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ASSESSMENT OF AGRICULTURAL PRACTICES AND FLORA DIVERSITY IN THE TROPICAL RAINFORESTS OF CROSS RIVER STATE, CALABAR, NIGERIA

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Abstract

This study examined the influence of agricultural practices on flora diversity in Ikom area of Cross River State in Nigeria. Thus, the study set out to ascertain the influence of five variables such as bush burning, grazing, tillage, intercropping, and application of herbicides on flora diversity. Consequently, five hypotheses were formulated and tested at .05 levels. Stratified and simple random sampling techniques were adopted in selecting three hundred and sixty-three adult male and female respondents residing in the six selected communities. A thirty-five Item Agricultural Practices and Flora Diversity Questionnaire (APEDQ) were utilized, as well as Participatory Rural Appraisal (PRA) techniques adopted include Semi-structured Interviews (SSIs), Focused Group Discussions (FGDs) and the Forest Inventory Method (FIM). Tropical rainforest plots with different levels of deforestation intensities were established for the FIM exercises. The findings revealed that the five independent variables influenced flora diversity in the Ikom Education Zone. For instance, For instance bush burning was found to have significantly influences flora diversity (F-value of 45.096, higher than critical F-value of 3.00 at 0.05 level of significance, with 2 and 346 degree of freedom. Also, Tillage was found to significantly influences flora diversity (Calculated F-value of 372.058, higher than the critical F-value of 3.00 at .05 level of significance, and 2 and 346 degrees of freedom. Recommendations proffered include the importance of forest conservation through sustainable management of forest exploitation, attitudinal changes in forest degradation through agricultural practices and Non-timber forest products (NTFPs) collection, as well as severe penalties for defaulters.

Keywords: Assessment, Agricultural Practices, Calabar, Flora Diversity, Tropical Rainforest,

1. Introduction

Concerns over the pattern, rate and impacts of deforestation on the environment, biodiversity and human population in Cross River State, are replete in literature (Akintoye, Bisong, Utang and Andrew-Essien (2013); Ukata, Akintoye, Ekeh and Ogar (2013);Mfon, Akintoye, Mfon, Olorundami, Ukata and Akintoye (2014); Philip, Akintoye, Olorundami, Ojong and Harrison (2014) Akintoye, Okibe, Essoka and Offiong (2017); Asiyanbi, Ogar and Akintoye (2019). Given the inadequacy of medical facilities and as such assess to treatments and medication (Akintoye, Isip, Obase (2022) the conservation of TRFs as store houses of medicinal plants cannot be over

emphasized. Apart from medicinal uses, the TRFs perform vital biogeochemical functions, and are major sources of industrial raw materials for the present and future generations. The threats posed by the escalating rates destructions, brought about by agricultural practises, and other numerous anthropogenic activities, is frighteningly alarming, especially in the tropical areas of the world (Akintoye et al.,2014)

Cross River State is a state in southeastern Nigeria with endemic fauna species, a diverse climate and topography. This diversity is reflected in the state's flora and fauna, as well as in its agricultural practices. Agricultural practices can have a significant impact on flora diversity. One of the most significant human endeavors that has a direct impact on the current state of flora variety is agriculture (Gall &Orians, 2012). Some agricultural practices, such as deforestation, and the use of pesticides, can lead to the loss of plant species. Other agricultural practices, such as agroforestry and integrated pest management, can help to conserve plant diversity. Flora species play an important role in an agricultural ecosystem. Due to the traditional practice of removing flora species from farmland, regardless of their ecological impact, vegetative diversity in agricultural landscapes is expected to decline. However, the importance of weed species in maintaining agricultural ecosystem stability has been recognized (Kegod, Forcella &Caly, 2017).

An understanding of flora changes and their causes and impacts is essential for identifying effective approaches for maintaining local ecosystem functions and achieving the goal of conserving biodiversity and promoting sustainable development in Nigeria in general and in central cross river state in particular. Moreover, an understanding of biodiversity change and its driving forces on these landscapes is an important prerequisite for the maintenance of flora diversity (Emma-Okafor, Ibeawuchi, &Obiefuna, 2009). Lack of understanding of the effect of agricultural practice poses a great danger to the ecosystem and may have negative impacts on agricultural production in the state. An understanding of the effects of agricultural practices on flora diversity within Cross Rivers State is crucial for promoting sustainable land management strategies. This study is therefore imperative.

Agricultural practices in Cross River State have a negative impact on flora diversity. Practices such as deforestation, bush burning, overgrazing, and the use of pesticides and herbicides reduce ecosystem services and biodiversity, increase soil erosion, and may ultimately lead to a decrease in agricultural production in Cross River State. Moreover, the conversion of natural landscapes into agricultural fields can lead to the loss of native vegetation, resulting in a decline in floral diversity while intensive agricultural practices, such as excessive tilling, can lead to soil degradation and erosion, negatively impacting plant diversity. Where flora has been severely destroy, there are significant influences on fauna habitats, and invariably, agricultural productivity, with socio-economic and health implications, in rural areas.

The major purpose of this study thus is to investigate the effects of agricultural practices on flora diversity in Cross River State. The specific objectives of this research are to ascertain the influence of bush burning on flora diversity in Cross River State; determine the influence of grazing on flora diversity in Cross River State; ascertain the influence of tillage on flora diversity in Cross River State; determine the influence of the application of herbicide on flora diversity in Cross River State and ascertain the influence of intercropping on flora diversity in Cross River State.
A total offive (5) hypotheses were tested at a .05 level of significance. The statements of the

hypotheses include (i) there is no significant influence of bush burning on flora diversity in Cross River State; there is no significant influence of grazing on flora diversity in Cross River State; there is no significant influence of tillage on flora diversity in Cross River State; there is no significant influence of the application of herbicide on flora diversity in Cross River State; and that there is no significant influence of intercropping on flora diversity in Cross River State.

2. Study Area

2.1 Location and Extent

The study area is Ikom Education Zone of Cross River State, Nigeria. This comprises six Local Government areas; Abi, Boki, Etung, Ikom, Obubra and Yakurr. Ikom Education Zone is bounded on the north by Obudu, Obanliku and Ogoja Local Government Areas, on the south by Akamkpa and Biase Local Government Areas; on the East by Cameroon Republic, and on the West by Abia and Ebonyi States. (Ministry of Land and Survey, Calabar, 2006) in Ukwetang (2011). It falls within the geographic region of moderately fair climate conditions, and lies between Latitude $5^{0}15^{1}$ North and 6^{0} 26^{1} North of the Equator and Longitude 8^{0} 02^{1} East and$8^{0}49^{1}$ East of the Greenwich Meridian. (Microsoft Encarta Premium 2009)

Figure 1 shows a map of Nigeria displaying Cross River State and Ikom Education Zone, while Figure 2, presents a map of the study area depicting the tropical high forests.

Ikom Education Zone of Cross River State has a population of 942,414 (National Population Commission, NPC, 2006) and have been projected to 1,350,479,262 in 2019. a land Area of about 7538.19km^2 (Ministry of Land and Surveys, Cross River State, 2005). The vegetation of the area is largely that of large broad leafed evergreen trees of divers species (Cross River State National Park, CRSNP, 2003).

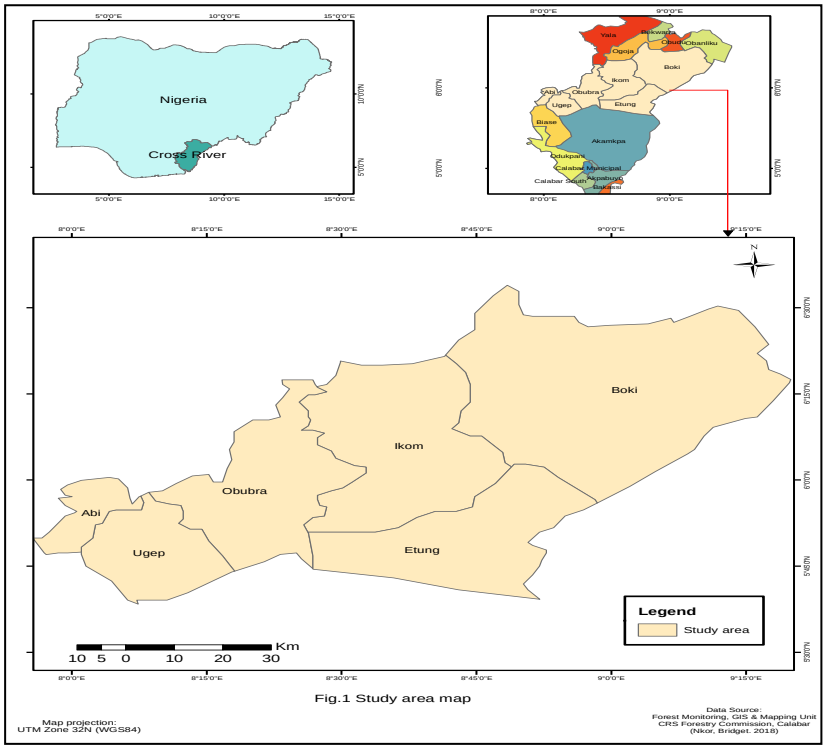

Figure 1: Map of Nigeria showing Cross River State and Ikom Education Zone
Source: Department of Environmental Management GIS Laboratory (2017)

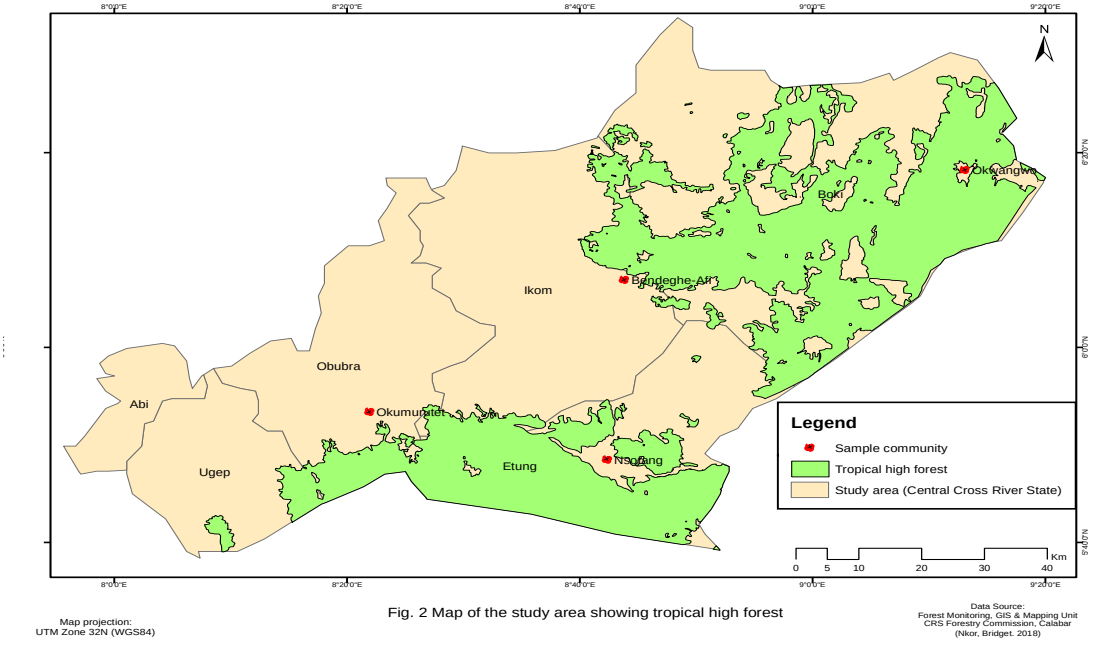

Figure 2: Map showing the study area with tropical high forests
Source: Cross River State Forestry Commission, 2019

The area is a tropical rainforest with a three-layered trees canopy. The flora diversity forms good habitats for wild animals and birds. These forests are also habitats for timber and non-timber forest products. The animals include reptiles such as crocodiles, Iguana, pythons and mammals such as apes, elephant, monkeys and baboons the tree species include, but are not limited Mahogany, Iroko, Obeche, Achi, Afara, Mariamma etc. there are also some non-timber forest products such as bush mango, alligator pepper, kola-nut, salad(afang), cocoyam, hot leave and other medicinal trees and herbs (Ministry of land and Survey, Calabar, 2005).The climatic conditions within the Ikom Education Zone are of the seasonal tropical climate characterized by the four seasons.

The people's primary means of subsistence include farming, gathering, and logging. Large- and small-scale farming are equally practiced at commercial and subsistence levels. Food crops farmed included; plantain, cassava, banana, yam, cocoyam and maize which are processed and sold to generate revenue. The hunting for bush meat or forest animals is carried out using local traps, bows, arrows and guns. Animals commonly hunted include monkey, porcupine, bush pigs, chimpanzee, grass (gutter etc. a reasonable number of business men and women also reside in the study area. Their presence and the location of most of the towns along the highway provide impetus for favourable markets for the disposal of the forest products (Ministry of Land and Survey, 2005).The reason for selecting the Ikom Education Zone as study area was based on the fact that the area of the state still harbors about 25% of the country's remaining Tropical high Forest with diverse flora species (Ministry of Land and Survey, 2005). This area of the state has high human activities or impacts on flora devastation and forest resources management is not intensively practiced. It is therefore in this area that the researcher is interested to determine influence of agricultural practices on flora diversity

3. Methodology

3.1 Population of the study

The population is made up of indigenes and residents of the study area. These inhabitants include farmers, civil servants, grazers, hunters, business men and women. From records of the National Population Commission (NPC, 2006), the Population in the Ikom Education Zone is 942,414 and have been projected to be 1350.479262 (Male and female) using population growth rate at 2.8. Table 2 presents the population projection to 2019, with a population of 1350.479262 persons. The accessible population of the study is 3,664 adults between the ages of 30 to 45 years from six communities to be used for the study (see Tables 1 and 2).

3.2 Sampling techniques

The stratified and simple random sampling procedures was adopted for this study. The stratification was based on each of the six Local Government Areas for this study that form a stratum. The criterion for stratification was based on the selection of respondents in each of the six Local Government Areas that formed stratum used for this study. Within each Local

Government Area, one community was randomly selected which makes a total of six communities used for the study. The various communities within each Local Government Area were documented on pieces of paper which were folded and thoroughly mixed in a container and someone was allowed to pick. Those six communities picked were, Boki-Bashua community, Ikom-Akparabong community, Etung-Abia community, Obubra-Apiapom community, Yakurr-Nko community, Abi- Anong community, automatically became the subjects of the study. It is from these sampled communities that actual representative sample of respondents were selected to participate in the study.

Table 1: Distribution of population and sample for the study by Local Government Area

S/n	LGA	Population	Sample 10%
1	Abi	573	57
2	Boki	658	66
3	Etung	551	55
4	Ikom	705	71
5	Obubra	565	57
6	Yakurr	612	61
Total		3,664	366

Fieldwork (2019)

Table 2: Population projection based on 2.8 percent annual increase

YEAR	2006	2007	2008	2009	2010	2011	2012
POPULATION VALUE	942,414	968.801592	995.189184	1023.461604	1052.676438	1081.891272	1112.04852
YEAR	2013	2014	2015	2016	2017	2018	2019
POPULATION VALUE	1143.148182	1175.190258	1208.174748	1242.101625	1276.028556	1311.840288	1350.479262

Source: Researcher's Projection (2013)

3.3 Sample Size

Three hundred and sixty-six (366) adult inhabitants (males and females) which is 10% percent of the population of all socio-economic status residing or carrying out one form of economic activities or the other in the study area were sampled. This sample was drawn based on the populations of each local government area by which one community in each local government area was identified. One percent of respondents were sampled from every one hundred inhabitants and ten percent respondents were sampled in every one thousand inhabitant.

3.4 Methods of Data Collection and Analysis

The research design used in the study is a survey research design. The instrument that was used for data collection is a 35-item questionnaire titled: *Agricultural Practices and Flora Diversity Questionnaire* (APFDQ) developed and validated by the researchers. The questionnaire has two sections. Section A, sought information on the demographic variables of the respondent, while Section B sought responses on different agricultural practices namely bush burning, grazing, tillage, application of herbicide, and intercropping, with additional ten items on flora species. The items in the questionnaire were developed based on the 4 -point Likert-scale with "SA" for strongly Agree, "A" Agree, "D" for Disagree and "SD" for Strongly Disagree. Subjects were required to respond by ticking (√) the appropriate Column that best fits their opinions or interests. The development of the

instrument was strictly based on each of the identified independent variables. The instrument's reliability estimate was calculated using the test-retest method of reliability.The reliability co-efficient of APFDQ ranges from 0.75 to 0.83.

The researcher visited the traditional and administrative heads of selected communities in the sampled areas and introduced the research mission to them. The town assigned two (2) local assistants to escort and assist the researchers, during the processes of reconnaissance and data collection, around the villages, as well as for the enumeration of the house residential houses inhabited by household members. Simple random sampling was carried out in the enumerated houses (only an even number of houses were used). Out of (366) copies of the questionnaire that were administered only 349 were successfully completed and retrieved and were used as the sample for the study.

The adoption of participatory and rural area-based research strategies for data collection was necessitated by the high level of dependence on indigenous agricultural knowledge and low-level educational attainment, in the study area. The Participatory Rural Appraisal (PRA) Research Method, enabled the collection of basic qualitative and mostly qualitative data. For instance, participatory rankings (PRs) allowed for rural respondents to rank quantities of harvests, seeds sown, quantities of other inputs, since some of them were not educated. This was done using broken sticks, stones, seeds, and drawing on the soil to represent quantities. Participatory transect walks (PTWs) allowed for traversing the study area, watching and recording processes, phenomenon, scenarios, while asking questions from the key informants (KIs), who are farmers, farm laborers, agricultural extension workers, plantation owners and so on. The key informants were also sources of information during semi-structured interviews which depended on Checklists.

Participatory mapping technique (PMTs), allowed to produce mental maps, drawn on provided markers and on soil surfaces, to show areas of arable crop and perennial crops cultivation, areas of deforestation with different intensities (lightly deforested, moderately deforested, intensively deforested and primary forest areas. Though somewhat rudimentary, in appearance and not presented in this article, the participatory maps of resources, land-use and residential areas, provided deep insights and were very informative. The seasonal calendar allowed the rural respondents to provide information on the temporal aspects of the various agricultural practices

Forest Inventory Method (FIM) was also utilized to assess the level of stocking of the TRFs studied. Sample plots of thirty metres by thirty metres (30M x 30 m) were created in sample plots with different intensities of deforestation (Primary, lightly deforested, moderately deforested, intensively deforested areas. The criteria for selection of the sample plots include canopy gap, tree stumps count, and duration of regeneration. Enumeration was carried out in company of two (2) taxonomists from the University of Calabar, Calabar, Nigeria.

4. Results

This section provides presents the findings of the study, with reference to the data, analysis and their interpretation

4.1 Influence of bush burning on flora diversity

In the study area, slash and burn agricultural practices is very common, given the prevalence of shifting cultivation, due to low soil sustainable management techniques adoption. Bush burning apart from the loss of flora, results in the loss of fauna (wild animals, commonly referred to as

"bush meat", earth worms, insects and important bacterial organisms. Hypothesis 1 indicates that there is no significant influence of bush burning on flora diversity. This hypothesis was tested using one-way the analysis of variance (ANOVA) statistical technique. The independent variable in this hypothesis is bush burning; while the dependent variable is flora diversity. The scores obtained from the respondents were split into the three categories of bush burning.

The highest score a respondent was expected to have is 20, lowest 5 and the average score was 10. Any respondent that scored 9 and below was below the average and was low, between 10 and 15 scores were within the average and were seen as moderate while those with the score of 16 and above were above the average and these were high. One-way analysis of variance (ANOVA) was the statistical approach used to evaluate this hypothesis. Table 1 displays the findings of the analysis.

Table 3: Summary of data and one-way ANOVA of the influence of bush burning on flora diversity (N=349)

Bush burning	N	$\bar{x}$	SD		
Low – 1	95	37.2105	.74226		
Moderate – 2	196	36.3367	1.91857		
High– 3	58	38.5345	1.30068		
Total	349	36.9398	1.77121		
Source of variance	SS	Df	Ms	F	Sig of F
Between group	225.740	2	112.870	45.096*	.000
Within group	865.996	346	2.503		
Total	1091.736	348			

* Significant at .05 level, critical F=3.00, df= 2, 346.

The results in Table 3 revealed that the calculated F-value of 45.096 was higher than the critical F-value of 3.00 at .05 level of significance, with 2 and 346 degrees of freedom. The null hypothesis was rejected as a result. This result therefore implied that, Bush burning significantly influences flora diversity. Since bush burning have significant influence on flora diversity, a post hoc analysis was employed using Fishers' Least Significant Difference (LSD) multiple comparison analysis. The result of the analysis is presented in Table 2.

Table 4: Fishers' Least Significant Difference (LSD) multiple comparison analysis of the influence of Bush burning on flora diversity

LSD

(I) Bush burning	(J) Bush burning	Mean Difference (I-J)	Std. Error	Sig.
Low	Moderate	.87379(*)	.19778	.000
	High	-1.32396(*)	.26363	.000
Moderate	Low	-.87379(*)	.19778	.000
	High	-2.19775(*)	.23648	.000
High	Low	1.32396(*)	.26363	.000
	Moderate	2.19775(*)	.23648	.000

* The mean difference is significant at the .05 level.

The result of the analysis in Table 4 showed that respondents whose outcomes of Bush burning is low are significantly different in their flora diversity from those whose Bush burning outcome is either moderate or high. Also, respondents whose bush burning outcomes are moderate are significantly different from those who are high in flora diversity.

4.2 Influence of Grazing on flora diversity

In Nigeria, the problems of animal grazing in agricultural areas has been explosive, resulting in destructions and abandonment of farm lands. This has resulted in loss of thousands of lives, as the ravaging drought in northern Nigeria required new areas of grazing for reared animals. Thus, was a dire need to gain an insight into the consequences of these activities on the TRFs. Hypothesis 2 states that there is no significant influence of grazing on flora diversity. The result in Table 4, revealed that the calculated F-value of 140.902 is higher than the critical F-value of 3.00 at .05 level of significance with 2 and 346 degree of freedom. The null hypothesis was rejected as a result.

Table 5: Summary of data and one-way ANOVA of the influence of Grazing on flora diversity (N=349)

Grazing	N	$\bar{x}$	SD	
Low – 1	69	35.5942	2.34093	
Moderate – 2	186	36.4946	.86523	
High– 3	94	38.8085	.98676	
Total	349	36.9398	1.77121	
Source of variance	SS	Df	Ms	F	Sig of F
Between group	490.051	2	245.025	140.902*	.000
Within group	601.685	346	1.739		
Total	1091.736	348			

*Significant at .05 level, critical F=3.00, df= 2, 346.

This result therefore implied that, grazing significantly impact flora diversity. Since Grazing has a significant influence on flora diversity, a post hoc analysis was employed using Fishers' Least Significant Difference (LSD) multiple comparison analysis. The result of the analysis is presented in Table 5.

TABLE 6: Fishers' Least Significant Difference (LSD) multiple comparison analysis of the influence of Grazing on flora diversity

LSD

(I) Grazing	(J) Grazing	Mean Difference (I-J)	Std. Error	Sig.
Low	Moderate	-.90042(*)	.18588	.000
	High	-3.21431(*)	.20905	.000
Moderate	Low	.90042(*)	.18588	.000
	High	-2.31389(*)	.16688	.000
High	Low	3.21431(*)	.20905	.000
	Moderate	2.31389(*)	.16688	.000

* The mean difference is significant at the .05 level.

The result of the analysis in Table 6 showed that respondents whose Grazing is low are significantly different in their academic performance from those whose Grazing is either moderate or high. Also, respondents whose Grazing is moderate are significantly different from those who are high in flora diversity

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4.3 Influence of Tillage on flora diversity

Tillage among arable farmers, who are largely tenant farmers, is mostly done with the se of hoes and cutlasses, with much reliance on manual labour, given low or absence of mechanization. Hypothesis 3: There is no significant influence of tillage on flora diversity. The result on Table 5, revealed that the calculated F-value of 372.058 was higher than the critical F-value of 3.00 at .05 level of significance, with 2 and 346 degree of freedom. The null hypothesis was rejected as a result.

TABLE 7: Summary of data and one-way ANOVA of the influence of Tillage on flora diversity (N=349)

Tillage	N	$\bar{x}$	SD		
Low – 1	41	34.0000	.00000		
Moderate – 2	203	36.5714	1.10291		
High– 3	105	38.8000	.98450		
Total	349	36.9398	1.77121		
Source of variance	SS	Df	Ms	F	Sig of F
Between group	745.222	2	372.611	372.058*	.000
Within group	346.514	346	1.001		
Total	1091.736	348			

*Significant at .05 level, critical F=3.00, df= 2, 346.

This result therefore implied that, Tillage significantly influences flora diversity. Since Tillage have significant influence on flora diversity, a post hoc analysis was employed using Fishers' Least Significant Difference (LSD) multiple comparison analysis. The result of the analysis is presented in Table 7.

TABLE 8: Fishers' Least Significant Difference (LSD) multiple comparison analysis of the influence of Tillage on flora diversity

LSD

(I) Tillage	(J) Tillage	Mean Difference (I-J)	Std. Error	Sig.
Low	Moderate	-2.57143(*)	.17135	.000
	High	-4.80000(*)	.18429	.000
Moderate	Low	2.57143(*)	.17135	.000
	High	-2.22857(*)	.12030	.000
High	Low	4.80000(*)	.18429	.000
	Moderate	2.22857(*)	.12030	.000

* The mean difference is significant at the .05 level.

The result of the analysis in Table 8 showed that respondents whose Tillage is low are significantly different in their flora diversity from those whose Tillage is either moderate or high. Also respondents whose Tillage is moderate are significantly different from those who are high in flora diversity.

4.4 Influence of application of herbicide on flora diversity

The application of herbicides, as indicated by findings through participatory research techniques, is low but gradually increasing as government has increased the supply of chemicals for usage by subsistent farmers. The use of herbicides requires knowledge of the exact types and quantities to be applied. This, are expected to be taught and demonstrated by extension workers. The participatory research techniques revealed that the extension workers are inadequate, and rarely are available. Hypothesis 4, indicates that there is no significant influence of application of herbicide on flora diversity. The result in Table 7, revealed that the calculated F-value of 56.308 is higher than the critical F-value of 3.00 at .05 level of significance with 2 and 346 degrees of freedom. Consequently, the hypothesis is rejected.

TABLE 7: Summary data and one-way ANOVA of the influence of Application of herbicide on flora diversity (N=349)

Application of herbicide	N	$\bar{x}$	SD
Low – 1	108	37.2130	.74947
Moderate – 2	197	36.3299	1.91604
High– 3	44	39.0000	1.01156
Total	349	36.9398	1.77121

Source of variance	SS	Df	Ms	F	Sig of F
Between group	268.081	2	134.041	56.308*	.000
Within group	823.655	346	2.381		
Total	1091.736	348			

*Significant at .05 level, critical F=3.00, df= 2, 346.

This result therefore implies that the application of herbicide significantly influenced flora diversity. Since Application of herbicide had a significant influence on flora diversity, a post hoc analysis was employed using Fishers' Least Significant Difference (LSD) multiple comparison analysis. The result of the analysis is presented in Table 8.

TABLE 8: Fishers' Least Significant Difference (LSD) multiple comparison analysis of the influence of Application of herbicide on flora diversity

LSD

(I) Application of herbicide	(J) Application of herbicide	Mean Difference (I-J)	Std. Error	Sig.
Low	Moderate	.88301(*)	.18473	.000
	High	-1.78704(*)	.27594	.000
Moderate	Low	-.88301(*)	.18473	.000
	High	-2.67005(*)	.25727	.000
High	Low	1.78704(*)	.27594	.000
	Moderate	2.67005(*)	.25727	.000

* The mean difference is significant at the .05 level.

The result of the analysis in Table 8 showed that respondents whose application of herbicide was low were significantly different in their flora diversity from those whose application of herbicide was either moderate or high. Also respondents whose application of herbicide was moderate were significantly different from those who were high in flora diversity.

4.5 Influence of Intercropping on flora diversity

This is an environmentally sustainable type of agricultural practice, allowing for two or more crops to be raised at the same time, on the same piece of farmland. This study examines its suitability in the study area. Null hypothesis 5, indicate there is no significant influence of intercropping on flora diversity. The result on Table 9, reveal that the calculated F-value of 579.552 is higher than the critical F-value of 3.00 at .05 level of significance with 2 and 346 degree of freedom. The null hypothesis was rejected as a result.

TABLE 9: Summary data and one-way ANOVA of the influence of Intercropping on flora diversity (N=349)

Intercropping	N	$\bar{x}$	SD
Low – 1	46	34.0000	.00000
Moderate – 2	186	36.4946	.86523
High– 3	117	38.8034	.98470
Total	349	36.9398	1.77121

Source of variance	SS	Df	Ms	F	Sig of F
Between group	840.763	2	420.382	579.552*	.000
Within group	250.973	346	.725		
Total	1091.736	348			

*Significant at .05 level, critical F=3.00, df= 2, 346.

This result therefore implied that, Intercropping has a significant influence on flora diversity. Since intercropping had a significant influence on flora diversity, a post hoc analysis was employed using Fishers' Least Significant Difference (LSD) multiple comparison analysis. The result of the analysis is presented in Table 10

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TABLE 10: Fishers' Least Significant Difference (LSD) multiple comparison analysis of the influence of Intercropping on flora diversity

	LSD			
(I) Intercropping	(J) Intercropping	Mean Difference (I-J)	Std. Error	Sig.
Low	Moderate	-2.49462(*)	.14024	.000
	High	-4.80342(*)	.14822	.000
Moderate	Low	2.49462(*)	.14024	.000
	High	-2.30880(*)	.10050	.000
High	Low	4.80342(*)	.14822	.000
	Moderate	2.30880(*)	.10050	.000

* The mean difference is significant at the .05 level.

The result of the analysis in Table 10 showed that respondents whose intercropping was low were significantly different in their flora diversity from those whose intercropping was either moderate or high. Also, respondents whose intercropping was moderate were significantly different from those who were high in flora diversity

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4. Discussion

The findings of this research have been very revealing. The implications of the findings on the negative impacts of the variables on flora, and invariably fauna, in the tropical rainforest, is of great concern. The rural communities in the TRF communities depend largely on the natural resources for building, furniture, medicinal plants, food, non-timber forest products (NTFPs), aesthetics, recreation and religious affiliations. Threats and possible destruction. Based on the study, it was found that bush burning significantly influenced flora diversity. Bush burning, has been a commonly applied tool for forest clearance worldwide. To increase agricultural productivity, fire is

utilized for hunting, agricultural field clearance, grassland maintenance, pest control, and the removal of dry vegetation and crop wastes. This finding, is in line with the view ofHough (2013) who observed that bush burning has been practiced in many parts of the world and has been accepted as an integral part of the traditional farming system. Paltridge and Latz (2009) also noted that, during bush burning, sensitive species are killed by fire, they are replaced by a more fire tolerant plants. Paltridge and Latz (2009) also noted that bush burning destroy soil nutrients and replace them by a more fire tolerant plants.

It was also discovered that overgrazing has a significant effect on flora diversity. The finding of this study agrees with that of Piekarczyk (2010) who observed that overgrazing reduces the ground cover vegetation, plant diversity and productivity. Furthermore, Sher, Ahmad, Eleyemeni, Fazl-i-Hadi and Sher (2010) also showed that nomadic grazing poses serious threat to the occurrence and the distribution of medicinal flora. This finding also aligns with Yuguang, Abouguendia and Redmann (2001). A major problem in Nigeria has been the issues of farmers-herders conflicts, due to the destructions caused by rampaging cattle. These, often has been the bedrock of inter ethnical conflicts, resulting in mass slaughter and national debates. These all have socio-economic implications on local and regional food security. Presently in Nigeria there is widespread food scarcity and very high inflation. The implications on the flora biodiversity, is enormous.

It was also found that tillage has a significant influence on flora diversity. The effect of reduced tillage on flora biodiversity is diverse. Soil tillage intensity had little effect on the species diversity of flora communities in agro-ecosystems. The findings are in line with the view of Similarly, Blecharczyk*et al*. (2010) who noted higher flora infestation with common wind grass under zero tillage.

The result also indicated that application of herbicide significantly influenced flora diversity. The findings are in line with the view of Ulber, Steinmann and Klimek (2010) who indicated that treatment by selective herbicides can provide considerable weed control with retention of beneficial species and flora diversity. Freedman, Morash and Mackinnon (2013), also noted that spray plots resulted in large reductions of cover by previous community dominants of flora species but only small changes in species richness and diversity. Bell and Newmaster (2002), also observed that herbicide treatments resulted in the highest number of herb and grass species. Conifer release treatments had the greatest effect on woody cover with herbicide treatments decreasing cover and affecting the floral community more than manual cutting treatments. However, plant diversity indices were relatively unaffected by the conifer release. The findings are in line with the view of Ulber, Steinmann and Klimek (2010) who indicated that treatment by selective herbicides can provide considerable weed control with retention of beneficial species and flora diversity. Freedman, Morash and Mackinnon (2013), also noted that spray plots resulted in large reductions of cover by previous community dominants of flora species but only small changes in species richness and diversity.

It was found that intercropping significantly influenced flora diversity. The types of nutrient resource including manure and chemical fertilizer did not affect flora community significantly, but the types and amount of fertilizer nutrient changed flora diversity and composition. Studies have also shown that the diversity of the rhizosphere microbial population and the composition of the microbial community can be influenced by the species and abundance of plants. The findings of Kegod, Forcella, and Caly (2017) corroborates this. Kegod*et al* (2017) discovered that intercropping of crops with weak competitive ability, such as onion (*Allium cepa*L.), leek (*Allium porrum*L.) and carrot (*Daucuscarota*L.), may be necessary to reach a level of weed control. Hafman, Regnier and Cardina (2013) also showed that an important problem of organic agriculture is weed management. They mentioned the approach for weed and pest management in organic agriculture is intercropping systems and mulch. Renne, Gerrish and Sanderson (2004) also demonstrated that with increasing species diversity in pastures, weed frequency decreased.

6. Conclusion

Based on the results of the test of hypotheses, it was confirmed, that: bush burning significantly influenced flora diversity; grazing significantly influenced flora diversity; tillage significantly influenced flora diversity; application of herbicide significantly influenced flora diversity; and that inter-cropping significantly influenced flora diversity.

The hypothesis concerning the influence of human activities (bush burning, grazing, tillage, herbicide application, and intercropping) on flora diversity in the tropical rainforest of Cross River State has significant implications for conservation strategies. The region's tropical rainforests are characterized by high biodiversity and play a critical role in carbon sequestration, water cycle regulation, and the maintenance of ecosystems.

Bush burning, a common agricultural and land-clearing practice, directly affects plant diversity. Fire alters soil properties, reduces organic matter, and eliminates certain plant species, particularly those that are fire-sensitive. It may favor fire-adapted species, reducing overall biodiversity. Frequent burning can lead to the loss of mature trees, shrubs, and ground flora, further degrading forest ecosystems. In Cross River State, where endemic species and rare plants exist, bush burning could exacerbate the risk of extinction for vulnerable species. Conservation strategies should focus on fire prevention and controlled burns where necessary, alongside reforestation efforts. Educating local communities on the adverse effects of bush burning and promoting sustainable alternatives to land clearing will be essential in maintaining flora diversity.

Grazing by livestock significantly affects plant composition and diversity, particularly when carried out in forest margins or cleared areas. Overgrazing can lead to soil compaction, degradation of plant cover, and the preferential loss of palatable species. As livestock graze, they often eliminate tender young plants and disturb the soil, making it difficult for slow-growing or shade-tolerant species to regenerate. The selective feeding patterns may lead to the dominance of less palatable species, resulting in homogenization of the plant community and reduced biodiversity. Effective conservation efforts should include rotational grazing practices, the creation of designated grazing zones away from critical forest areas, and alternative fodder sources. Controlling grazing pressure can reduce habitat degradation and promote the recovery of flora diversity.

Tillage, the mechanical disturbance of soil for agricultural purposes, disrupts the natural

structure of the soil, affects root systems, and alters the nutrient cycling within the ecosystem. It often leads to erosion, loss of soil organic matter, and changes in soil microbial communities, all of which influence the plant species that can thrive. Intensive tillage can particularly harm sensitive forest ecosystems by accelerating the loss of soil fertility, thus reducing the diversity of flora. To mitigate the negative effects of tillage, conservation practices should include no-till or reduced-tillage farming techniques, which help preserve soil structure and protect native plant communities. These approaches promote higher plant diversity, which is critical for sustaining ecological balance in rainforest systems.

Herbicide application can lead to significant reductions in flora diversity by selectively or non-selectively killing plant species. While herbicides are used to control weeds in agricultural settings, they can also inadvertently harm non-target species, including native forest plants. Prolonged herbicide use can lead to the dominance of resistant species, which may alter the competitive dynamics of the ecosystem and lead to a decrease in overall biodiversity. Reducing herbicide use and adopting integrated pest management (IPM) practices can help protect native flora while maintaining agricultural productivity. Conservation programs should promote organic farming techniques and natural weed management systems, which reduce the chemical impact on rainforest flora.

Intercropping, the practice of growing two or more crops together, can have both positive and negative impacts on flora diversity. When done correctly, intercropping mimics natural plant diversity, encourages the health of soil, and reduces the need for chemical inputs like fertilizers and herbicides. However, improper intercropping practices could lead to competition between crops and native species, resulting in a decline in local flora diversity. Encouraging the adoption of agroforestry and biodiversity-friendly intercropping practices can enhance flora diversity. By integrating native species into agricultural systems, farmers can reduce habitat fragmentation and create a more diverse landscape that supports the conservation of forest species.

Conclusively, each of these practices—bush burning, grazing, tillage, herbicide application, and intercropping—has a measurable impact on flora diversity, with potential long-term effects on ecosystem health in Cross River State. Sustainable land-use practices, education, and effective policy enforcement are key to balancing agricultural activities with the conservation of rainforest biodiversity. The Cross River region's rich biodiversity and ecological importance make it critical to implement science-based conservation strategies that mitigate these human influences

7. Recommendations

The study's findings led to the following recommendations being made:

1. There is a dire need to develop and enforce fire management strategies to prevent uncontrolled bush burning. This includes community awareness campaigns on the negative impacts of fire on flora diversity and the adoption of firebreaks and controlled burning techniques.
2. Itis evident that there needs to be an introduce rotational grazing systems and designated grazing areas away from sensitive forest zones to reduce overgrazing.
3. Government should encourage livestock owners to adopt pasture management practices that protect native vegetation.

4. Need to encourage conservation tillage methods, such as no-till or reduced-till farming, to minimize soil disruption and protect soil structure. These practices will help conserve plant biodiversity by allowing natural regeneration of native plant species.
5. There should be efforts to reduce reliance on herbicides by encouraging the adoption of integrated pest management (IPM) approaches. This includes the use of biological pest control methods and organic farming practices to minimize the chemical impact on flora diversity.

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