

## ANALYSIS OF BUSH BURNING IN THE NORTHERN GUINEA SAVANNAH OF KADUNA STATE: IMPLICATION FOR AGRICULTURE AND THE ENVIRONMENT

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### Abstract

Bush burning is a common practice in both savannah and forest zones of Nigeria and has greatly altered the original vegetation. Bush burning, therefore, has become a subject of great concern to the society, especially the study area. The study has been carried out to identify the causes of bush burning in the Northern Guinea Savannah of Nigeria, examine the implication of the bush burning on agricultural crops and the environment. A structured questionnaire was administered randomly to 198 respondents in twenty communities of seven local governments in the Southern part of Kaduna State. These include Kaura, Jema'a, Zangon Kataf, Sanga, Kachia, Kujama and Kajuru local government areas. Simple descriptive analysis using tables, means and percentages were used. The results of the study reveal that there is a gradual reduction and loss of plant species, destruction and decrease of crop yields, loss of soils through erosion, disappearing of animal species and reduction in volumes of water reservoirs. The paper offered suggestions such as public enlightenment campaign through the media on the need to retain our environments, Wild life mortifications projects be encouraged in all the states of the federation to improve the rural communities, establishment of Forest Fire Service Units of the State and Local Government levels, involving traditional rulers in reporting cases of fire outbreaks and large scale land resource development projects be embark on.

Keywords: Bush burning, Savannah zone, Environment, Agriculture and Indiscriminate.

### Background to the study

Bush burning is a common practice in both savannah and forest zones of Nigeria and has greatly altered the original vegetation. In recent years, our environment which was taken for granted has become a subject of great concern to the society. The biotic and abiotic component of the ecosystem has been shaped over time and continues to do so (Hamid, Usman, Elaigu and Zubaru, 2010). It is generally believed that the use of fire in Africa started about 50,000 years ago (Adetunji and Onumadu, 2005). Fire is one of the few tools available to an African man for clearing land for land for crops and the practice of burning vegetation and still part of the system of shifting cultivation. In some cases the fire spreads far beyond the confines of the farmlands uncontrolled and destroys the adjoining forest or wood land areas (Okonkwo and Kareem 2009).

As more land is being cleared and prepared for cropping, hunting and grazing annually, burning has become the easiest and most convenient method quite often employed. The vast majority of area burnt and cleared annually for cropping, to drive game for hunters, to improve grazing condition for livestock and for migration and land settlement lies within the savanna ecological zone (Isah and Adegeye, 2002). This practice invariably results in heating and drying of the soil and destroying the ecosystem of the savannah. The soil temperature reached during such burnings ranged from 930c to 10040C as a result of burning different types of materials and the time of exposure to heating (Roberts, 2005; Isaac and Hopkins, 2007).

All fires, regardless of whether they are natural or human-caused, alter the cycling of nutrients and the biotic, physical, moisture, and temperature characteristics of soil (Isaac and Hopkins, 2007). In many cases however, these impacts are either negligible or short-lived and thus have little, if any, impact on the overall ecosystem. In some cases however, the impact of fire on soil conditions can be moderate to severe. The overall degree and longevity of this impact is determined by numerous factors including fire severity, temperature, fire frequency, soil type and moisture, vegetation type and amount, topography, season of burning, and pre- and post-fire weather conditions. Studies by Roberts, 2005 and Isaac and Hopkins, 2007 pointed out that relatively large-scale loss of nutrients and an alteration of soil physical conditions occur after a fire.

In many areas, the attitude changed to one of total burning (wildfire) and this becomes a major cause of depletion of the environment. This necessitates a research of this kind to ascertain the implication of bush burning on the agriculture and the environment of the Northern Guinea Savannah of Nigeria.

## Literature Review

### Bush Fire Occurrence across the Savanna Region

Vegetation burning in the Sahelian region of Africa is a common practice. From the very first satellite fire images obtained from the Advanced Very High Resolution Radiometer (AVHRR) (Stroppiana, Perrackis Kafka and Ennis, 2000), the savanna areas of Africa were identified as the region with the highest occurrence of vegetation fires around the globe. Bush burning is generally known to take place during the dry season (November to March). Large areas of natural vegetation are annually burned in the process. The fires have both natural and anthropogenic causes (Sheuyange, Oba and Weladji, 2005). They are affected by environmental, seasonal climate, and geophysical conditions such as fuel load, fuel moisture, relative humidity, wind speed and ambient temperature. Ignition by lightning is the main natural cause of bush fires. Anthropogenic activities such as seasonal land clearing for farming and hunting (Sheuyange 2002) are reported to be the main cause of bush burning across West African. Farmers' burn vegetation covers during land preparation, for weed control, to rid the land of crop debris, and to remove rubbish. Arsonists may set vegetation on fire indiscriminately, while cigarettes discarded irresponsibly initiate fires across the region. Van Stroppiana et al. (2000) reported that the anthropogenic source of vegetation fire accounts for over 70% of all fires across the African continent.

Winds continuously supply oxygen and help the spread of fires to neighbouring vegetation's. The stronger the wind therefore, the greater the spread of bush fires (Wilkinson and Boulding, 2003). On

the other hand, burns are impeded by the moisture content of vegetation at the time of burn (Kreye, Varner and Knapp. 2011) and by the relative humidity of the surrounding air. For a given fuel load, the higher the fuel moisture content/relative humidity, the slower the burn. Burns across the West African savanna region are enhanced by drying up of vegetation by dust-laden,

Dry-seasonal north-easterly surface winds (Harmattan) that render vegetation vulnerable to burn in the dry season. The regularity of annual bush fire occurrences may have contributed to the establishment of the savannah landscape across the region

#### Environmental and Agricultural Impact of Annual Bush Fires on Savannah Landscapes

Bush fires are part of the natural ecosystems of most savannah landscapes. They are the main buffering element that maintain the structure of the savannah system and prevent formation of forests by keeping a balance between tree species and grasses (Scholes and Walker 2004). Fire impacts ecological succession. It discourages diseases and insects, affects ecosystem sustainability and prevents flowering and/or seeding of some tree species (Stroppiana et al. 2000). Some plants require heat or products of fire to grow. For instance, the whispering bells (*Emmenanthe penduliflora* Benth. Var. *rosea*) sprouts when exposed to the NO<sub>2</sub> in smoke. Ecosystems that depend on fire may thus become unstable without it. Plant nutrients such as N and P may be taken up and stored in plant tissues and may not be available for cyclic plant growth. This has a negative influence on, for example, seedling establishment, or may result in stresses at a later stage. Wildlife numbers and diversity could decline as a result of the decline in plant growth. Annual bush fires therefore play a major role in determining the shape, structure and function of most savanna ecosystems and lead to the formation of existing communities (Stroppiana et al. 2000). Besides herbivory, fire is the most important determinant of the inherent structure imposed on savannah ecosystems by climate and soil. Fire may cause simultaneous germination of some species such as the kapok (*Ceiba pentandra* (L.) Gaertn) and *Terminalia avicennioides* Guill. & Perr. (Duval 2008; Dayamba 2010). Burns may affect germination of some plant seeds. Heat from bush fires breaks dormancy in some thick-coated seeds while it destroys the viability of other seeds (Wuver et al. 2003), eventually determining the vegetation composition of the savanna ecosystem. Fires may lead to a changed soil-microbial composition (Wilkison et al. 2011). The extent of bush fires and the patches of unburned vegetation created are critical to the survival and hence the population of most plant and animal species. Pollution caused by smoke, particulate matter and gaseous emissions is detrimental to human health (Sheugange et al. 2005). During annual vegetation burns, large amounts of carbon dioxide (CO<sub>2</sub>) and other greenhouse gases are emitted into the atmosphere. These greenhouse gases absorb and re-emit radiation (within the thermal infra-red region) from the earth's surface, a process that results in the warming up of the earth's atmosphere thereby affecting the global climate (Crutzen and Andreae 1990; Lehsten et al. 2009). Each greenhouse gas has a different warming potential. For instance, a unit mass of N<sub>2</sub>O has 310 times the global warming potential (GWP) of a unit mass of CO<sub>2</sub>, while CH<sub>4</sub> has about 21 times for a time horizon of 100 years (White et al. 2011). The higher the quantity of atmospheric greenhouse gases, the stronger the warming of the global climate. Since vegetation removes CO<sub>2</sub> from the atmosphere during the process of photosynthesis, plant destruction during annual fires also results in the removal of the natural sinks for CO<sub>2</sub> capture from the atmosphere and subsequent assimilation into plant tissues. The

consistent annual bush-fire carbon-sink removal through burns and the related direct carbon and greenhouse gas emissions into the atmosphere therefore contribute to the observed changes in the global climate.

Agricultural losses due to bush fires are diverse (Andersson et al. 2004). Fire results in abrupt physical destruction of vegetation and its related ecosystem function (Andersson et al. 2006). They result in direct loss of plant and animal life. Fire destroys the soil aggregate structure. It results in the combustion and volatilization of volatile soil- and plant-constituent elements (White et al. 2011). Bush burning therefore results in the direct losses of essential plant nutrients (N, P, K, Ca, Mg) and functional plant nutrients (e.g., Na), (Andersson et al. 2004).

In the northern region of Nigeria, bush fire has been suggested to be a reason for the observed decline in soil fertility (White et al. 2011). Nutrient-rich ash that remains after vegetation burning may be transported from the burned sites to other areas through surface erosion losses, it may be leached to lower horizons beyond plant root zones (Stark 1977), or may be carried along by runoff and wind to different sites, resulting in a local loss of plant nutrients. Temporal loss of plant nutrient manifests in reduced plant growth, degraded soils and environment, and an unsecured future food production. The demerits of annual fires far outweigh their merits (White et al. 2011).

Across the savanna areas of West Africa, only few studies exist relating plant nutrient losses due to bush fires to their consequences for soil degradation and the foreseeable impact on food security. The available studies often omit some aspects of the loss quantification parameters and are not complete. For example, dry-season bush burning across the northern region of Ghana is observed between November and March of each year. Wilkinson and Boulding, (2003) estimated net annual bush fire losses for N, P and K in the northern region of Ghana to be about 10-22 kg N ha<sup>-1</sup>, 1-7 kg P ha<sup>-1</sup> and 2-12 kg K ha<sup>-1</sup>, based only on a 2-month estimation (December and February). Annual nutrient loss based on two months of data serves as a proxy for predicting the annual. However, data on nutrient losses during burns in November and January could add to the existing data and give a clearer picture on the seasonal variations in fire induced elemental losses. Bush fire nutrient losses need to be quantified for the entire period when the fires occur in order to project the potential for depleting the soil nutrient resource against the background of the expected increase in food demand for the ever increasing human population.

The temporal cumulative effect of annual vegetation-burns and the related plant nutrient losses should have detrimental effects on current and future soil productivity parameters across the region. This is not, however, observed in the short term, suggesting some form of nutrient balancing mechanism through nutrient gains is operating.

**Theoretical Framework: An ecological perspective of change and development:**

The perspective is associated with the works of Wilkinson and Boulding (2003). The theory is concerned with issues of change and development in contemporary societies, especially as they relate to environmental changes and/or ecologically related trends of population growth and the need to

devise and sort out techniques of tackling environmental problems. The theory states that, as the population of a society increases in size, individual members of the society exert more pressure on scarce available resources such as land, vegetation and other natural endowments for survival, they directly or indirectly carry out activities that destroy the environment and agricultural farmland. The activities, according to these theorists include bush burning and subsistence agricultural activities of people in agrarian societies of Africa, Latin America.

The perspective further argued that development is needed when a society outgrows its resource base and productive system. The perspective therefore posits that as the established economic system of a given society is proved inadequate and productive system becomes more problematic, societies are therefore driven to change their methods. For instance, as the population of a society outgrows the available resources, especially in agrarian societies, people are forced to involve into other activities like hunting etc. Wilkinson and Boulding conclude that these activities directly and/or indirectly destroy the environment with its attendant consequences on biodiversity.

#### Problem of the Study

In the northern guinea savannah, uncontrolled and indiscriminate bush burning has become a common yearly occurrence during the dry seasons. This is caused by human activities such as farming, hunting, trap and seeking for fresh fodder for cattle consumption (Adetunji and Onumadu, 2005). In the area, indiscriminate bush burning is a disaster. It causes large scale destruction of the forest and wild-life resources. It destroys beneficial crops, animals, micro-organisms, insects, birds, reptiles and mammals (Adetunji and Onumadu, 2005). Some of these animals such as pollinators and decomposers are very important. Losing them therefore, upsets the whole ecological balance of the environment. The serious detrimental effects of bush burning in the study area have great socio-economic implications on the local government growth and development.

Indiscriminate bush burning has affected various components of the vegetation ecosystem of the study area. If proper steps are not taken to prevent and control bush burning in the area, the livelihood and survival of the present and future generations would be in danger. Therefore, in the light of these trends, calls the study that will unravel the implications of the bush burning on agriculture and the environment of the Northern Guinea Savannah of Nigeria.

Literatures shows that related work on the effects of bush burning on the soils have been done in the Southern Guinea Savannah and no attempt has however been made on the analyses of bush burning in the northern guinea savannah of Kaduna State and its implication for agriculture and environmental management.

Therefore, the analyses of bush burning in the northern guinea savannah of Kaduna State and the implication for agriculture and the environment is necessary.

### Aims and Objectives

The aim of the study is to evaluate the implication of Bush Burning in the Northern Guinea Savannah of Nigeria on agriculture and the environment.

The specific objectives are:

1. To identify the causes of bush burning in the Northern Guinea Savannah of Nigeria.
2. Examine the implication of the bush burning on agricultural crops in the Northern Guinea Savannah of Nigeria.
3. Examine the implication of the bush burning on the environment of the Northern Guinea Savannah of Nigeria.

### The Study Area

The study area is situated in the Northern Guinea Savannah of Nigeria. It lies between latitude 100 18'N and 100 30' N and longitude 70 15' and 70 45' E and has a total land area of 32km<sup>2</sup> (BLSK, 2010). In the 2006 census, the population of the area was estimated to be 3,407 people. The major occupation of the area is farming. The climate of the area is part of the tropical wet and dry climate of Nigeria. The wet season begins in April and ends in October, though there is fluctuation Sahara desert in November to March. The annual rainfall is about 1140mm to 1204mm and has the annual average temperatures of about 26.40c (BLSK, 2010). The area is located in the slightly thick wooded vegetation of the north guinea savannah. The activities such as overgrazing, bush burning, over cropping, tree felling for fuel wood have generally modified the vegetation to wooded shrub like-vegetation. The vegetation comprises of transitional woodland, with species like Daniela, Oliverii, vitex, Domana, Diospyros, Mespiliformus, Khaye, Grandifohala and albizia Africana. The area is noted for having large quantities of fuelwood and consumers of wood all year round.

### Methodology

The Northern Guinea Savannah of Kaduna State is located in the vast free forest area and was purposely selected because of the intensive activities of bush burning in the area. In order to acquire the data for this research work, 20 communities were selected out of the seven local government areas. These include Kaura, Jema'a, Zangon Kataf, Sanga, Kachia, Kujama and Kajuru local government areas. The data for the study were collected through questionnaire and existing Journal, electronic libraries and text books. The research was conducted in the month of November and January, 2013. The data collected include the socioeconomic characteristics of the respondents, the causes of bush burning, the effect of the bush burning on the crops, vegetation, water and animals. A total of 198 questionnaires were administered to the respondents randomly in the twenty communities. The data were analysed using frequencies, tables and percentages

### Results

#### The Socio – Economic Characteristics of Respondents

Demographic analysis of the respondents' shows that age groups of 30 – 40years have the highest number of respondents (39.90%). This was followed by the age group of 20 – 30years with 27.76%. The year group of 10 – 20 followed with the ranking of 17.17%. The list year group is 40 years and above with

16.16%. This shows that majority of the respondents are in their active periods and bread winners for their respective family within their communities, according to Amaza, (2004), the respondents age is at a stage at which marginal productivity and productive efficiency, physical energy to work, managerial ability and interest are assumed to increase with age.

The results observed that majority of the respondents 74.75% were females while 25.25% were males, which mean that bush burning is more done by males even though females are involved in the bush burning. The results also show that majority of the respondents (66.16%) were married, 18.18% of the respondents are singles and 15.66% of the respondents are widows/widowers. This result is in line with the findings of Jande, (2005) who reported that married people have more responsibilities such as the provision of food, education, health and well-being of their spouses and children. This may be the reason why the bush burning is common by the married people.

Most of the respondents (38.38%) in the result obtained secondary school, 28.28% of the respondents did not attend primary education, 24.75% of the respondents did not attended formal school and 8.59% of the respondents attended tertiary education. This depicts that educational level of the people is inversely proportional to the number in the people involve in the bush burning, implying that those that are well educated are not many in the bush burning. This is not surprising since a great percentage of the people in the communities have little education. This shows that literacy level concerning the effects of bush burning in the study area is low. The result also indicates that majority (73.23%) of the respondents are farmers by primary occupation, 8.59% of the respondents were craftsmen, 8.08% of the respondents are civil servant and 6.06% of the respondents were traders. As observed bush burning in the study area is dominated by farmers.

The result also shows that 37.37% of the respondents have the experience of bush burning in the area for about 10 - 20years, 27.27% of the respondents have 30years and above of bush burning experience and 21.22% of the respondents have bush burning experience in the area for 1-10years. This indicates that majority of the people have the knowledge of the environmental problems from the bush burning.

The distribution of the household size revealed that the largest households have been between 5 -10 people amount to 45.3%, 15 – 29 have 17.3%, 10 – 15 people of respondents have 16.2% and the rest have 5.3%

**Table 1: Socio - economic characteristics of respondents**

Age	No. of Respondents	Percentage %
10 – 20	34	17.17
20 – 30	53	27.76
30 – 40	79	39.90
40 and above	32	16.16
<b>Total</b>	<b>198</b>	<b>100</b>
<b>Gender</b>		
Male	148	74.75
Female	50	25.25
<b>Total</b>	<b>198</b>	<b>100</b>
<b>Marital Status</b>		
Single	36	18.18
Married	131	66.16
Widow/Widower	31	15.66
<b>Total</b>	<b>198</b>	<b>100</b>
<b>Years of informal school</b>		
No formal education	49	24.75
Primary education	56	28.28
Secondary education	76	38.38
Tertiary education	17	8.59
<b>Total</b>	<b>198</b>	<b>100</b>
<b>Occupation</b>		
Civil Servant	16	8.08
Public servant	08	4.04
Farmer	145	73.23
Trader	12	6.06
Craftsmen/women	17	8.59
<b>Total</b>	<b>198</b>	<b>100</b>
<b>Years of bush burning experience</b>		
1 – 10	42	21.22
10 – 20	74	37.37
20 – 30	28	14.14
30 and above	54	27.27
<b>Total</b>	<b>198</b>	<b>100</b>

### The Reason(s) for Bush Burning in Northern Guinea Savannah of Kaduna State

The section discusses the causes of bush burning in the study area. From the table, it is clear that 31.31% of the respondents attributed the causes of bush burning in the study area to hunting, 30.81% of the respondents attributed the causes of the bush burning to animal grazing, 29.80% of the respondents indicated land clearing as the caused to bush burning and 8.08% of the respondents attributed the causes of bush burning to fear for enemies.

Table 2: The respondents Reason(s) for Bush Burning in the Northern Guinea Savannah

Reason(s) for Bush Burning	Number of Respondents	Percentage (%)
Land Clearing	59	29.80
Animal Grazing	61	30.81
Hunting	62	31.31
Fear for Enemies	16	8.08
Total	198	100

#### Implication of Bush Burning on the Environment of Northern Guinea Savannah of Kaduna State

The implication of bush burning on the environment is been presented in this section. The table shows that 58.08% of the respondents do not experience erosion activities in their locality while the 41.92% of the respondents experience erosion activities. The results also show that 95.45% of the respondents noticed the loss and reduction of plant species while 4.46% of the respondents did not noticed such loss and reduction in their locality.

The results in the table reveal that 64.14% of the respondents observed the loss and drying of water reservoirs while 35.86% of the respondents do not observed the reduction and loss of the water bodies.

It was also observed that 51.01% of the respondents noticed the loss and disappearances of animal species in their areas while 48.99% of the respondents did not observed the loss and disappearances of the animal species. It was observed by 91.41% of the respondents of the appearances of desert like condition in the area while 8.59% of the respondents did not observe the desert like condition.

For the occurrences of floods in the study area, 62.12% of the respondents noticed the occurrences of floods while 37.88% of the respondents did not noticed the occurrences of floods in the area.

Table 3: Environmental Implications of Bush Burning of Northern Guinea Savannah of Kaduna State

Environmental Implications of bush burning	Yes	No. of Respondents and Percentages		
		Percentage	No	Percentage
Erosion activities	83	41.92	115	58.08
Loss and reduction of plant species	189	95.45	09	4.46
Reduction in volume/drying of water bodies	127	64.14	71	35.86
Reduction and disappearance of animal species	97	48.99	101	51.01
Appearance of desert like condition	181	91.41	17	8.59
Occurrences of Flood	123	62.12	75	37.88
Total	198	100	198	100

#### Implication of Bush Burning to Agriculture in the Northern Guinea Savannah of Kaduna State

The section explains the implication of the bush burning to Agriculture. It is observed that 97.98% of the respondents noticed the loss of organic matters in their farmlands while 2.02% of the respondents do not observed the loss of organic matter in their farmlands.

On the soil fertility, 88.89% of the respondents have noticed a great loss of soil fertility in their farmlands while 11.11% of the respondents do not noticed any loss of soil fertility in their farmlands. The results reveal that 82.83% of the respondents experience poor harvest in their farmlands while 17.17% of the respondents experience great harvest their farmlands.

54.04% of the respondents have their economic trees and crops burnt in their farmlands and open forest while 45.96% of the respondents do not experience such in their farmlands. The table indicates that 46.46% of the respondents observed the migration of grazers to other places while 53.54% of respondents do not observed the movement of the grazer to other places.

Table 4: Implication of bush burning to Agriculture in the Northern Savannah of Kaduna State

Implication to Agriculture	No. of Respondents and Percentages			
	Yes	Percentage	No	Percentage
Loss of Organic Matter	194	97.98	04	2.02
Loss of soil fertility	176	88.89	22	11.11
Poor harvest	164	82.83	34	17.17
Burnt economic trees/crops in the farms	107	54.04	91	45.96
Migration of grazers	92	46.46	106	53.54
Total	198	100	198	100

### Discussion of Findings

The analysis of the data collected from the respondents, reveals that various views were held regarding the causes of bush burning practices in the Northern Guinea Savannah of Nigeria. All respondents stated that they practice bush burning in order to derive different benefits. This confirmed the work of Jamala et al (2012), that more than half of bush burning throughout Nigeria is deliberately lit. Hamdi et al (2010), also reported that bush burning is embedded in the cultural values and traditional farming system of many people and that bush burning is part of some countries way of life.

Majority of the respondents attributes the causes of bush burning in the study area to hunting, in bid to driving game from cover to facilitate their capture, land clearing and pastoral herdsman for rearing of animals (table 2). These various opinions are in agreement with the previous findings of Edwin (2006), Awudu (2002) and Gnado (2004) who observed that farmers use bush burning in order to hunt for games or bush meat and also to clear the land for farming. Despite its widely acclaimed advantages, the long-term effects of fires are devastating.

The findings also revealed that there has been considerable decrease cover and loss of plant species due to the rate of bush burning in the area. Majority of the respondents accede the decrease to bush burning couple with other forms of deforestation such as fuel wood harvesting. Consequently, the environmental effects such as erosion activities, loss and reduction of plant species, reduction and disappearance of animal species, reduction in volumes and drying of water bodies, appearance of desert like condition and occurrences of flood are been experience in the area. Majority of the respondents attested that there has been serious disappearance of many tree species within their surroundings in the last 10 years. This finding agreed with that of Abui, Galadimawa, Shat and Mercy, (2014) that over 50% of the forest cover in the Southern part of Kaduna environments and suburbs have been destroyed by bush burning and affected the environment negatively.

Majority of the respondents attributed the erosion activities to bush burning. The burning of the vegetal cover in the study area exposes the soil to the early rains which initiates the ground surface to sheet and rill erosion.

The respondents observed that bush burning has destroyed the feeding, hiding and breeding grounds of the animal species. In the study area such animals like Lions, Hyenas, Antelopes, Hippopotamus, etc and birds like fowls and others have been forced to migrate and are not found again (table 3). According to the respondents, some of the animals have sustained injuries during burnings and died as they are trying to escape. Some birds' Nests and their young ones are burnt. The findings is in agreement with Abui, Makarau and Banta, (2013), that pockets of forest containing wild life species are often encircled and burnt down, while a ring of hunters wait with cutlasses, Dogs, Guns, clubs and Harpoons to kill any wild animal that want to escape when bushes are burnt to clear areas for farming. This explains why there is very little surviving wildlife around the Northern Nigeria Guinea Savannah of Kaduna State.

The results also reveal that bush burning have caused the loss of water in rivers, streams and other reservoirs in the study area. This finding concord with that of Hopkins (2006), that bush burning is known to cause changes in the structure of vegetation's along streams and rivers courses which results to increase in evaporation and reductions in volumes of the water bodies.

The results show that the act of bush burning in the study area has caused the nomadic Fulani herdsmen now find it difficult to graze their cattle. Hence, they are forced to walk long distances to find green pasture and water. Large-scale fires shrink the radii of the grazing land, thereby exacerbating the stressful conditions under which the animals live. In some States in Nigeria for example Kano, the authorities have outlawed burning and have instituted steep penalties of heavy monetary fines on violators.

The results reveal that, the farmers complained of a gradual decrease in the crop yields in their farmlands. These decreased is as a result of the removal of the organic matter by the fire (table 4). This constituted a major loss of vegetal cover which is not returned to the soils but merely produces Ashes which cannot perform the various functions of organic matter input into the soils. According to Jamala et al (2012), that bush burning has a negative effect on soil conditions, and soils may take much longer to recover. The bush burning brings about reduction in soil fertility, promotes soil erosion and also destroys soil micro and macro-organisms. The respondents also complained of the loss of economic trees and crops in the field through bush burning. During bush burning, Mango trees, Cashew etc, and crops that have not been harvested in the field and also the one harvested and heap in the forest are destroyed by the fires.

## Conclusion

The study have shown that bush burning have gradually resulted to reduction and loss of plant species, decrease in crop yield, loss of soil through erosion and reduction in volume of water reservoirs. Due to the detrimental effects of the bush burning in the study area, the environmental sustainability campaign is very important in order to protect our environment.

Bush burning is a multidimensional, only a collaborative effort will ensure protection, preservation of our environment. It is therefore, necessary for all government and non-governmental Agencies as well as private sector and individuals to join force together to fight the menace of bush burning that is threatening our continued sustainable livelihood. All hands must be on desk in preventing and

controlling the consequences of this phenomenon on the ecosystem of Northern Nigeria Guinea Savannah of Kaduna State in order to have sustainable environment.

### Recommendations

The problems of bush burning have to be addressed using the following recommendations:

1. Preventives Measures
  - a. Public enlightenment campaign through the press, Radio, personal contacts, posters, films and lectures, demonstrations, organization or co-operative groups and fire preventions lessons in school curricula should be embarked on. The information could be aired using local languages to enhance understanding.
  - b. Wildlife mortifications projects are encouraged in all States of the federation to improve the standard of living of the rural communities. For example, Grass cutter farming, Rabbits, Snail farming, Bee keeping, Guinea and Pig farming. These projects would help in reducing the rate of bush burning in searching for delicious palatable bush meat.
  - c. Establish of forest fire service units at the state, local governments and District levels.
  - d. They should be well staffed and funded.
  - e. There is the need to build fire towers at strategic places existing obsolete laws should be reviewed in line with the present development trend. Local communities should be adequately involved in reviewing and enforcing the laws of bush burning.
2. Control Measures
  - a. To Establish Man Power Developing Centres at the Federal and State levels for training and retraining of forest fire fighters and fire officers' protection matters.
  - b. There is the need to involve traditional rulers in reporting cases of fire outbreaks and enlightenment and education of members of the local communities of the importance of this, that would generate adequate data on bush burning required for modelling fires in Nigeria.
  - c. Large scale land resource development projects (afforestation, forest reserves, national parks game reserves, recreational parks and range lands) should have a fire unit and that whenever prescribed fires are to be under taken for their management, such areas should first be traced

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