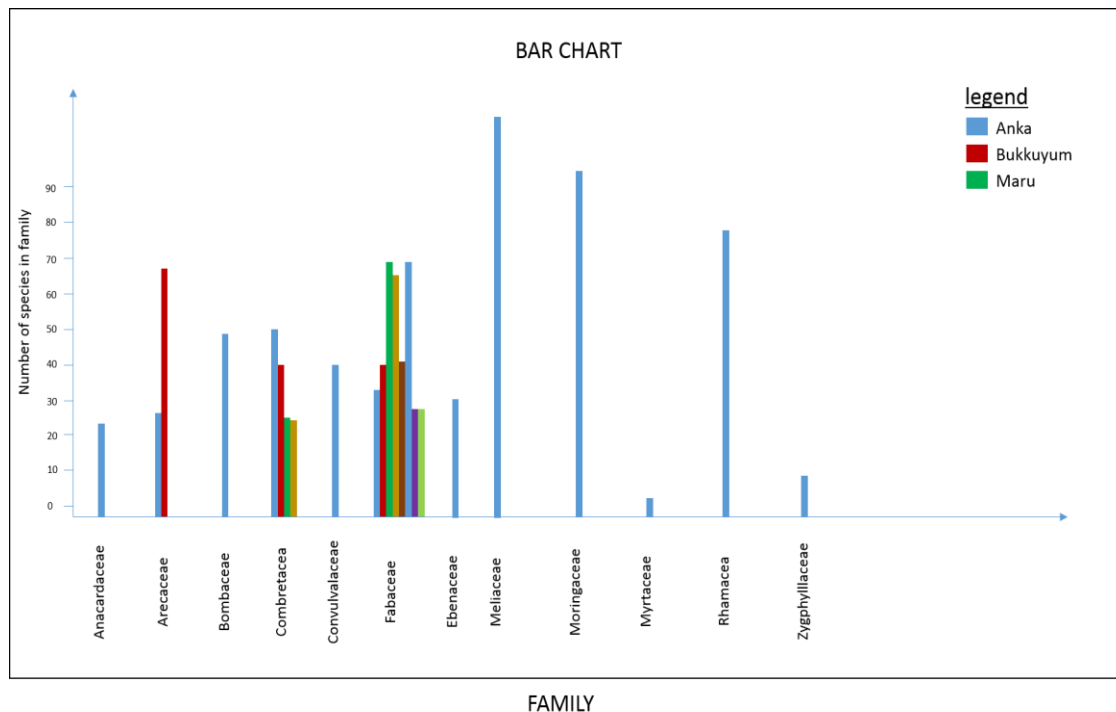


favouring unpalatable species, and affects tree size (Dangulla, 2013). Bush burning which is one of the characteristics of Savanna region and exploitation of woody species for medicinal purposes are also very important drivers of woody biodiversity loss (Tabuti et al., 2009). At the family level, the most frequent and dominant species were found in the family Fabaceae, as its species representatives were observed all sampled sites. Species in the family Fabaceae adapts to a broad range of climate and soil conditions, they tolerate extremely high drought (FACT net, 1997). The lowest relative frequencies *Psidium guajava* (15) and IVI (*Lannea acida* 7.99) were recorded.

**Table 2:** Relative Frequency, Relative Abundance, Relative Density, Important Value Index (IVI), of Plant Species in Zamfara State.

S/No	Species identified	Relative Frequency	Relative Abundance	Relative Density	IVI
1	<i>Acacia nilotica</i>	2.85	2.50	4.34	9.69
2	<i>Acacia senegalensis</i>	3.25	3.33	4.34	10.92
3	<i>Adansonia digitate</i>	1.87	2.88	4.34	9.09
4	<i>Balanites aegyptiaca</i>	2.20	1.93	4.34	8.47
5	<i>Bauhinia rufescens</i>	5.69	5.00	4.34	15.03
6	<i>Borassus aethopium</i>	5.53	4.53	4.34	14.40
7	<i>Cassia fistula</i>	5.69	5.08	4.34	15.11
8	<i>Cassia singueceae</i>	3.01	1.95	4.34	9.30
9	<i>Combretum micranthum</i>	3.25	2.86	4.34	10.45
10	<i>Combretum nigricans</i>	2.03	2.78	4.34	9.15
11	<i>Diospyres mespiliformis</i>	2.44	2.50	4.34	9.28
12	<i>Anogeisus leiocarpus</i>	4.07	2.94	4.34	11.35
13	<i>Gueira senegalensis</i>	1.95	2.67	4.34	8.96
14	<i>Hyaphaene thebaica</i>	3.98	3.50	4.34	11.82
15	<i>Ipomea ascarifolia</i>	3.25	2.22	4.34	9.81
16	<i>Lannea acida</i>	2.12	1.53	4.34	7.99
17	<i>Mimosa pigris</i>	5.69	3.04	4.34	13.07
18	<i>Azadirachta indica</i>	15.87	27.86	4.34	48.07
19	<i>Moringaceae</i>	12.21	7.89	4.34	24.44
20	<i>Psidium guajava</i>	1.22	2.50	4.34	8.06
21	<i>Piliostigma thanningii</i>	2.44	2.00	4.34	8.78
22	<i>Tamarindus indica</i>	2.44	2.72	4.34	9.50
23	<i>Ziziphus mauritainia</i>	6.92	5.67	4.34	16.93
Total		99.97	99.88	99.82	299.67

The families Meliaceae, Moringaceae and Rhamaceae shows the highest number of occurrence while Fabaceae shows the highest number of abundance (Figure1). The researcher found 1229 individual woody plants comprising of 23 different species in three L.G.As (Anka, Bukkuyum and Maru) (Table 1). The vegetation covers of Anka and Bukkuyum L.G.A s were characterised by savannah plant species as *Acacia* spp. *Azadirachta indica* and *Moringaceae* recorded the highest at various sampling points. A total of 485 trees and shrubs stands were counted at Maru L.G.A which belong to sampling site 1(80), site 2(50), site 3(85), site 4(70), site 5(30), site 6(60), site 7(90), site 8(20) were identified. Records of the vegetation cover in Maru L.G.A. shows that *Azadirachta indica* (Neem tree- Family *Meliaceae*) has the highest number (Figure1). Other major tree crops include Mango, Baobab, *Moringa Spp*, and Fan palm.



**Fig. 2:** Bar chart showing the distribution, abundance and composition of tree species in the study areas

#### 4. CONCLUSION AND RECOMMENDATIONS

The vegetation cover in the communities studied could best be described by the following tree types *Guiera senegalensis*, *Combretum macronthum*, *Piliostigma thonningii* complex. Farmers in these communities should be encouraged to establish woody species such as *Parkia biglobosa*, *Acacia spp.*, *Combretum spp.* and alternative exotic species such as *Eucalyptus spp.*, *Khaya senegalensis*, *Pinus spp.*, and *Grivellea spp.* as these species have high resilience and adaptability to stress and harsh climatic conditions. Woodlots and afforestation exercises cum introduction of exotic species should be presented and encouraged by rural inhabitants in collaboration with the three tiers of government. There is need for more research work on savannah wood land since the samples used for this work were not exhausted. The local communities should be encouraged to conserve the forest reserves and more scientists sponsored on more research work, especially on the trees that are threatened and vulnerable to extinction.

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