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Uses and Relative Abundance of Non-Timber Forest Plants in Farmlands of Selected Tiv Communities in Benue State, Nigeria

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Authors' contributions

This work was carried out in collaboration between all authors. Authors SSA and MR designed the study, wrote the protocol and wrote the first draft of the manuscript. Author UAU managed the literature searches, analyses of the study and performed the structural equation modeling and discuss the conclusion. All authors read and approved the final manuscript.

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ABSTRACT

Majority of the rural farmers in Nigeria supplement their livelihoods with goods and services within and around their farmlands. Non-Timber Forest Products (NTFPs) are harvested for their subsistence and commercial use and forms an inherent part of rural economy which helps them to meet both food and non-foods needs especially during periods of crop failure and famine. The present study was undertaken to identify and examine the uses and relative abundance of non-timber tree species in farmlands of selected Tiv communities of Benue State, Nigeria. Sample plots

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of 100 m x 100 m in selected farmlands were surveyed in each of the three randomly selected kindreds within each of the three Local Government Areas (LGAs) purposively selected for the study. In each farmland, five 10 m x 100 m grids were marked at 20 m intervals and every NTFP plant species encountered in each of the grids was identified by its local name, counted and recorded. Group interviews with farmers in the selected kindreds gave community-level knowledge on uses of the tree species within their farmlands. In Guma LGA, 21 tree species pertaining to 13 families were found predominated with Rubiaceae (38.5%) and followed by Mimosoideae (23.1%). *Acacia nilotica* and *Borassus aethiopum* were the most preferred species (14.1%) on the farms. Ten plant taxa of 9 families were identified and documented as plants allowed to grow with crop plants within farmlands in Gboko LGA. Five standing species were identified within the farms and *Parkia biglobosa* was the most abundant (33.3%) among the species due to its multiple benefits. In Kwande LGA, 9 species from different families were identified. Four (4) standing plant species were documented, with *Parkia biglobosa* being the most preferred (42.9%), followed by *Vitex doniana* (28.6%) among the standing species. Given the importance of the tree species on farmlands and their uses to farmers' well-being, ranging from use as food, medicines, crafts, local construction, shelter, soil improvement and stability, it is recommended that their conservation be prioritized using appropriate policies and programs to ensure their continued availability on the farmlands of the people.

Keywords: Non-timber forest products; farmlands; Tiv communities; relative abundance; parkland agroforestry.

1. INTRODUCTION

Plants provide food, medicine, construction material, artistic material, cosmetic, fuel wood, and remain an important source of income for the rural community [1-4]. In developing countries, wild foods gathered from the forest and other natural or modified landscapes especially in farmlands are vital in supplementing agricultural production by contributing to improved food availability and quality [1,2]. The farming systems in the Sahel which combine trees, crops and livestock reflect strategies developed by the farmers for generations to reduce their vulnerability to risks related to climate [5,6] and soil degradation. Parklands generally incorporate several agroforestry tree species and genera that constitute important sources of firewood, medicine, food and nutrition [7,8]. Parklands are generally understood as landscapes in which mature trees occur scattered in cultivated or recently fallowed fields [9]. Parklands occupy a vast land area, representing a large part of the agricultural landscape under subsistence farming in the tropics, constituting the predominant agroforestry system in semi-arid West Africa [10,11]. In Nigeria, many communities live on forest reserves from which they earn their living through taungya farming, hunting and fishing which contributes to their socio-economic lives [12].

Non- Timber Forest Products on the other hand refer to all products derived from biological resources found on forest land, other wooded land but not including timber or fuelwood [13,14]. [15] recognized NTFPs to include all biological materials other than timber extracted from wooded systems for livelihood benefits. These NTFPs are crucial especially in years of crop failure usually as a result of extreme climate events (droughts and floods), disease, pest outbreaks and other natural disasters [1,3,4]. [16] adds that NTFPs provide 'a safety net', a sort of green social security to billions of people in the form of low cost building materials, income, food supplements and traditional medicines. Trades in a wide range of NTFPs can improve household livelihood and economy that allows for the purchase of food for both dietary diversification and food shortage supplementation, which indirectly contributes to food security [17]. Increased consumption on NTFPs in times of stress can thus be viewed as an effective mechanism for dealing with threats to food security [1,18]. NTFPs have high economic and commercial value. In some cases, they even contribute to a country's export earnings, as in the case of rattan in Indonesia, *Vitellaria paradoxa* seeds (Shea tree), *Parkia biglobosa* (African locust tree) and *Irvingia* kernels across Central and West Africa [19,20]. It is estimated that close to one billion people in the world rely on some NTFPs for their livelihood [21,22,2]. Due to the free and open access to this great variety of biological resources, many Africans depend on them for their livelihood [23,24]. [25] identifies urbanization, agricultural growth, real

estate speculation and tourism as factors responsible for habitat destruction due mainly to human activities. In addition, native and rural inhabitants according to [26], depend directly on forest plants for some of their livelihood, increasing the pressure on plants. Anthropogenic activities can influence the availability of plants directly and/or indirectly by modifying their environment, especially their resource base –the soil [27]. Plant community composition and diversity changes rapidly upon tillage, and this is thought to create a relaxation of competition due to the elimination of dominant species, which takes time to re-establish [28,29]. Traditional knowledge on plants is a cumulative body of knowledge, know-how, practices and representations maintained and developed by aboriginal people with extended histories of interaction with their natural environment. According to [30], most of the traditional knowledge about plants and their uses is fast disappearing as a consequence of socio-economic and land use changes. [31] added that documentation of indigenous traditional knowledge (ITK) and practices is very important for future critical studies leading to sustainable utilization of the resources. This study therefore, focused on the identification of wild plant species allowed to grow on farmlands of selected farmers, their growth forms, documentation of their utility patterns and the relative abundance of the plant species within the ethnic territory of the Tiv communities in Benue State.

2. METHODOLOGY

2.1 Study Area

Benue state is located in the derived/guinea savannah region in North-Central Nigeria. It lies between latitudes 6° 25'N to 8° 8'S and longitudes 6° 25'N to 10℄E. The wet or rainy season begins in April and ends in October with total annual rainfall ranging between 1,200 - 1,800mm while the dry season starts in November and ends in March [32,33]. According to [34], temperatures are constantly high, averaging between 28-32℃ and sometimes rising to 37℃. The vegetation varies from the South to the North and comprises of forests (mostly riparian forests along rivers and streams) and relics of the rainforest in the South and scattered trees in grasslands in the North. The State is made up of 23 local Government Areas (LGAs), out of which the Tiv ethnic group occupies 14. Three (3) LGAs (comprising Gboko, Guma, and Kwande) within the Tiv ethnic territory were purposely selected for the study (Fig. 1) to reflect the tree vegetation stratification and the major sub-ethnic groups or kindreds of the Tiv people in Benue state as shown in Table 1.

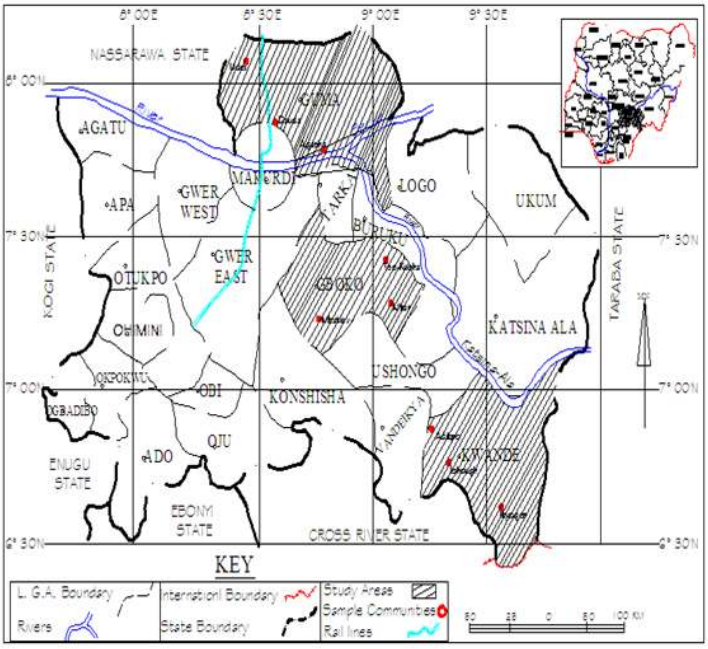

Fig. 1. Map of study area showing study LGAs and communities

Table 1. Selection of kindreds within selected LGAs of Benue state

LGA	Sub-ethnic group	Number of kindreds	Selected kindreds	Major vegetation characteristics
Guma	Minda	Nongov Nyiev Mbawa Mbagwen	Nongov Nyiev Mbawa	Scattered trees within grasslands (Benue North)
Gboko	Jemgbah	Ipav Mbatiav Mbayion Mbatyerev	Ipav Mbatiav Mbayion	Scattered trees within grasslands and hills (Benue Central)
Kwande	Jechira	Shangev-ya Turan Ikyurav Nanev	Shangev-ya Turan Ikyurav	Relics of the rainforest within rangelands and undulating hills (Benue South)

2.2 Sampling Technique

A multi-stage sampling technique was employed for the study. The first stage involved purposive selection of the three Local Government Areas (LGAs), identified for their vegetation stratification which represents a mix of guinea savannah in Benue North (Guma LGA), relics of the rainforest in Benue South (Kwande LGA) and Gboko LGA in Benue Central region. In the second stage, three farmlands of 1 hectare each were randomly selected from three (3) kindreds, randomly selected from each LGA, representing 60% of kindreds in the selected Local Government Areas (LGAs). The one-hectare plots were marked out by measuring 100 m x 100 m, with one side serving as a baseline from which perpendicular sampling lines were marked. Five 10 m x 100 m grids were marked at 20 m intervals from the baseline and every NTFP plant species encountered in each of the grids was identified by its local name, counted and recorded [35]. In each farmland selected, all the standing trees and stumped but not uprooted trees species were identified, counted and recorded, between January – August, 2011. The relative abundance of each NTFP species was obtained [36] as follows;

Relative abundance = (Number of each species / Total number of species) x 100

The Simpson's diversity index (*D*) was used to characterize species diversity in each of the LGAs and was calculated [37].

$$\text{Simpson's index (D)} = \frac{\sum n(n-1)}{N(N-1)}$$

Where,

n= total number of plants of a particular species.
N= Total number of individual plants of all species.

With this index, 0 represents infinite diversity and 1, no diversity.

Group Interviews were conducted with farmers in each sub-tribe to elicit community level knowledge on the importance/uses of the tree plants in their farmlands (Plate1). Group interviews were convened using local methods of convening meetings within the kindreds. Each group interview engaged as many farmers who honoured the call, made up of men and women from clans within the kindred. A collection of vital parts (branches with leaves, fruits and flowers etc) of plants found on farmlands surveyed was brought to the interview where the farmers identified each of the plants by providing their local names and also giving the use(s) of each of the plants. Responses on plant uses were probed for further information where necessary using SAS2 tools on facilitation skills for social learning and collaborative enquiry [38]. In each community Group Interview, the purpose of the study was clearly explained and a verbal Prior Informed Consent (PIC) obtained before the commencement of discussions with each of the sub-tribes or kindreds [39,40,41]. The Group Interviews were carried out in a friendly and participatory manner to enable participants feel free and safe to respond to questions on the plants. Each interview lasted for about two hours in the local language, tape recorded and transcribed for analysis and reflection. At the end of each interview, the results were validated by

reading the information obtained and allowing the people agree that those were their views on each of the plants. Furthermore, the tree species were identified from their local names using the guide provided [42] and botanical information on each of the plant species was obtained with the aid of standard texts [43-45] and support from virtual plant identification platforms especially Angiosperm Phylogeny Group (APG).

Plate 1. A group interview in Mbawa community of Guma Local Government Area

3. RESULTS AND DISCUSSION

3.1 Results

3.1.1 Relative abundance and uses of wild Plants species in farmlands of farmers in Guma LGA

In Guma LGA, 21 tree species in 13 families were found in farmlands with Rubiaceae having 38.5% of the species, followed by Mimosoideae (23.1%). *Acacia nilotica* (L.) Delile and *Borassus aethiopum* Mart. were the most preferred species (14.1%) with low abundance which supported better tree-crop combination on the farms (Table 2). *Prosopis africana* (Guill. & Perr.) Taub. had the highest number of benefits ranging from food as a condiment, local construction especially culverts and bridges, crafts (especially mortar and pestle making), medicine, shelter and fish poisoning. *Borassus aethiopum* and *Acacia nilotica* were the most abundant (13%) among standing plants within the farmlands. *Borassus aethiopum* was preferred perhaps due to its palm-like, fan-shaped petiolate leaves [44] and its uses as edible plantlets valued as an economic vegetable, sap as palm wine, timber for local construction and fronds for craft making. *Acacia nilotica* could be preferred due to its spiny straight boles with crowns allowing for good penetration of sunlight, its seeds used as condiment, boles as hole handles and soil improvement. This practice corroborates [3] that tree species with high economic value are retained in farmlands.

Among tree species allowed to grow but pruned regularly, the most abundant were *Mytragyna inermis* (Wild.) Kuntze (with a relative abundance of 11 plants), followed by *Piliostigma thonningii* (Schum.) Milne-Redh.and *Stereospermum kunthianum* Cham. with 8 plants each. The stumped plants on the farm provided soil stability through root anchorage; enhanced soil fertility by the decay and decomposition of leaf litter through pruning with some plants parts used for medicinal purposes.

3.1.2 Relative abundance and uses of wild Plants species in farmlands of farmers in Gboko LGA

Ten plant taxa of 9 families were identified and documented as tree plants allowed to grow with crop plants within farmlands in Gboko LGA (Table 3). Fabaceae had 20% of total plant species identified while the remaining families had 10% each. Five (5) standing species were identified within the farms and *Parkia biglobosa* was the most abundant (33.3%) among the species, due to its multiple benefits ranging from food as a highly sought condiment, surrogate to exotic spices, local construction, crafts, medicine, farm shelter and fish poisoning. Eight (8) species of stumped plants were documented with *Ficus sur* and *Daniellia oliveri* being more abundant with a percentage frequency of 20% each. *Daniellia oliveri* is prolific in germination and this might be the reason for the more number of seedlings in the farms as seed fall is annual and dehiscent, preferred in farms as stumped due to its height (15-25 m) with a spreading relatively dense inverse coned-shaped crown often branching low down [46]. [47] noted that the richness of NTFPs can be used as an opportunity to device alternative strategies for the sustainable management of the plants.

3.1.3 Relative abundance and uses of wild Plants species in farmlands of farmers in Kwande LGA

In Kwande LGA, 9 species from different families were identified. Four (4) standing plant species were noted, with *Parkia biglobosa* being the most preferred (42.9%), followed by *Vitex doniana* (28.6%) as shown in Table 4. However, the decision of the rural farmers to leave stands of *Parkia biglobosa* and *Vitex doniana* to stand

could be due to their reported food and medicinal values, agreeing with the findings of [44] that both tree species are highly valued for their food, medicinal, raw materials and contributions to rural economy in Savannah regions of West Africa. Nine (9) species of stumped plants were documented with *Daniellia oliveri* (34%) and *Vitex doniana* (24%) most dominant while *Terminalia avicenniodes, Khaya senegalensis* [Desr.] A. Juss. and *Antidesma venosum* E. Mey ex Tul. were the least abundant (5.3%).

3.2 Discussion

A total of 90 plant species were encountered in Guma, 16 in Gboko and 60 in Kwande LGAs (Fig. 2), made up of standing and stumped tree plants. In all the LGAs, Guma farmers retained more standing tree species (23) compared to Gboko (6) and Kwande (7), this may be due to farming practices passed down to the present generation in the sub-tribe (Fig. 3). Generally, standing tree species with multiple benefits were preferred on farmlands across the study area, giving an indication that current value of plants was one of the reasons for allowing tree plants to grow to maturity on farms. Standing tree species like *Parkia biglobosa* with multiple uses was most abundant in Gboko (33.3%), Kwande (42.6%) and was among the abundant in Guma (8.7%). *Borassus aethiopum* (13%) and *Acacia nilotica* (13%) were the most preferred standing trees in Guma, while *Parkia biglobosa* was most preferred in Gboko (33.3%) and Kwande (42.6%) along with *Vitex doniana* (28.6%) with each having multiple benefits for the farmers. *Prosopis africana* and *Parkia biglobosa* were utilized for food as condiment, local construction, medicine, shelter and fish poisoning as collaborated by [48] that *Prosopis africana* is used in Nigeria for food, medicine and as inputs in rural industries. [49] confirmed that all parts of *Prosopis africana* has been utilized as medicine and also for fish poisoning, erosion control, shade or shelter, nitrogen fixation and ornamental purposes. The source noted that it also serves as a good species for intercropping with great potential for parkland agroforestry systems and improved agroforestry technologies in the Sahel, where it grows well in valleys and rocky soils. Some of the standing trees such as *Prosopis africana* and *Parkia biglobosa* have also been noted for nitrogen fixation, enriching the soil [44].

The practice of allowing stumps of living plants within croplands was observed more in Guma LGA (67 stumps), followed by Kwande LGA (53) and least in Gboko LGA (10) as shown in Fig. 3. The stumped plants pruned at every weeding reduced competition with crop plants for light, space and enhanced soil cover and nutrition through decay and decomposition of the organic materials. According to [50,51] pruning as a management tool has also been successful in increasing cereal yields in agroforestry parklands. Root systems of the living stumps supported soil stability through root anchorage. The Simpson's Diversity Index indicated that the plant species in the farmlands in Guma (0.9), Gboko (0.9) and Kwande (0.8) were less diverse. This is expected of trees in farmlands as a diverse population would inhibit crop growth and development, leading to losses in yield. Plants listed in the study area were not endemic to Benue State but have also been reported within the country [42,43,45] and West Africa [44].

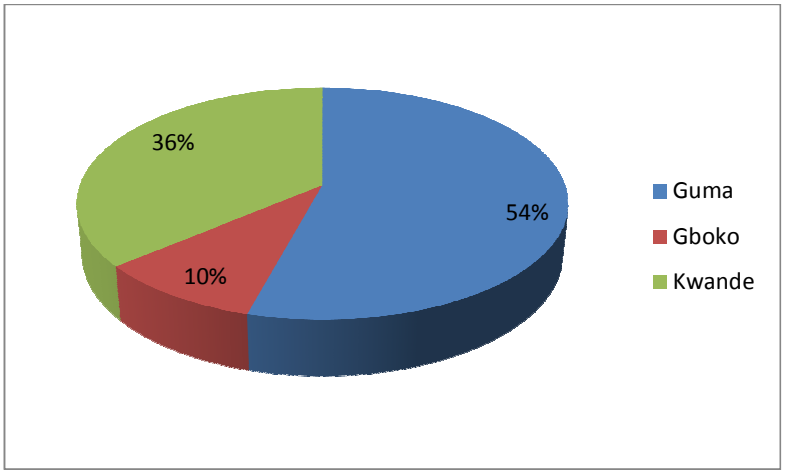

Fig. 2. Total number of plants encountered in the study area

Table 2. Relative abundance and uses of wild tree species in farmlands of farmers in Guma LGA

S/No	Botanical name	Family	Local name (Tiv)	Average number of species				Total	(%)	Utility pattern
				Standing	(%)	Stumped	(%)			
1	*Acacia nilotica* (L.) Delile	Mimosoideae	Saa anula	3	13.0	-	-	3	3.3	1,4,8
2	*Annona senegalensis* Pers.	Annonaceae	Ahur	-	-	1	1.5	1	1.1	1,3
3	*Borassus aethiopum* Mart.	Arecaceae	Kuugh	3	13.0	7	10.4	11	12.2	1,2,3
4	*Bridelia ferruginea* Benth.	Euphorbiaceae	Kpine	-	-	7	10.4	8	8.9	1
5	*Crossopteryx febrifuga* (Afzel. ex G. Don) Benth.	Rubiaceae	Iikwar	1	4.3	-	-	1	1.1	-
6	*Daniellia oliveri* (Rolfe) Hutch. & Dalziel	Caesalpinaceae	Chiha	2	8.7	-	-	2	1.7	1,2,3,5
7	*Ficus sur* Forssk.	Moraceae	Tur	1	4.3	2	3	3	3.3	1,2,3
8	*Flueggea virosa* (Roxb. ex Willd.) Voigt	Euphorbiaceae	Yareghagum	-	-	7	10.4	7	7	2,3,7
9	*Gardenia erubescens* Stapf & Hutch.	Rubiaceae	Shoondugh	1	4.3	-	-	1	1.1	1
10	*Maranthes polyandra* (Benth.) Prance	Chrysobalanaceae	Ibua	1	4.3	-	-	1	1.1	-
11	*Mitragyna inermis* (Willd.) Kuntze	Rubiaceae	Sohonor	-	-	11	16.4	11	12.2	2
12	*Parkia biglobosa* (Jacq.) G.Don	Mimosoideae	Nune	2	8.7	-	-	2	1.7	1,2,3, 5,6,8
13	*Piliostigma thonningii* (Schum.) Milne-Redh.	Caesalpinoideae	Nyihar	-	-	8	11.9	8	8.9	3,4
14	*Prosopis africana* (Guill. & Perr.) Taub.	Mimosoideae	Gbaaye	1	4.3	-	-	1	1.1	1,2,3, 4,5,6,8
15	*Sarcocephalus latifolius* (Sm.) E.A.Bruce	Rubiaceae	Ikyura-ukase	2	8.7	6	9.0	9	10	1,4
16	*Sterculia setigera* Del.	Sterculiaceae	Kumendur	-	-	1	1.5	1	1.1	-
17	*Stereospermum kunthianum* Cham.	Bignoniaceae	Umanatumba	2	8.7	8	11.9	11	12.2	3
18	*Strychnos spinosa* Lam.	Loganiaceae	Maku	1	4.3	-	-	1	1.1	1,7
19	*Terminalia avicennioides* Guill. & Perr.	Combretaceae	Kwegh	-	-	7	10.4	8	8.9	3,4
20	*Vitellaria paradoxa* C.F.Gaertn.	Sapotaceae	Chamegh	1	4.3	2	3	3	3.3	1,2,3,5
21	*Vitex doniana* Sweet	Verbenaceae	Hulugh	2	8.7	-	-	2	2.2	1,4
Total				**23**	**100**	**67**	**100**	**90**	**100**	**-**

1-food and food additives, 2- local construction, 3- medicine, 4-crafts 5-shelter, 6-poison, 7-social purposes, 8-soil improvement

Table 3. Relative abundance and uses of wild tree species in farmlands of farmers in Gboko LGA

S/No	Botanical name	Family	Local name (Tiv)	Average number of species				Total	(%)	Utility pattern
				Standing	(%)	Stumped	(%)			
1	*Daniellia oliveri*	Caesalpinoideae	Chiha	1	16.7	2	20	3	18.8	1,3
2	*Ficus sur*	Moraceae	Tur	-	-	2	20	2	12.5	1,3
3	*Lonchocarpus laxiflorus* Guill. & Perr	Fabaceae	Konjor	-	-	1	10	1	6.3	-
4	*Maranthes polyandra*	Chrysobalanaceae	Ibua	1	16.7	-	-	1	6.3	-
5	*Parkia biglobosa*	Mimosoideae	Nune	2	33.3	1	10	3	18.8	1,2,3,5, 6,7
6	*Pericopsis laxiflora* (Baker) Meeuwen	Fabaceae	Giragba	1	16.7	-	-	1	6.3	-
7	*Sterculia setigera*	Sterculiaceae	Kumendur	-	-	1	10	1	6.3	4
8	*Stereospermum kunthianum*	Bignoniaceae	Umanatumba	-	-	1	10	1	6.3	4
9	*Syzygium guineense* (Willd.) DC.	Myrtaceae	Daanyam	-	-	1	10	1	6.3	1,2
10	*Terminalia avicennioides*	Combretaceae	Kwegh	1	16.7	1	10	2	12.5	-
Total				**6**	**100**	**10**	**100**	**16**	**100**	-

1-food and food additives, 2- local construction, 3- medicine, 4-crafts 5-shelter, 6-poison, 7-soil improvement

Table 4. Relative abundance and uses of wild tree species in farmlands of farmers in Kwande LGA

S/No	Botanical name	Family	Local name (Tiv)	Average number of species				Total	(%)	Utility pattern
				Standing	(%)	Stumped	(%)			
1	*Anona senegalensis*	Annonaceae	Ahur	-	-	5	9.4	5	8.3	1,3,4
2	*Antidesma venosum*	Euphorbiaceae	Baver-kpua	-	-	3	5.7	3	5	-
3	*Daniella oliveri*	Caesalpinoideae	Chiha	-	-	17	32.1	17	28.3	4,5
4	*Ficus sur*	Miraceae	Tur	1	14.3	3	5.7	4	6.7	1,3
5	*Khaya senegalensis*	Meliaceae	Har	-	-	3	5.7	3	5	1,3,4
6	*Maranthes polyandra*	Chrysobalanaceae	Ibua	-	-	5	9.4	5	8.3	1
7	*Parkia biglobosa*	Mimosoideae	Nune	3	42.6	3	5.7	6	10	1,3,4, 6,5, 7
8	*Terminalia avicenniodes*	Combretacceae	Kwegh	1	14.3	2	3.8	3	5	4
9	*Syzygium guineense*	Myrtaceae	Daanyam	-	-	1	10	1	6.3	1,2
10	*Vitex doniana*	Verbenaceae	Hulugh	2	28.6	12	22.6	14	23.3	1,2,3
Total				**7**	**100**	**53**	**100**	**60**	**100**	-

1-food and food additives, 2- local construction, 3- medicine, 4-crafts 5-shelter, 6-poison, 7-soil improvement

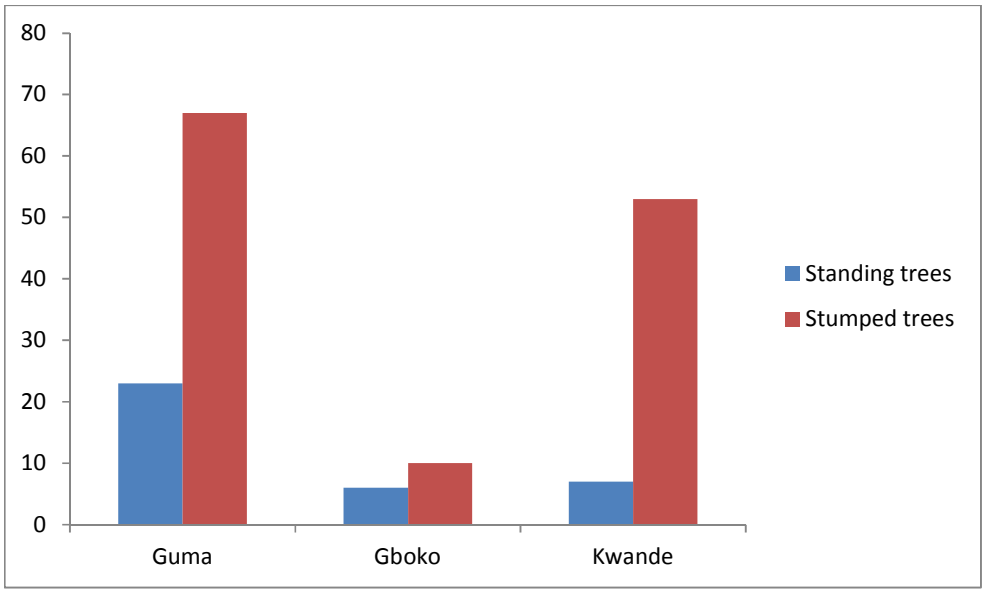

Fig. 3. Number of standing and stumped trees in the study area

4. CONCLUSION

Plants in farmlands of the Tiv people were used as food and food additives, for local construction and as sources of traditional medicine. The plants were also used as crafts, shade/shelter, poisons, for social purposes, soil improvement and stability. The standing trees in the farmlands were less diverse, a feature of parkland agroforestry which supports crop growth and improved yields. The stumped plants were more abundant compared to trees allowed to grow to maturity because they occupied less space with minimal shade cast on the growing crops within the farms. The stumped plants pruned during every weeding reduced competition with crop plants for sunlight, minerals and space while the pruned material added organic matter to the soil and improved soil structure. The stumped plants also supported soil anchorage and reduced erosion. This farming practice regarded as parkland agroforestry has proved to be better than clear felling of all trees and shrubs for crop cultivation purposes, common with mechanized farming which may facilitate vulnerability of farmlands to soil and wind erosion. Given the importance of these tree species on farmlands and their uses to the farmers, it is recommended that their regeneration and conservation be prioritized using appropriate policies and programs to ensure their continued availability for improved livelihoods, environmental amelioration and sustainability.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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