EFFECTS OF MODERN YAM FARMING ON TREE SPECIES CONSERVATION IN BENUE STATE NIGERIA

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(Received 02nd May 2024; Revised 29th July 2024; accepted 06th August 2024)

Abstract. Effects of modern yam farming system on tree species abundance and conservation status was studied in Ukum Local Government Area (LGA), Nigeria. Data were obtained through the use of semi structured questionnaire and woody species field survey using purposive and simple random sampling methods. Five (5) districts out of thirteen (13) were randomly selected using a sampling intensity of 40%. A total of 250 respondents (50 per district) who practice the modern system of yam farming were randomly sampled for the study. A total of ten (10) rectangular sampling plots of (100x100) m (1 ha) was established at random in the study (two plots per district), all the individual trees with ≥10 cm DBH existing within the plots were identified and counted. Data were analyzed using quantitative parameters (IUCN red list of threatened species) and qualitative tools (tables, percentages, frequency and ANOVA) through SPSS version 20 software. Results of the study revealed that majority of the respondents were male (76.40%), married (78.00) and middle-aged farmers who are active and energetic in carrying out farming practices such as pruning, lopping, clear cutting, site preparation. The result indicated that majority of farmers (90.40%) harvest wood from natural forests (62.40%) and plantations (32.40%) for yam staking using unsustainable method of destroying the whole plant. This practice decreases the availability of tree resources at high rate (67.60%). A total of 43 species representing 23 families was encountered with Vitex donniana having the highest number of trees (12.53%). Majority of the tree species (91.00%) were found as Least Concern in the study area. The ANOVA results showed significant difference, implying that yam cultivation has produced a significant effect on tree species abundance in the study area. This suggests the use of alternative stakes and the implementation of conservation policies and agroforestry practices in the study area.
Keywords: *wooden stake, yam, conservation, sustainable management, tree species*

Introduction

Yam (Dioscorea spp.) is an important and major Dioscoreaceae vine plants grown in various parts of Ukum local government area (LGA) of Benue State, Nigeria. The modern yam farming system in Ukum LGA has made great strides recently, hence the

nickname the food basket of Benue state. Nigeria is the largest producer of yam in the world, followed by Ghana, Côte DIvoire, Benin, Togo, and Cameroon (FAO, 2013). Yam is the fifth most harvested crop in Nigeria. After cassava, yam is the most commonly harvested tuber crop in the country (NBS, 2012). West Africa produced 62 million tons of tubers (91% of world production) in 2014 (Frossard et al., 2017). Until now the increased tuber demand was achieved by enlarging cultivated surfaces from 0.9 million ha in 1961 to 7.0 million ha in 2014 (Frossard et al., 2017). The yam belt of West Africa spans from the humid forest where yam is cultivated for food security to the northern Guinean savanna where yam is also cultivated as a cash crop (Asiedu and Sartie, 2010).

Yam was traditionally planted as the first crop, after a long-term fallow due the high demand (Carsky et al., 2010). The efficiency of staking in yam production was well known, but because of the amount of work involved it was not well pronounced in the traditional system. Experiments (Frossard et al., 2017; Bassey and Akpan, 2015) have shown that Dioscorea species cultivars respond best to staking and that the operation proves relatively more efficient with modern farming system. In practice, these results have two implications: (1) Speeding the growth of tubers, staking can be used to correct the consequences of less favourable fertility conditions. (2) Speeding the development of shoot growth thereby, increasing yam production. However, sometimes yam farming can be carried out without staking. In areas where land is scarce, farmers grow yam after only a year of fallow or without fallow (Frossard et al., 2017; Maliki et al., 2012). The increasing human population, land scarcity and technology advancement are the major factors that influenced the replacement of traditional methods (including shifting cultivation, peasant, fallowing, primitive farming, etc) from the highly modern methods of yam farming (continuous or sedentary farming, capitalistic farming, corporate farming, diversify farming and specialized farming) that were characterized by many technical problems. The negative effect of modern yam farming system is the reduction of tree species density due to increase in size of mound (heap) which results to increase in use of stakes. The reduction in plant density is usually aggravated by increasing the area cultivated and other human disturbances.

Boyle (2024) reported that Upwards of 50,000 acres of trees are cleared by farmers per day worldwide. Clear cutting is a highly invasive method of tree removal that destroys all trees and seed sources from an area. This method of destruction is common in yam cultivation because of the need to expand croplands and increase yield. The destruction of tree species (which are the bedrock of ecological communities) threatens tree species abundance thereby, decreasing carbon absorption that in turn results in amplification of greenhouse gases, disruption of water cycles, increased soil erosion, and excessive flooding (Boyle, 2024). Over the years, human activities such as farming, logging, fuelwood collection, charcoal production and infrastructural development have resulted in reduction of tree species in both forest and savanna ecosystems (Omoro et al., 2010). This has impacted negatively on abundance, indigenous knowledge of tree species and their conservation (Ogwu et al., 2016). The conservation status of organism indicates current status of such organism which depends upon many factors like agriculture and other known threats (Khan et al., 2013). Quantitative floristic inventories are fundamental to an understanding of the ecology of tropical vegetation and for developing management strategies (Sudhakar Reddy et al., 2011). Therefore, the study aimed at assessing the effects of modern yam farming system on tree species abundance and conservation status in the study area.

Materials and Methods

Description of the study area

Ukum Local Government area is well known as the food basket of Benue State, Nigeria. It was created in September 1999. The local government lies between latitude 6°30' to 7°30' North and longitude 9°30' to 9°10' east. The local government is located in the east north of Benue State, Nigeria and shares its north and east boundaries with Nassarawa and Taraba States respectively. It is also bordered on the south-east by Katsina-Ala local government area and south-west by Logo local government area (*Figure 1*). The local government is made up of thirteen Districts (Council Wards) with a land mass of 42910 km^2. The local government area is characterized by two (2) seasons, warm-wet and cold-dry seasons. The warm-wet season lasts from April to October while the dry season begins from November and ends in March. The annual rainfall ranges from 1200 mm to 1500 mm. The temperature is generally high ranging from 22 °C to 30 °C in rainy season. The hottest period occurs from March to April just before the rains start when the temperature rises above 33 °C (Ikyaagba et al., 2014).

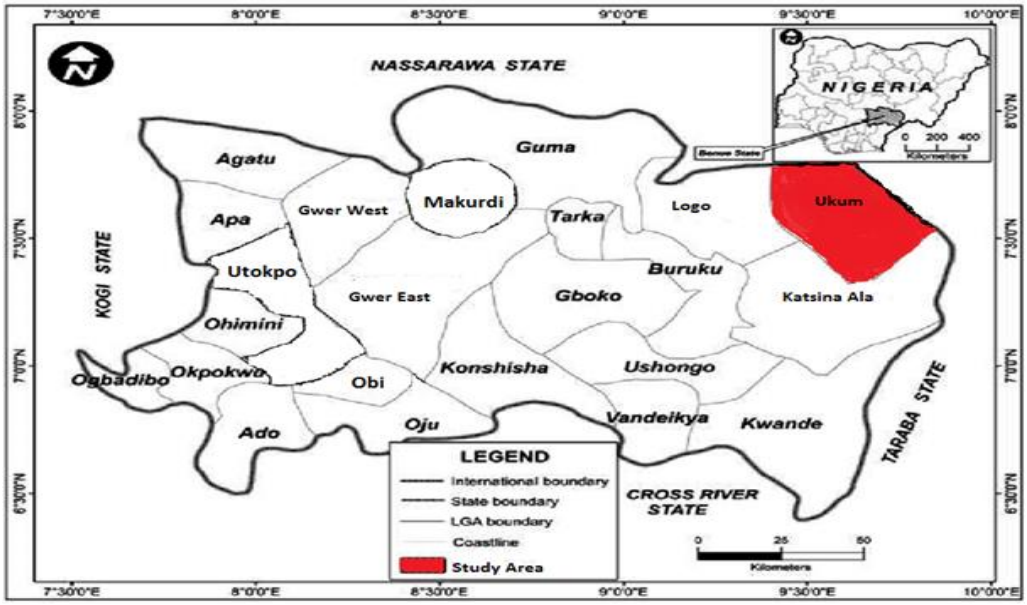

Figure 1. *Map of Benue State showing the study area.*

According to National Population Census (NPC, 2013), the population of Ukum local government area was estimated to be 216930 with a projection of 569094 in 2011. The major occupation of the people of Ukum local government area is agriculture. Cash crops produced in the area include Groundnut, Maize, Rice, Black-eyed beans, Pepper and Soya bean. Crops like Yam, Cassava, Potatoes, Millet and Sorghum are produced in commercial quantity. Tree crops cultivated in the study area include Mango, Orange, Cashew, Guava among others. In addition, Cattle, Sheep, Goats and Swine are reared for commercial purpose. Similarly, the people undertake other livestock production activities such as poultry and fish farming in fairly large scale (Ikyaagba et al., 2014). The study area is made up floodplain which is undulating lowland of the eastern plains. It is drained by rivers Anikya, Bar, Afia, Lafa, Te, Ututu and Unguragya which are seasonal rivers. The soil is fertile, well drained and sand-loamy with some clay.

Data collection & data analysis

The study was conducted using purposive sampling method where semi structured questionnaire was administered to key respondents who were anticipated to have a particular insight or opinion about the subject under investigation. Five (5) districts (council wards) out of the existing thirteen (13) districts were randomly selected using a sampling intensity of 40% of the total number of districts. The randomly selected districts include Kundav, Lumbur, Mbayenge, Mbazum and Tsav districts. Fifty (50) respondents were randomly selected from each district giving a total of 250 respondents who practiced the modern system of yam farming in the study area. The administration of questionnaire was carried out using Snowball sampling methods as described by Agbelade et al. (2017). The abundance and conservation status of tree species in the study area were assessed through simple random sampling technique. Two (2) rectangular plots of 100 m x 100 m (1 ha) in size were established at random in each district (council ward) giving a total of ten (10) plots sampled in the study area. All the individual trees having ≥10 cm DBH were identified and counted. The number and scientific names of all the tree species encountered in each plot were recorded. When it was difficult to identify the species in the field, the common/local name were recorded, and plant specimens were collected for identification at the Department of Forestry Technology herbarium, Akperan Orshi College of Agriculture Yandev, Gboko, Nigeria.

Data were presented using quantitative parameters and descriptive statistics such as Tables, Percentages and Frequency. The abundance and conservation status of all the tree species of the study area were checked and confirmed on International Union for Conservation of Nature (IUCN) red list of threatened species version 2021-1 (IUCN, 2021). All the recorded trees were represented by 9 conservation categories, viz. Data Deficient (DD), Least Concern (LC), Not Evaluated (NE), Near Threatened (NT), Vulnerable (VU), Endangered (EN), Critically Endangered (CR), Extinction in the wild (EW) and Extinction (EX) (Britannica Web Portal, 2019; IUCN, 2001). Data obtained from respondents were subjected to ANOVA using SPSS version 20 software to test for the significant difference of the effect of modern yam farming system on trees species abundance and conservation status.

Results and Discussion

The result of the demographic characteristics of respondents in Table 1 showed that 76.40% of the respondents were male while 23.60% were female. Majority (69.20%) of the respondents were between the age group of 35-49 years, followed by the age group of 20-34 years (37.60%). The educational level of the respondents revealed that majority (34.80%) had primary school education, 24.00% and 9.20% had secondary and tertiary education respectively, while 32.00% were illiterate. Result of marital status indicated that 78.00% of the farmers were married while 22.00% of them were single. *Table 1* finally indicates that 78.00% of the respondents were farmers who identified themselves in the course of the interview as yam cultivating farmers while 24.00% were business people who trade yam produce. Furthermore, 24.00% goes to civil servants who adopt yam farming as their secondary occupation. The majority of the population in the study area was male, married and middle-aged farmers who are active and energetic in carrying out farming practices such as pruning, lopping, clear cutting, site preparation, etc. They also have little or no formal education and depend solely on farming occupation as the only source of income. This implies that the conservation of

tree species will definitely become a huge challenge in view of the indiscriminate exploitation of trees and expansion of agricultural land areas. This agreed with Dudley and Alexander (2017) report which confirmed that agriculture is the largest contributor to biodiversity loss with expanding impacts due to changing consumption patterns and growing populations.

Table 1. *Demographic characteristics of respondents.*

Variable	Frequency (N=250)	Percentage (%)
Gender		
Male	191	76.40
Female	59	23.60
Age Group		
20-34 years	94	37.60
35-49 years	123	49.20
50 years and above	33	13.20
Education		
Primary	87	34.80
Secondary	60	24.00
Tertiary	23	9.20
Illiteracy (no formal education)	80	32.00
Marital Status		
Married	195	78.00
Single	55	22.00
Occupation		
Farming	179	71.60
Civil servant	11	4.40
Business	60	24.00

The results in *Table 2* showed that 90.40% and 6.00% respondents, representing high and low rates respectively, agreed that they use wood from tree species to construct or establish local wooden stakes/trellises on their yam farm to support the elevating creeping yam vines and tubers growth for maximum yield. Only 3.60% of them do not use wooden stake in their farm for staking. The study also revealed that 62.40% of the respondents harvest the wood for staking yam vines from the wild or natural forests while 32.40% harvest the wood from plantations or orchards. 50.40% destroy the whole plant for staking while 45.60% remove the branches only for staking. All the respondents agreed that tree species in the study area are decreasing in availability at high (67.60%) and low (32.40%) rates. Staking is a method of elevating creeping vines above ground level by means of supporting structures like wooden stake obtained from tree species. Generally, the uses of wood from tree species to construct or establish local wooden stakes/trellises on yam farm were higher in the study area. This finding was consistent with Ndegwe et al. (1990) who noted high stake population among Nigerian yam farmers. This might be due to the availability of stake sources like natural forests and plantations along with unsustainable harvesting method like clear cutting. This calls for staking options like the use of plastic stake, live-stake, among others to address the problem of deforestation through yam production. The findings further indicate that the high rate of decrease in availability of tree species in the study area may not be due to agricultural activities only, but a combination of factors in the study area. This confirms Aguilar-Santelises and del Castillo (2013) that tree species abundance in an area significantly declines with increasing human activities.

Table 2. *Tree species exploitation for staking yam farm in the study area*.

Variable	Frequency (N=250)	Percentage (%)
Use of wood as local wooden stakes/trellies on yam farm		
High	226	90.40
Low	15	6.00
None of the above	9	3.60
Sources of woods (wooden stake)		
Wild trees	156	62.40
Plantation	81	32.40
None of the above	13	5.20
Method of harvesting wood for staking by yam farmers		
Cutting the whole plant	126	50.40
Cutting branches only	114	45.60
None of the above	10	4.00
Decreasing in availability of tree species		
High	169	67.60
Low	81	32.40
None of the above	0	0.00

Results of tree species abundance and conservation status revealed that a total of 2427 individual trees were identified and counted. These trees were represented by a total of 43 species belonging to 23 families (*Table 3*). Vitex donniana possess the highest number of trees (12.53%), followed by Daniella oliveri (6.96%) and Vitellaria paradoxa (5.52%). Least frequencies were observed in most species like Burkea africana (0.21%), Combretum nugricens (0.21%) and Ficus sycomornus (0.29%). Similarly, combretaceae family had the highest number of species (6) followed by chrysobalanaceae, caesalpinoideae, euphorbiaceae, mimosoideae, moraceae and rubiacaea with 3 species each (*Table 3*).

Table 3. *Abundance and conservation status of tree species in Ukum LGA.*

Family name	Species name	Tiv	Hausa	N	%	CS
Anacerdiaceae	Mangifera indica	Chamen ikenya	Mangwaro	9	0.37	DD
Annonaceae	Annona senegalensis	Ahur	Gubduu	67	2.76	LC
Arecaceae	Borassus aethiopum	Kuugh	Giginya	28	1.15	LC
Bombacaceae	Bombax costatum	Genger	Kuryaa	65	2.68	LC
Caesalpinoideae	Afzelia africana	Yiase	Fasa dagaa	21	0.87	VU
	Daniella oliveri	Chaha	Maaje	169	6.96	LC
	Piliostigma thonningii	Nyihar	Cancalii	62	2.56	LC
Chrysobalanaceae	Parinari curatellifolia	Ibua-kyuna	Gawasa	87	3.59	LC
	Parinari excelsa	Ibyua kyom	Gawasa	64	2.64	LC
	Parinari polyandra	Ibyua	Gawasa	51	2.10	LC
Combretaceae	Combretum molle	Azulugh	Gogen damo	16	0.66	LC
	Combretum nigricans	Alo	Gooda jiki	5	0.21	LC
	Terminalia avicenniodes	Kwegh	Baushen	95	3.91	LC
	Terminalia glaucescens	Kwegh ii	Giiwaa	102	4.20	LC
	Terminalia laxiflora	Kwegh upupuu	Baushee	85	3.50	LC
	Terminalia schimperiana	Ukwegh	Gawasa	45	1.85	LC
Euphorbiaceae	Bridelia cathartica	Kpine nyiaan	Jan Kizni	26	1.07	LC
	Bridelia ferruginea	Ikpine	Kizni	55	2.27	LC
	Bridelia micrantha	Kpine daa	Kizni	32	1.32	LC
Fabaceae	Burkea africana	Gbagbogon	Kurdii	5	0.21	LC
	Pericopsis laxiflora	Giragba	Makarfo	12	0.49	LC
Hymenocardiaceae	Hymenocardia acida	Iikwar to	Jan yaro	92	3.79	LC
Loganiaceae	Strychnos innocua	Kpan amako	Girgita	16	0.66	LC
Loganiaceae	Strychnos spinosa	Amako	Girgita	36	1.48	LC
Malvaceae	Sterculia africana	Hilenune	Koyou	21	0.87	LC
Meliaceae	Khaya senegalensis	Han	Male	31	1.28	VU
Mimosoideae	Entada africana	Liemen	Tawatsa	31	1.28	LC
	Parkia biglobosa	Nune	Dabano	134	5.52	LC
	Prosopis africana	Gbaaye	Kirya	38	1.57	LC
Moraceae	Ficus platyphylla	Tur u nyian	Gamji	12	0.49	LC
	Ficus sur	Tur	Girca	133	5.48	LC
	Ficus sycomorus	Hirkar	Bauree	7	0.29	LC
Myrtaceae	Syzygium guineese	Daanyam	Malmoo	21	0.87	LC

Ochnaceae	Lophira lanceolata	Hookula	Namijin kadanya	37	1.53	LC
Rubiaceae	Crossopteryx febrifuga	Iikwar gbande	Kaashin	74	3.05	LC
	Gardenia erubescens	Ibohogh	Gaunde kura	27	1.11	LC
	Nauclea latifolia	Ikura-ukase	Ìgiyaa	79	3.26	LC
Sapotaceae	Vitellaria paradoxa	Chamegh	Kadanyar	157	6.47	VU
Simaroubaceae	Hannoa undulata	Gbur	-	13	0.54	LC
Sterculiaceae	Sterculia setigera	Kumendur	Kukkuki	16	0.66	LC
Tiliaceae	Grewia mollis	Hueza	Dargajii,	19	0.78	LC
Verbenaceae	Gmelina arborea	Malina	Malaina	28	1.15	LC
	Vitex donniana	Hulugh	Dinyaa	304	12.53	LC
Total	-	-	-	2427	100	-

Note: N=Frequency; %=Percentage; CS=Conservation Status; DD=Data Deficient; LC=Least Concern; VU=Vulnerable.

Vitex donniana, Daniella oliveri and Vitellaria paradoxa were the most abundant species and widely distributed in the study area. The abundance of these species could be attributed to the fact that they are susceptible to insect attack when used as stakes hence they minimally utilized for stakes. The abundance of the three (3) species of trees in the study area is comparable to those reported by Adagba et al. (2016) and Buba (2015). Adagba et al. (2016) recorded 38 plant species in Ukohol community of Benue state with Vitellaria paradoxa being one among the species that were rated high by the respondents. Buba (2015) in his work revealed that Daniella oliveri and Vitellaria paradoxa had the highest species diversity among the sampled species. The total tree species abundance reported in the study area (43 species) is lower than the one reported by Meer and Tella (2018) (60 species) from the same guinea savanna ecological zone. The low frequencies of many species reported in the study could be connected to the rate of human disturbance including yam cultivation. These findings are in agreement with those of Neelo et al. (2015); Meer and Tella (2018) who reported that excessive anthropogenic disturbances such as logging usually result in an immediate decline in species abundance. The recorded tree species were found to be represented by 9 conservation categories, viz. Conservation Dependent (CD), Data Deficient (DD), Least Concern (LC), Not Evaluated (NE), Not Evaluated but seems to be rare (NE but seems rare), Near Threatened (NT), Vulnerable (VU), Endangered (EN) and Critically Endangered (CR). Majority (91.00%) representing 39 tree species were found as Least Concern (LC) in the study area. Only 7.00% and 2.00% representing 3 and 1 tree species were found as Vulnerable (VU) and Data Deficient (DD) respectively (*Figure 2*).

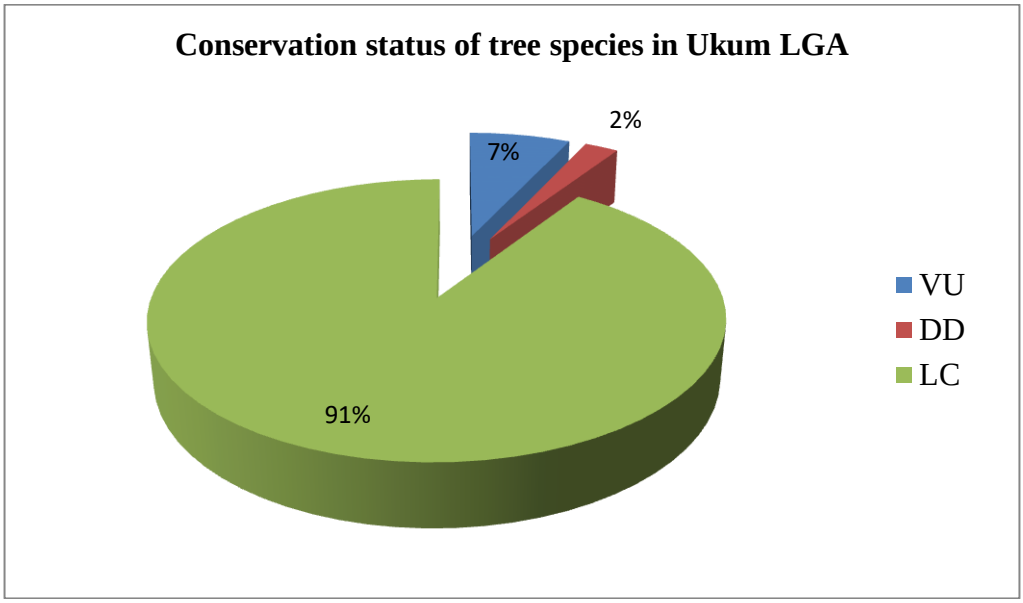

Figure 2. *Conservation status of tree species in Ukum LGA.*

In recent time, many tree species are at different stages of risk in Nigeria (Emma-Okafor et al., 2010). IUCN (2001) reported that 132 plant species including Afzelia africana, Khaya senegalensis and Vitallaria paradoxa were found as vulnerable (VU) in Nigeria. These species were vulnerable for their overexploitation for timber, firewood, charcoal and agriculture. According to Amonum et al. (2016) Khaya senegalensis is reported to have anti termite properties, hence is preferred in construction sites. It is also used in curing various ailments. Vitallaria paradoxa is a multipurpose tree species which has a wide range of food and medicinal uses as well as supplying timber, soap, oil and latex. It is used for carving mortar and pestle; these products are used in the study area for pounding yam. The wood is a good source of firewood and it is also used for the production of high value charcoal. It is commonly harvested using destructive method hence the need to protect the tree.

The studys Analysis of variance (ANOVA) results are shown in *Table 4*, where it was found that the F-calculated value (36.53) was higher than the F-tabulated value (4.26 at 0.05 levels of significant respectively). This implies that yam cultivation alone has a negative impact on the abundance and conservation status of tree species. Nigeria's biodiversity has continued to be seriously threatened by high levels of tree species exploitation (Emma-Okafor et al., 2010). The diversity of tree species is significantly impacted by human activities, with agriculture being the most significant (Meer and Tella, 2018). According to Neelo et al. (2015), substantial anthropogenic disturbances like tree cutting and logging typically cause a rapid loss in species diversity. These disturbances are the separate occurrences that disrupt the ecosystem population structures of tree species, dramatically altering the amount of available resources (Meer and Tella, 2018; Aguilar-Santelises and del Castillo, 2013). To increase the number of tree species and their state of conservation, it is necessary to put into place conservation policies and manage agroforestry techniques sustainably.

Table 4*. ANOVA results of the study.*

Source of variance	Degree of freedom	Sum of square	Mean square	F_{-Cal} value	F_{-Tab} value (a=0.05)
Treatment	2	2675.17	1337.59	36.53	4.26

Error	9	0183.50	1131.50	-	-
Total	11	92.858.67			

Conclusion

Increasing technology, agriculture, deforestation and lack of awareness have increasingly become the main cause of tree species loss with expanding impacts due to changing consumption patterns, growing populations and high-stake utilization among yam farmers in Ukum LGA of Benue State, Nigeria. Rural residents who are primarily farmers rely heavily on tree species resources to fulfill their basic needs such as fuelwood for cooking, heating, foliage for livestock, timber for shelter, non-timber products for food and medicine as well as wooden stake for farming. The fact that most tree species have low frequencies suggests that these species need good management and conservation. Due to stake scarcity and the need to cut more trees for staking, the diminishing state of tree species brought on by yam farming and deforestation demands for an alternative usage of live stakes, iron, or bamboo stakes. To increase the quantity and protection of tree species, it should be a top priority to implement conservation policies and manage agroforestry methods sustainably.

Acknowledgement

This research is self-funded.

Conflict of interest

The authors confirm that there is no conflict of interest involve with any parties in this research study.

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