Full Length Research Paper

Exploring the relationship between farming practices and vegetation dynamics in Benue State, Nigeria

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This study examines the relationship between farming practices and vegetation degradation with a view to recommend best farming practices in Benue State. The main objective of the study was to identify and describe the major farming practices as a factor of vegetation degradation in Benue State. Data on farming practices and vegetation was obtained through personal interviews; questionnaire and onsite assessment. The data was coded, extracted and analysed using frequencies and simple percentages. The analysis of the result revealed that majority of the farmers' practised farming on full-time basis. Those sizes of the farm plots in the 1980s were generally small but have become large in 2010. Apart from been small, the farms are scattered a factor that accelerates vegetation degradation and change. Fallow periods were generally long in the1980s but have reduced to between 1 to 3 years in 2010. The study also identified shifting cultivation, zero-tillage and alley cropping as the major farming practices in Benue State. Chi Square was used to test the significance of the farming practices identified. The result of the test confirm that shifting cultivation, zero-tillage and alley cropping are significant at p<0.05 in explaining the relationship between farming practices and vegetation degradation in Benue State. Hence, the study recommends that farmers should minimize the practice of zero-tillage and aggregate the size of their farms while alley cropping and afforestation for all vegetation types should be encouraged to conserve the vegetation in the State.

Key words: Farming practices, vegetation degradation, shifting cultivation, zero-tillage alley cropping, Benue State.

INTRODUCTION

Many human activities such as farming, mining, urban extension, bush burning, mineral exploration and constructions have been known to modify the earth"s landscape, not only in Benue but in many other regions of the world. Since the economy of Benue State is agrarian dependent, more than 70% of the state"s population is engaged in one form of agriculture or the other (Nyagba, 1995).

Therefore, it is obvious that much of the vegetated land area of the State is currently used for various agricultural activities (SIGWA, 2001). However, the rate and intensity at which the farming activities affect the vegetation negatively could vary, depending on the nature of the modernization of the farming activities and on the level of enlightenment of the farmers. These factors have often not been built into the analysis of farming-vegetation relationships in Benue State.

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Although, considerable research and monitoring activities in the tropics most especially Nigeria (Nyagba, 1995; SIGWA, 2001; Adeola et al., 2004; Madulu, 2004) have generally placed more emphasis on the impacts of vegetation change. These studies have generated copious amount of information and recommendations on many aspects of vegetation change, yet very little empirical studies have been done that relate farming practices to vegetation degradation in the State. There is no doubt that the importance of vegetation to both human and the environment are quite enormous. Ecologically, apart from conserving the soil and improving its fertility; vegetation ameliorates local climate through sequestration of carbon dioxide, transpiration cooling and enhances air humidity; it also provides habitat to several species of animals (Ukpong, 2009). Socio-economically, vegetation provides timber and non-timber forest products which are raw materials for many industrial products such as paper, latex and rubber. In view of these benefits derived from vegetation, Rawat et al. (2004) concluded that vegetation is crucial to the economic development of many developing countries including Nigeria.

In recognition of the benefits and the role vegetation plays in the environment, it changes and decline calls for a greater attention. Related to that and with particular reference to the declining state of vegetation in Nigeria, Nigeria Environmental Study Team (NEST) in 1991 (that is 20 years) estimated that over 350,000 ha of vegetative land in the country are lost annually due to farming alone. These figures can only be imagined today due to extensification of agricultural activities. Similarly, 7 years ago a study carried out by Adeola et al. (2004) illustrated the apparent effect of farming activities in the modification of the original pristine vegetation while some other vegetation resources such as wildlife have been threaten by extinction. These few studies among many revealed the significance and direct impact of human activities as driver of vegetation degradation in Nigeria. It is also true that agriculture is not the only factor that contributes to the dynamics of vegetation change; population pressure, changes in land tenure system, and climate change are among the other factors (Madulu, 2004). However, comparatively, the rate at which agricultural activities contribute to vegetation degradation has been observed to be much higher than the other factors stated.

In view of the above, a reconnaissance survey was carried out to determine the status of vegetative cover among some farming communities in Benue State. This survey suggested that in Benue State, vegetation degradation can be attributed to intensification of farming activities since the dominant source of livelihood is farming. Many of the agricultural activities observed in Benue are not design to conserve the natural vegetation rather; they seem to contribute to its degradation. Hence there is no limit to the extent of forestlands these farming activities require, and it is still not clear, whether these practices will be replaced by better and sustainable methods in the future.

Therefore, this study was set out specifically to examine the relationship that exists between farming practices and vegetation change in Benue State. Hence, the study seeks to provide answers to these two basic questions; what are the dominant farming practices in Benue State and which one contributes greater to vegetation change? And what has been the role of farming practices in modifying vegetation in Benue State? Answers to these questions will perhaps lead to a proper understanding of the relationship between vegetation degradation and farming practices in Benue State. The main objective of this study was to identify the major farming practices and describe which ones lead to greater vegetation change in Benue State.

MATERIALS AND METHODS

Study area

Benue State lies between latitudes 6° 25" and 8° 25" N, and on longitudes 7° 47" and 10° 00" E in the central part of Nigeria called „Middle Belt" (Nyagba, 1995). The State shares boundary with Nassarawa in the north and Taraba States in the northeast. In the south, it shares boundary with Cross River State, while its southwest boundary is shared with Enugu and Ebonyi States respectively. To the west it is bounded by Kogi States, while a short international boundary is shared with the Republic of Cameroon around Kwande LGA (Figure 1).

Benue State falls within the Koppen"s Aw climate Classification which experiences marked wet and dry seasons. Rainfall in Benue State averages seven (7) months in the year with annual totals ranging from 1,200 to 2000 mm (Nyagba, 1995). Annual rainfall totals are generally higher in the southern parts of the state than the northern parts and this is clearly reflected in the lusher and denser nature of the vegetation (Ologunorisa and Tersoo, 2005). There is usually one or two heavy early rain from passing east-west line squalls in January, February or March. The significance of this early out of season rain is that it enables the yam farmers to prepare their mounds and plant seedlings during the late winter period well before the onset of the rainy season. Temperatures are constantly high averaging between 28 to 32°C and sometimes rising to 37°C especially within Makurdi the state headquarters.

The parent materials forming soil in Benue State are largely of sedimentary origin. These produce the deep loamy soils the basis of agricultural production in most parts of the State. Generally, there are about seven different soil classes distributed across the State. These include lithosols, aerosols, fluvisols, cambisols and regosols (BENSEPA, 1999). However, the most extensive are the luvisols occurring mostly in the western
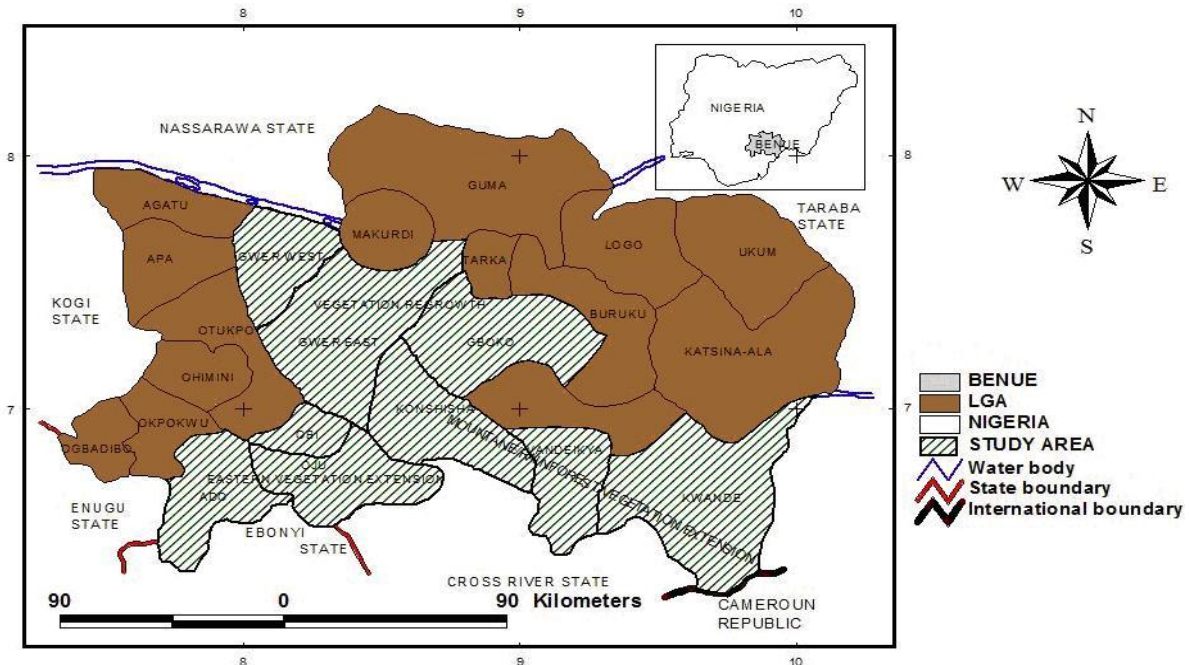
Figure 1. The map of Benue State showing the Study Area. Source: Benue State Ministry of Lands and Survey, Makurdi (2001).

and southern parts of Benue State. The soils are fine-textured with poor internal drainage. A common feature of the soils is the movement of clay within the soil profile. This results to the rather compact illuviated clay or duricrust. The agronomic significance of the deep seated duricust is that, it often produces perched ground water sources which are important sources of capillary water hence supporting farming activities. The topsoil is low in organic matter content.

Benue State is located within the guinea savanna belt which is also the broadest vegetation zone in Nigeria and is characterized by heterogeneous species of scattered trees and grasses (Nyagba, 1995). These trees included *Khaya senegalensis* (Mahogany) which is found in the south-western part, mostly along stream courses while *Daniella oliveri* ("chiha"), *Linnea sp* and *Isoberlina doka* ("akovol") are found mostly in the north-east and north-western parts of the State respectively. Other tree species such as *Parkia biglobosa* (Locust bean tree), *Prosopsis africana* (Iron tree), *Vitellaria paradoxa* (Shea butter tree) and *Burkea africana* (oil bean tree) are also common (Hula, 2010). However persistent clearance of the vegetation for arable agriculture, lumbering and the practice of bush fallowing system create regrowths and characteristic parklands that attract animal grazing and cattle herdsmen. According to the National Population Commission (2006), Benue State has a population of four million, two hundred and fifty three thousand, six hundred and forty one (4,253,641) people as at the last census in 2006 and agriculture employs more than 70% of this population.

Study population and sample size

The targeted study population was made up of two components (that is the farmers and the major vegetation cover types) in the study area. Using Taro Yamene (1964) formula, a sample size of 384 farmer was determined at p<0.05. Data was collected from these 384 farmers initially drawn from Ado, Obi, Oju, Gwer-East, Gwer-West, Gboko, Konshisha, Kwande and Vandeikya LGAs of Benue State. In the course of the selection, emphasis was placed on heads of household who have had adequate knowledge of their environment, farming practices and vegetation in their various communities and who have been consistently farming at least for the past 20 to 30 years.

Sampling techniques

Since farming activities are heterogeneous in Benue State and in order to obtained in-depth information on the farming practices, systematic sampling techniques was used to draw the sample size of the farmers for the purpose of questionnaire administration and interviews. On the other hand, random and a two-stage cluster sampling technique was used to obtain information on the state of vegetation in the State. Hence, three vegetation

cluster groups were defined as representing the study area as a whole and also to maintain the heterogeneity of the study population. These cluster groups were the northern extension of the eastern Nigerian oil palm vegetation; Secondary or regrowth vegetation and; the transitional extension of the Cross-River rainforest and the Cameroon mountain vegetations. Hence, the study covered contiguously the entire vegetation in Benue State which exhibits varying degree of vegetal cover in association with different farming practices. In order to effectively identify and describe the farming practices in relation to the state of the vegetation across the three cluster groups, field sampling with line intercept and quadrants used in the study.

Data collection and analysis

Personal interview and questionnaire survey was used to collect data from the farmers on various farming activities which directly or indirectly affect vegetation in the study area. These farming activities include classification of farmers/farming activities, farm sizes, fallow periods and major farming practices. While on the other hand, onsite assessment and field survey were employed to collect information on the state of the vegetation in the study area. This information obtained was coded, extracted and analysed using tables and percentages for clear assessment while the proceedings of the interviews were transcribed and later reviewed for in-depth analysis of the view points. A three sample Chi-Square (x^2) was used to test the significance of the relationship between farming practices and vegetation degradation in the study.

RESULTS AND DISCUSSION

Socio-demographic characteristics of the farmers in Benue State

It is evident that the age of a population plays a significant role in the productivity of its economic activities. Benue State is not an exception as the age of her population has direct link to agricultural production which in every sense will definitely have an effect on the vegetation. The result of the survey derived from the 373 valid responses out of 384 sets of questionnaire initially administered is presented to address each question in the study. Table 1 show that, 72.1% of the respondents were between the ages 25 to 34 and 35 to 44 years corresponding to the virile age full of energy that has been channelled mostly to farming and other agricultural activities in the State. This finding has confirmed the result of Adeola et al. (2004), that majority of the people involved in farming in Nigeria and many other developing countries of the world are the youths who are full of energy and can stand the stress. Only 27.9% of the respondents were 45 years andabove. It is also clear

that the percentage of the category of the farmers targeted which were those who have been farming for at least 20 to 30 year is comparatively small to those below 20 years.

Furthermore, 74.8% of the farmers selected were male, while only 25.2% were female. This does not go with the expectation that the males dominate farming and agricultural production in some other states in Nigeria. Several studies have indicated that women in Africa and indeed Nigeria are responsible for up to 60% of African agricultural workforce. In agreement with what Okonkwo (2002) reported, that Nigerian women contribute a lot to food production, although their contributions have often been under-valued. Therefore, as the homemakers, more women than men may be involved in farming in order to supplement the food needs of their households thereby causing irreversible damage to the vegetation where these activities are intense. Similarly, 92% of the farmers in Benue State have acquired one form of western education or the other while only 8% of the farmers do no acquire any formal education.

Invariably, the level of education of the people in one way or the other affects their level of agro-technological perception, adoption and skill acquisition which in the long run affects the vegetation negatively. For example, in some communities such as Shanna, Mbamar, Ankyoo and Agagbe in Gwer-East and Gwer-West LGAs where mechanized commercial rice farming is practiced predominantly, the use of some agrochemicals has shown a marked degradation of the vegetation. Related to that, analysis done by agricultural extension workers confirms that farmers who have attained some level of formal education are more likely to adopt new agricultural innovations more than those without any formal educational qualification. In ranking the farmers on the basis of ethnicity, the study reveals that 70.2% of the farmers belong to the Tiv ethnic group. This is followed by Igede with 16.6%, while Idoma and other ethnic groups such as Etulo, Jukun and Ijaha take 13.2% respectively. The ranking shows that the Tiv people are predominantly farmers and thus vegetation degradation in Benue State seems to have a positive correlation among the farming communities in the Tivland than the other ethnic groups. With regards to the farmer"s experience, 60.3% of the farmers have been farming between 1 to 10 years, 32.2% between 11 to 20 years, while only 7.5% were above 21 years. This indicates that most of the farmers have not been farming for a long period of time and yet have got the knowledge of crop selection and farming practices that are most suitable to their environment but detrimental to the vegetation.

Classification of farmers and farming activities in Benue State

Benue State is known to be the Food Basket of the

Table 1. Socio-demographic characteristic of the farmers in Benue State.

Socio-demographic characteristics	Response	Percentage
Age		
25-34	32	8.6
35-44	237	63.5
45 and above	104	27.9
Sex		
Male	279	74.8
Female	94	25.2
Education status		
No formal education	30	8.0
Primary education	195	52.3
Secondary education	97	26.0
Tertiary education	51	13.7
Ethnicity		
Tiv	262	70.2
Idoma	38	10.2
Igede	62	16.6
Others	11	3.0
Farming Experience (Years)		
1-10	225	60.3
11-20	120	32.2
21 and above	28	7.5
Total	373	100

Source: Researcher''s Fieldwork 2010.

Table 2. Farmers/Farming classification in Benue State.

Classes	Response	Percentage
Full time farming	180	48.3
Full time/livestock herding	101	17.2
Farming/livestock herding	64	27.0
Part time in combination with others	28	7.5
Total	373	100

Source: Researcher''s Fieldwork 2010.

Nation as a result; many people in the State are presumably farmers. However, as observed by Ortserga (2010), it was difficult to differentiate the core farmers from the other occupations as many people in the State that have secondary vocation also practice one form of agriculture or the other. This notwithstanding, there exist variations in the nature of the farming activities carried out by farmers in the State.

Therefore, the farmers were classified on the basis of farming activities for the purpose of understanding the extent to which these activities affect the vegetation in the State. It can be seen from Table 2 that, 65.5% of the farmers in Benue State practice farming on full time basis. This is in line with what Nyagba (1995) opined that agriculture employs more than 70% of the population in Benue State. This percentage of the farmers has no any other source of livelihood than farming and is known to have contributed greatly to vegetation degradation. The quest to cultivate more lands for food production has resulted in higher pressure on the available vegetation

Table 3. Average size of farm plots in Benue State.

LGAs	1980s (Farmer's recollection)			2010 (Measured in the field)		
	Length (m)	Width (m)	Area (ha)	Length (m)	Width (m)	Area (ha)
Ado	-	-	0.19	100.52	80.45	0.8045
Obi	-	-	0.24	98.34	65.23	0.6415
Oju	-	-	0.17	123.09	79.65	0.9804
Gboko	-	-	0.16	58.62	45.32	0.2656
Gwer-East	-	-	0.19	118.23	87.11	1.0299
Gwer-West	-	-	0.60	78.06	54.12	0.4224
Konshisha	-	-	0.32	134.33	71.09	0.9549
Kwande	-	-	0.76	143.28	81.27	1.1644
Vandeikya	-	-	0.38	108.76	71.03	0.7725
Average			0.33	107.03	70.59	0.7818

Source: Researcher"s Fieldwork 2010.

making it poor of it resources. In most communities such as in Gwer East, Gwer West, and parts of Gboko and Konshisha LGAs where this class of farmers dominated, the rate of vegetation degradation quite high. In addition, 27% of the farmers practise farming on full time but combine livestock herding such as goats and sheep.

Further interaction with the farmers revealed that animals such as goats, sheep and pigs are kept by this class of farmers. It is also worthy of note here that, cattle rearing is not a very common practice in Benue State as the few heads of cattle that were seen belong to the Fulani herdsmen who migrate from the northern part of the country in search of pasture. This notwithstanding, 7.5% of the farmers engage in farming as a part time business in combination with other livelihoods such as teaching, trading, civil service and religious activities. These categories of the people were mostly school teachers and local government staff whose incomes are relatively low. Therefore, they turn to the cultivation crops such as maize, cassava, and rice both for subsistence and commercial to augment their incomes. Consequently, these are the set of farmers that would afford the procurement of some agrochemical inputs such as herbicides which have impacted negatively on the both the environment and the vegetation at large.

Spatial variation in farm sizes in Benue State

Not much recorded information exists on agricultural land-use particularly farm sizes in Benue State since its creation 35 years ago (that is in 1976). All we can rely on are reports made on the subject by anthropological researchers and memories of members of the community. However, the available information gathered revealed a significant change in initial size of farm plots from what it used to be in the 1980s. It should be noted at this point that one of the most unstable patterns of agricultural land-use in Benue State is size of farms.

Farm size is a tangible attribute of agricultural land use for which vegetation degradation can be measured. This is because factors determining farm size such as population of farmers, occupational ratio between farming and other sectors and land tenure system which defines access to land, in any area are quite unstable (Ortserga, 2010). The study revealed that farm sizes in Benue State are generally not large with an average area of 0.33ha in 1970s and 0.78ha in 2010. This is an indication that there is marked increase of 0.45 ha in farm sizes between 1970s-2010 corresponding with the population and demand for arable land which has a palpable link to vegetation degradation in the State.

It was also gathered that some small portions of what was formerly regarded as marginal lands (surfaces characterised by stoniness and rock outcrops) have been brought under cultivation; but that has been insignificant addition that cannot raise the size of per capita landholdings (Table 3).

For example most communities in Kwande and Gwer East LGAs that average farm sizes were 0.19 and 0.76ha in the 1980s have been raised to 1.03 and 1.16 ha in 2010 respectively. In contrast however, farm sizes Benue State according what Ortserga (2010) found out cannot be compared to those found in some agriculturally advanced countries like China, Thailand and Brazil which their per capita landholdings is not less than 5ha per farmer. In as much as these farm sizes are not large, they are scattered in pockets thereby creating a condition good for the conversion of the natural vegetation which leads to it eventual degradation.

The summary of fallow periods in Benue State

The time lag in between crop cultivation, land rotation and vegetation regeneration is also very important in understanding vegetation richness and its degradation in an area.   In view of that interviews and discussions were

Table 4. Spatial variation in the range of fallow years in Benue State.

LGAs	Fallow years	
	1980s	2010
Ado	10 – 15	2-4
Obi	12 – 16	1-3
Oju	08 - 13	3-4
Gboko	07 - 11	<1
Gwer-East	10 - 15	2-3
Gwer-West	12 - 14	1-3
Konshisha	08 - 10	1-2
Kwande	13 - 20	4-6
Vandeikya	07 - 10	1-2
Average	8-10	1-3

Source: Researcher"s Fieldwork 2010.

Table 5. Summary of farming systems in Benue State.

LGAs	Shifting cultivation	Zero-tillage	Alley C.	Total
Ado	25	4	9	38
Obi	18	3	5	26
Oju	25	2	5	32
Gboko	42	11	25	78
Gwer-East	26	5	4	35
Gwer-West	20	3	1	24
Konshisha	26	6	14	46
Kwande	30	7	9	46
Vandeikya	18	3	27	48
Total	230 (61.7%)	44 (11.8%)	99 (26.5%)	373 (100%)

Source: Researcher"s Fieldwork 2010.

held with the farmers across Benue State to unveil vital information on fallow system. The result of the interviews shows that fallow periods have significantly declined in the State due to intensification of farming activities. Globally, the quest for cultivatable land to feed the increasing world population has put tremendous pressures on land and vegetation generally. Hence, the extension of croplands coupled with increasing food production has been responsible for the reduction of areas under forest and grassland cover in the State (Table 4).

As noted by most of the farmers interviewed, fallow periods in the 1970s were between 8 to 10 years on average but this has declined to between 1 to 3 years across the State. The finding of this study contradicts what Nyagba (1995) illustrated that agricultural intensification encourages regeneration of vegetation due to minimum fallow threshold which was not stated. This change is more drastic in some farming communities in Gboko where the fallow period has been reduced to less that one year followed by Konshisha and Vandeikya

LGAs which is between 1 to 2 years. This was further confirmed by one of the farmers interviewed in Gwer LGA, he specifically stated that fallow period within his own community before now was between 10 to 15 years but due to the increase in population and the pressure on land and, it has been reduced to between 2 to 3 years. Although, these changes may not be spectacular compared to what happens elsewhere, but they are real and tangible enough to arouse vegetation degradation and academic interest.

Major farming practices identified in Benue State

The study identified Shifting Cultivation (61.7%) as one of the major and dominant farming practices preferred by farmers in the State (Table 5). This type of farming practice involves the cutting down and burning of forests, or woodlands to create way for other farming activities such as heap making, ridges, and planting of crops (Emielu and Emielu, 1995). Shifting cultivation is widely

practiced across the State but most dominant among farmers in Gwer East, Gwer West, Gboko, and Konshisha LGAs where the practice has created vegetation regrowth at various stages of seral development.

In practice, these farmers look for areas of primary or secondary forest slash the vegetation, burn it and cultivation begins. The site selection for cropping is at random, thus destroying many of the forested areas in the State. Shifting cultivation as currently practice in the State is a very primitive form of land use that degrades the natural vegetation and its resources rather than conserves it. Its effect is devastating and far-reaching as it has resulted in large-scale deforestation, weed invasion and other alien species. The vigour and growth of the natural vegetation has gradually declined after each cycle of rotational shift in cultivation.

Alley cropping (26.5%) was also identified as the second most dominant farming practice in the study area. Alley cropping as an agroforestry practice involves the deliberate integration of woody perennials plants with crops on the same parcel of land (Kang et al., 1991). In Benue State, alley cropping is mostly practiced in areas where the population density and pressure on agricultural lands are relative high. These areas are in Konshisha, Vandeikya, Kwande and parts of Ushongo, Gboko and Gwer East LGAs of Benue State. The basis for the shift to alley cropping was due to due to lack of adequate farmland. The crops cultivate include yams, maize, cassava and melon between hedgerows of multipurpose trees such as oranges, mangoes and cashew on the same land. Contrary to the effects of other types of farming practices such as shifting cultivation, alley cropping has been used by the farmers in Benue State as a strategy to combat soil erosion and as a means agricultural diversification with other integrated benefits.

The study also identified Zero-Tillage (11.8%) as another major farming practice in Benue State. Zero-tillage is the art of growing crops from year to year without disturbing the soil through tillage (Ortserga, 2010). It is a type of farming where farmers either clear their farm plot without tilling the soil or use herbicide in killing the bushes. Zero-tillage is practised mostly among farmers in Agagbe and Aondona in Gwer West, Kwande, Vandeikya, Konshisha and parts of Gwer East LGA particularly in Mbalom, Mbalim, Mbatyough and Mbakyan districts. The growing interest in zero-till farming in Benue State has been facilitated by the emergence of some improved agrochemicals mostly herbicides (such as Round-up, Touch-down, bush fire, vanish and Gloyste) that are capable of killing virtually all kinds of plants. This has posed as serious threat and extinction of several species of plants and increase weed with disease infestations. This farming practice has caused irreversible damage to the ecological system in Benue State.

Consequently, a three sample Chi-Square (χ^2) was used to test the significance of the relationship between farming practices as a causative factor of vegetation degradation in the State using the information presented on Table 5. The result of the test show that since the calculated value (11.29) was greater than the table value (9.488) at $p<0.05$, the study confirms that shifting cultivation, alley cropping and zero-tillage can be adequately used to explain the relationship between farming and vegetation degradation in Benue State.

Conclusion

Considering the nature, intensity and rate at which farming activities are practised in Benue State, the study concludes that farming has been one of the major drivers of vegetation change in the study. Therefore, the study recommends that farmers should be discouraged from practicing shifting cultivation and zero-tillage on large scale but embark on extensive practice of alley cropping which seeks not only to maintain the soil fertility but helps in vegetation conservation. Slash-and-burn component of shifting cultivation should be discouraged while; afforestation and reafforestation programmes for all vegetation types should be encouraged. This can be done through the implementation and enforcement of ecosystem conservation policy all levels of government.

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