American Journal of Experimental Agriculture
2(3): 359-369, 2012

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Evaluation of Environmental and Vulnerability Impact of Bush Burning in Southern Guinea Savanna of Adamawa State, Nigeria

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Research Article

Received 29th July 2011
Accepted 18th January 2012
Online Ready 18th April 2012

ABSTRACT

Aims: To evaluate farmer's perceptions about the environmental and vulnerability impact of bush burning.
Study Design: Field survey.
Place and Duration of Study: Southern Guinea savanna of Adamawa State, Nigeria, between 1995 and 2010.
Methodology: The respondents interviewed were selected using a simple random sampling and purposive sampling techniques proportional to the size of the areas studied. A sample of 120 respondents formed the sample size. Data were collected from hunters, farmers, herdsmen, foresters and civil servants in the study area. At the end of data collection only 100 questionnaires were correctly filled and returned. The remaining 20 were rejected owing to inconsistencies in their responses. Descriptive statistical analyses such as frequency and percentage were used to analyze the data obtained using statistical package for social science (SPSS 13).
Results: The results obtained show that 96% of the respondents interviewed were males and 4% females. Most of them were aged between 31 to 40 years with 45% representing active part of the population. 30% of the respondents engaged in farming, 21% hunting, 20% pastoralists, 16% foresters and 13% civil servants. Almost all the respondents agreed that they practice bush burning in order to derive various benefits that include; 24% as a means of land clearing and 18% on maintenance of soil productivity. 23% were on the view that it promotes rapid growth of succulent vegetation for livestock. 18% said that it helps them in their hunting expedition and 14% looked at it as a means of conserving the natural vegetation. At the same time 27% of the respondents maintained that this practice leads to lack of pasture for livestock, 22% pointed out that it leads to destruction of wildlife habitat, others, 18% observed that it brings about reduction in soil fertility, promotes soil erosion

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and also destroys soil micro-organisms. An overwhelming view was that due to this practice, the climate was getting drier. 27% of the respondents attributed the dryness to a reduction in the amount of rainfall, 24% observed that there was decrease in vegetation cover, 20% maintained that there is increase in hammattan dust and others, 16% and 13% said there has been drying of water bodies and poor harvest. A pressing issue is how to support people to use the soils, the biota and other natural resources without destroying those resources, and without affecting the climate adversely.

Keywords: Bushfire; climate; vulnerability; environment; pollution.

1. INTRODUCTION

Man's environment is under constant threat from his own activities resulting from expanding population and this remains one of the biggest challenges to the quality of environment. Bush burning, whether the result of a wildfire or a controlled burning, affects not only the appearance of the landscape, but the quality of the soil. The landscape may quickly recover after a fire, with fresh new growth and emerging seedlings. However, bush burning has a negative effect on soil conditions and soil may take much longer to recover, (NRCS, http://www.mt.nrcs.usda.gov/technical/ecs/agronomy/technotes/agtechnoteMT86.html). Man has emerged as a very important geomorphic agent and is capable of changing the environment at a much faster rate than many of the natural processes. Bush burning or fire is the chemical reaction between oxygen and fuel which is raised to ignition temperature by heat. The reaction is self sustaining unless extinguished or the fuel concentration falls below minimum level. Most often bush burning results from a rapid exothermic reaction in combination with oxygen and one combustible material (Lemon, 1967). Hamid et al. (2010) observed that bush burning is part of some countries way of life.

Bush burning is one of the major air pollutants that are emitted during bushfire and these include Carbon monoxide, Carbon dioxide, oxides of Nitrogen, oxides of Sulphur, particulates and Hydrocarbon as a result of incomplete combustion of cellulose materials (Stern, 1976). These do not only pose health hazards to man alone but also affect the environment in general. Oxides of Sulphur and nitrogen remain hazardous as they cause respiratory disorder characterized by excessive mucus secretion in the bronchial tubes.

Apart from soil destruction and desert encroachment caused by the effect of bush burning, it also has a marked increase in global warming due to the emission of NO_2, SO_2, SO_3, NO, CO and CO_2 gases which have tremendous effect on the Ozone layer. There is also the formation of acid rain which deteriorates plants, damages Calcium in soils and also increases acidity of the surrounding lakes, rivers and soils (Judge, 1991). In a previous study conducted, (Edwin, 2006) observed that rampant bushfires cause significant damage in all the ecological zones, and is most pronounced where the savanna vegetation predominates and the incidence also remain the highest. Nsiah-Gyabaah (1996), Awudu (2002), Gnado (2004) and Edwin (2006) maintained that bush is burned in order to hunt for games or bush meat and to clear the land for farming. Fire is also a common land management practices in many agricultural areas of some countries including Nigeria where it is used to burn the by-products of some agricultural crops such as Sugarcane waste, wheat or rice stubble and forest residues.

Wildlife populations are severely depleted due to bushfire, and animal habitats in unprotected forests and savannas continue to be threatened. Fire is used to chase out, kill and destroy animals habitats such as African hare, antelope, waterbuck, bushbuck, elephant, grass cutter, giant rat (NSBC, 2000). The cost of bush meat in the region is an indication of the extent to which wild animal populations are severely depleted (Environmental protection Council, 1992). According to Songsore (1994) human activities such as the use of bush burning and bad farming practices have also exposed the environment to land degradation, deforestation, loss of biodiversity and a decrease in soil fertility, leading to low crop yield and large-scale hunger among the people.

The causes of bushfires are both natural and anthropogenic. Climatic factors especially dry spells; nature of vegetation and wind speed all play an important role. When there is a prolonged dry season, and where the potential evaporation exceeds the rain fall during the year, the natural vegetation becomes dry and therefore vulnerable to fire incidence. Human activities such as land clearing and burning of bush by herdsmen in order to stimulate germination of new grasses are also causes of uncontrolled and indiscriminate bushfires.

Sanders et al. (1996) also observed and maintained that bush burning is an agent in the process of deforestation, owing to the low relative humidity of the semi-arid zone coupled with very dry hammattan wind. There is always a high incidence of bushfires every dry season. The depletion of biodiversity and generally arid climate with occasional droughts in the study area tend to result in desertification, and growing climatic variability leads to lack of water resources to support fauna and flora lives. Growing aridity may cause reductions in ground water recharge of between 5 and 22% by the year 2020 (Edwin, 2006).

The issue of bush burning is one of the challenges or conflicts between man and the environment. Burning is embedded in the cultural values and traditional farming systems of many people. An expert, Dr. Ismail Iro who is the founder of www.gamji.com. and Programmer/Data Analyst in Washington, D.C. USA, in his article, “Traditionalism Vs. Modernism: A Look at Fulani Methods of Livestock Disease Management” said, “Bush burning is the commonest traditional method of combating insects. All of the cattle-raising Fulani who have been interviewed say they habitually use moderate, localized fires to fight off ticks, insects, and harmful pests from the homes and kraals. When the Fulani set fire, their intention is not to generate heat but to send out dense smoke that repels the ants, bugs, bees, locusts, rodents and reptiles.

More than half of bush burning throughout Nigeria is deliberately lit, costing millions of naira damages annually. The questions which need answers are, what motivates an arsonist and what do they feel when the bush is burning? This feature proffers solutions to the problems. The negative impact of bush burning need not to be over emphasized especially during the hot season in northern Nigeria as apart from environmental pollution and health hazards, bush burning obviously causes immense catastrophes in many quarters. They include bush burning as public nuisance, the suffocating experience felt by people due to the huge smoke soaring in the air during the heat, and the pollution of the ozone layer of the environment. In this regard, the menace is of double tragedy in the sense that while the heat is unbearable, bush burning fires also heat up the soil thereby blazing up its nutrients including the fertilizer elements. Furthermore, the fire is smoldering and all the proponents of the plants as well as the grasses that are useful in conserving the forest, Wildlife and small animals are being destroyed in large proportion.

The effect of bushfire on rural livelihoods and on the ecosystem is increasingly becoming extensive and damaging. This means that there is need for a clear understanding of the causes and effects of bushfires so that policies can be made to address the undesirable effects with respect to forestry, arable agriculture, rangeland, soil conservation and wildlife. Studies and Information on the environmental and vulnerability impact of bush fires in the Southern Guinea savanna of Adamawa State, Nigeria is scanty though bush burning remains as old as human existence. The menace of bush burning will be adequately looked into with a view to discouraging it especially in the northern parts of the country. Therefore, this study was carried out to evaluate farmer's perceptions about environmental and vulnerability impact of bush burning in the Southern Guinea savanna of Adamawa State, Nigeria.

2. MATERIALS AND METHODS

The study area is situated at the southern Guinea Savanna of Adamawa State, Nigeria. It lies between latitude 9^{o} 4´ north of the equator and longitude 11^{o} 6´ east of Greenwich meridian. The area is sparsely populated, with an estimated population density of 19–22 people/km². Agriculture is the most important economic activity in the area, employing more than 90% of the labour force. Most of the farmers are subsistence oriented.

The area receives an annual rainfall of 700–1600 mm. Rainfall distribution is unimodal, with much of the rain falling between May and October. The wettest months are August and September (Adebayo, 1997). The rainy season is followed by a long dry season. During this period, the area comes under the strong influence of the hammattan (winds that originate in the Sahara and blow across the Sahel region). The hammattan very dry, and, as a result, humidity may be as low as 10–20% during the dry season.

The temperature characteristics are typical of the West African savannah climate. Temperature in this climate region is high throughout the year because of high radiation income, which is relatively evenly distributed throughout the year (Adebayo and Tukur, 1999). Maximum temperature can reach 40^{o}C particularly in April while minimum temperature can be as low as 18^{o}C between December and January. The mean monthly temperature ranges from 26.7^{o}C in the south to 27.8^{o}C in the northeastern part (Kowal and Knabe, 1972).

Humidity follows the simple relationship with the change of the seasons. It is generally lowest in the dry season (about 20%) and is very high in the wet season (about 80% in August). An increase in the humidity always precedes the onset of the rains in May.

With the southerly movement of the inter-tropical convergence zone from October to April, the wind blows consistently from the north or more often, the Northeast. During this period the area is exposed to very dry winds blowing from the Sahara, (the hammattan), often carrying a thick haze of wind borne, conspicuously diatomaceous dust (Carroll and Hope, 1970). From May and throughout the summer it rains until September. The direction is reversed and the wind blows mainly across the area from the southeast.

Fig. 1. The focal study area

2.1 Sample size and sampling procedure

This study focuses on evaluation of farmer's perception about the environmental and vulnerability impact of bush burning in the southern guinea savanna of Adamawa State, Nigeria, between 1995 and 2010. A reconnaissance survey was made of the study area to obtain a general overview and to collect secondary information relevant to the study. Interviews were also held with farmers: Checklists were used to find out why farmers behave the way they do and to help develop appropriate questionnaires.

An in-depth (informal) survey of 60 selected respondents was conducted to obtain information on household, age distribution and sources of bushfires and to identify some of the causes of bushfires. Information was gathered by means of checklists, as well as by visit to the farmer's fields and plantations. Questionnaires designed on the basis of information obtained in the two previous surveys were administered to one hundred and twenty (120) randomly selected respondents.

The respondents interviewed were selected using a simple random sampling and purposive sampling techniques proportional to the size of the areas studied. A sample of 120 respondents formed the sample size. Data were collected from hunters, farmers, herdsmen, foresters and civil servants in the study area. At the end of data collection only 100 questionnaires were correctly filled and returned. The remaining 20 were rejected owing to inconsistencies in their responses.

2.1.1 Analytical Techniques

Descriptive statistical analyses such as frequency and percentage were carried out using statistical package for social science (SPSS 13).

3. RESULTS AND DISCUSSION

The result in Fig. 1 shows that about 96% of the respondents were males and 4% females. This means that male gender dominates in agricultural activities than their female counter part. A possible reason might be that farm operations are tedious, hence the less participation of women folk. Another reason could be that the Muslim women are not allowed to work on farm, they only participate within the confine of purder (Jamala and Shehu, 2011). Land clearing, shepherding, hunting expedition are mostly carried by men in the region.

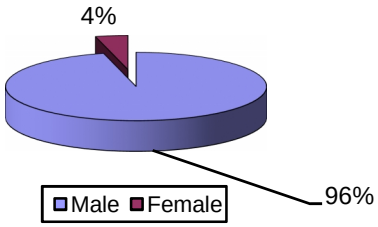

Fig. 1. Distribution of respondents based on sex

Most of the respondents were aged between 31 to 40 years with 45% (Fig. 2) representing active part of the population, engaged in farming. Persons younger than 25 years were generally not interviewed, as it was assumed that their knowledge of climate changes and environmental vulnerability over the past 15 years will not be as accurate as those over 30 years.

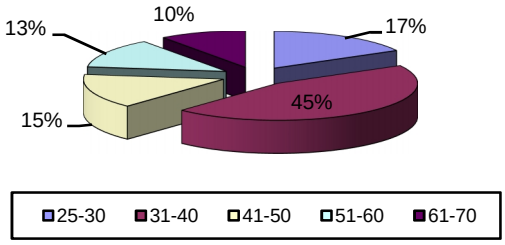

Fig. 2. Distribution of respondents based on age

Fig. 3 shows that majority (50%) of the respondents lived in household of about 5-6 and 7-8 persons. The roles of family members in farming operations are distinct although each member can take part in any activity. The men are often responsible for land preparation, particularly land clearing. An explanation of this is that more adult members in a household will lead to more land being cleared and put under cultivation.

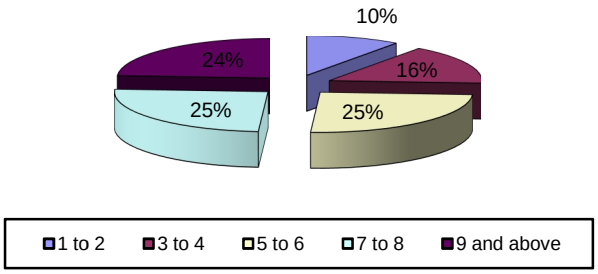

Fig. 3. Distribution of respondents based on Household

The result in Fig. 4 indicates that 30% of respondents are engaged in farming, 21% hunting, 20% pastoralists, 16% foresters and 13% civil servants. Almost all the respondents 87% said that their primary occupations involved the use of land resources, while (13%) maintained that even though they spent most of their active hours in civil service, nevertheless they also engaged in the use of land resource as well. This indicates that the changes brought about on the environment are mostly due to human influence and activities. “Therefore, Man’s environment is under constant threat from his own activities resulting from expanding population and this remains one of the biggest challenges to the quality of environment”.

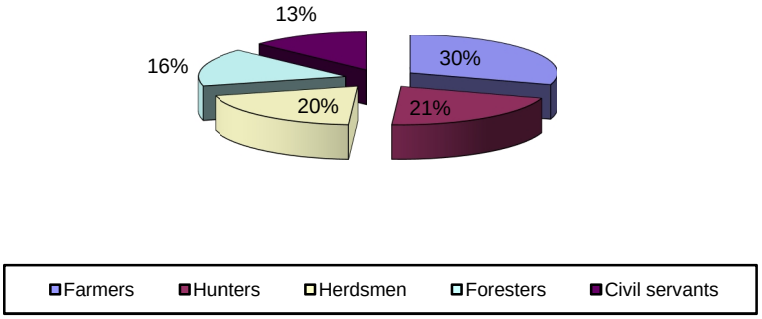

Fig. 4. Distribution of respondents based on Occupation

Various views were held by the respondents regarding causes of bush burning practices. Twenty six percent of the respondents were farmers, twenty four percent herdsmen, eighteen percent hunters, seventeen percent foresters and fifteen percent civil servants (Fig. 5). All respectively states that they practice bush burning in order to derive different benefits. This confirms the fact that “More than half of bush burning throughout Nigeria is deliberately lit” and is in agreement with the report that “bush burning is embedded in the cultural values

and traditional farming systems of many people". Hamid et al. (2010) also maintained that bush burning is part of some countries' way of life.

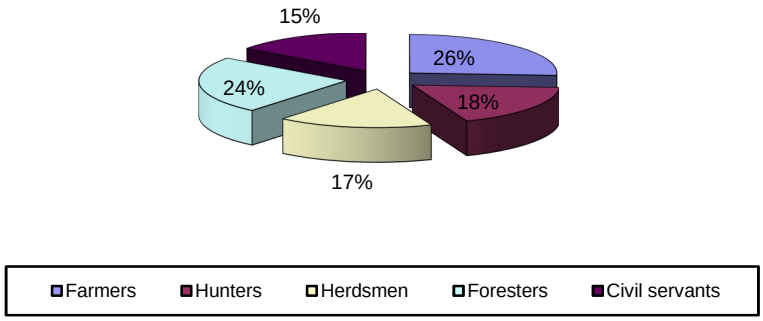

Fig. 5. Distribution of respondents based on causes of bushfire

According to the respondents, some positive impacts of bushfire include 25% as a means of land clearing and 19% for maintenance of soil productivity. Twenty four percent are of the view that it promotes rapid growth of succulent vegetation for livestock. Eighteen percent maintained that it helps them in their hunting expedition and fourteen percent look at it as a means of conserving the natural vegetation (Fig. 6). The various opinions are in agreement with the previous findings of Edwin (2006), Nsiah-Gyabaah (1996), 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. Bush burning, whether the result of a wildfire or a controlled burn, affects not only the appearance of the landscape, but the quality of the soil. The landscape may quickly recover after a fire, with fresh new growth and emerging seedlings. However, bush burning has a negative effect on soil conditions, and soil may take much longer to recover, according to the National Resources Conservation Service.

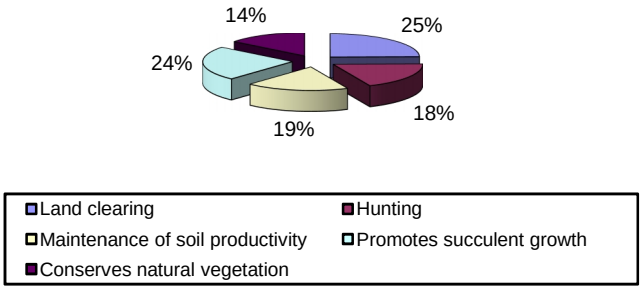

Fig. 6. Distribution of respondents based on positive impacts of bushfire

At the same time twenty seven percent of the respondents maintained that this practice leads to lack of pasture for livestock, twenty two percent pointed out that it leads to destruction of wildlife habitat, eighteen percent observed that it bring about reduction in soil fertility, promotes soil erosion and also destroys soil micro-organisms 15% (Fig. 7). It was clear that burning is an old and established practice which was useful in the past as a means

of land clearing and pastures regeneration. The act of bush burning has also caused the disappearance of certain species of trees and animals. Also, nomadic Fulani herdsmen now find it difficult to graze their cattle, since they are forced to walk long distances to find green pasture. However, with the severe population pressure and accompanying land degradation within an increasingly dry environment, this practice does not help much to solve farmers' current agricultural problems. The major hazards being experienced, as a result includes land degradation, flooding, erosion, deforestation, desertification and climatic drought.

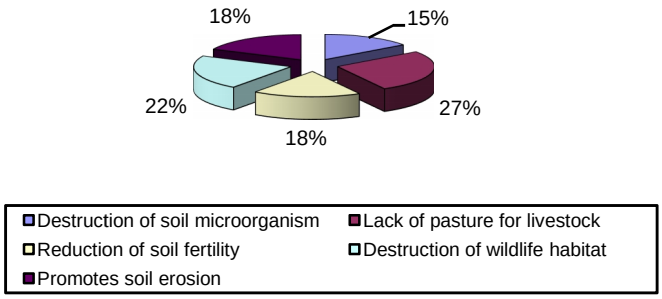

Fig. 7. Distribution of respondents based on negative impact of bushfire

Fig. 8 provides a summary of the perceptions of respondents to climate vulnerability. An overwhelming view was that the climate is getting drier. Twenty seven percent of the respondents attributed the dryness to a reduction in the amount of rainfall, twenty four percent observed that there was decrease in vegetation cover, twenty percent maintained that there is increase in hammattan dust and others, sixteen and thirteen percent say there has been drying of water bodies and poor harvest. The survey findings suggest that farmers and other land users are aware of temporal trends in climate and the status of land, and that their views of climate variations and qualitative changes in land are similar to those of scientists. On the whole, they perceive that the climate is getting drier and the land is degrading. Large-scale fires shrink the radii of the grazing land, thereby exacerbating the stressful conditions under which the animals live. In some states for example Kano, the authorities have outlawed burning and have instituted steep penalties of heavy monetary fines on violators.

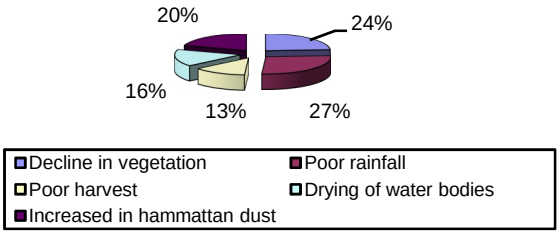

Fig. 8. Distribution of respondents based on knowledge of climate variability

4. CONCLUSION

The integrity of the environment is related to the efficient use and management of available land. The survey findings suggest that farmers and other land users are aware of temporal trends in climate and the status of land as a result of bushfire, and that their views of climate variations and qualitative changes in land are similar to those of scientists. On the whole, they perceive that the climate is getting drier and the land degrading. The need for efficient management of land is the more urgent in the face of an ever-increasing population and the growing demands in all the various activities based on land. Land resources and the processes of their development and use, however, have varying consequences on the environment and specifically land becomes more vulnerable to climate variability, which subsequently affects productivity of land. A pressing issue is how to support people to use the soils, the biota and other natural resources without destroying those resources, and without affecting the climate adversely.

ACKNOWLEDGEMENTS

The authors would like to thank all farmers in the study area who availed us their time during field data collection for this study.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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