Journal of Agriculture and Ecology Research International
2(1): 30-38, 2015; Article no.JAERI.2015.004

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Forest Resource Degradation and Sustainable Practices in Plateau State, Nigeria

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Authors' contributions

This work was carried out in collaboration between all authors. Author MEI designed the study, performed the statistical analysis and wrote the final draft of the manuscript. Author SPP coordinated the administration and retrieval of the instruments. Author LOA managed the literature searches and wrote the first draft of the manuscript. All authors helped to administer and retrieve the instrument, read and approved the final manuscript.

Article Information

DOI: 10.9734/JAERI/2015/12173
Editor(s):
(1) Mirza Hasanuzzaman, Department of Agronomy, Faculty of Agriculture Sher-e-Bangla Agricultural University Dhaka-1207, Bangladesh.
Reviewers:
(1) Anonymous, Imo State University, Nigeria.
(2) Aneeza Soobadar, Agricultural Chemistry Dept, Mauritius Sugarcane Industry Research Institute, Réduit, Mauritius.
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Complete Peer review History: http://www.sciencedomain.org/review-history.php?iid=682&id=37&aid=6399

Short Communication

Received 21st June 2014
Accepted 6th September 2014
Published 8th October 2014

ABSTRACT

Aims: The study was carried out to determine the causes of degradation and sustainable practices for forest and its resources in Plateau state of Nigeria.
Study Design: Descriptive survey research design.
Place and Duration of Study: Kanke, Langtang, Quan Pan, Shendam, and Wase Local Government Areas (LGAs) of Plateau State, between July 2013 and April 2014.
Methodology: The study was guided by two research questions while the population was made up of local forest users. Stratified random sampling method was used to obtain a sample size of 500 local forest users. The instruments for data collection were a structured questionnaire and a structured interview guide. The reliability of the questionnaire instrument was established using Cronbach alpha technique and a co-efficient of 0.81 was obtained. Frequency and simple

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percentage were used to answer the research questions and to interpret the results.
Results: The study found 8 out of 12 causes of degradation and 13 out 14 adoptable sustainable practices for forest and its resources in the study area.
Conclusion: The implementation of the identified sustainable practices for forest and its resources in Plateau state is necessary to help save and improve on the remnant forest in the state.

Keywords: Forest; sustainability; degradation; renewable resources; forest users; Plateau State; Nigeria.

1. INTRODUCTION

Forest remains a reliable supply of fresh and naturally occurring animal and plant resources for human and industrial uses. Forest is a large area of land covered with trees and bushes, either growing wild or cultivated. It is a complex ecological system dominated by tall growing trees [1] and covers about 30% (1/3) of the total earth surface containing roughly 90% of the world's terrestrial biodiversity [2,3]. Forest could be deciduous, evergreen, temperate or tropical depending on the geographical location [4]. There are two class of forest: natural and artificial [2]. Natural forests occur without human intervention while the artificial forest is man-made which involves planting of tall growing trees at calculated distribution, usually planting variety of species on an allocated land. Forest can be found in all regions capable of sustaining tree growth. The types of forest and their distinctive characteristics in their area of existence are determined by climatic factors as well as the extent and nature of human activities of the area. In Nigeria, eight major forest classifications exist, which are lowland rain forest, freshwater swamp forest, mangrove forests, montane forest, riparian forest, plantation, savanna and woodland [5]. A forest is divided into an upper section called the cover story and the lower section referred to as understory. The cover story is made up of higher tree parts such as the tall grown branches bearing the leaves while the understory is the lower section of the forest and is composed of the herb, moss and shrub layers as well as soil microbes. Forest is not limited to only trees but also contains a wide mixture of wild growing plants and animals which gives the forest its vast resources of various origins. Forest resources are such materials obtainable from forest lands to satisfy a need in production or direct utilization. Forest resources are grouped into three categories of timber based, non-timber based resources of plant origin and non-timber based resources of animal origin [2]. Timber based resources are the wood-producing plants while the non-timbers are plant and animal resources of value uniquely found within forest lands. The forest is an important component of the ecosystem.

Forests provide a full suite of goods and services that are vital to human health and livelihood, which is called ecosystem services [6]. The goods and services are of high importance to human and the ecosystem. For example, forest stores carbon, preserves soil and nurtures a diversity of species [7]. Healthy forest ecosystems are ecological life-support systems and provides habitat for wildlife. Forest provides humans with wood, which are exported and used in all parts of the world for production and construction. Forest provides hydrological services to agriculture, moderates the quantity and quality of surface water available for irrigation and also controls sedimentation of irrigation infrastructure [8,9]. Forest serves as watershed: rivers running through forests are kept cool and from drying out [10]. Forest provides employment to people such as forest guards and those involve in lumbering [11] and provides a source of income for individuals as well as a source of generating revenue for government. Forest accounted for 0.50% of gross domestic product (GDP) in Nigeria in 2012 [12]. History has, however, shown that with human mismanagement and over-exploitation, forest and other renewable resources can either be degraded or entirely lost [13].

Degraded resources are often scaled down in value. Degradation results from over usage of resources to a level of low replenishment. Degradation is the reduction in supply and value of a naturally occurring resource. It refers to unfavourable alteration of the resource largely as a result of anthropogenic activities directly and/or indirectly [4]. Forest degradation refers to the impoverishment of standing woody land mainly caused by human activities [14]. Forest, over the years, has been an unrestricted source of wood, charcoal, and land for agricultural purpose which has led to present depletion. Utilizations of forest resources should be anchored on intermediate disturbance hypothesis (which states that forest

resources such as species diversity are maximized when ecological disturbance is at intermediate levels – i.e. not too much or not too little in terms of intensity/ frequency of disturbance). Forest exploitation at this level ensures maintenance and optimum utilization of forest for ecosystem services. Thus high disturbance will negatively affect the balance of resources as well as the regeneration period needed for complete replenishment. Forest degradation in regions like Africa can be traced back to the colonial era. The desire of the colonial overlords to supply homes and industries with raw materials resulted to over-exploitation of forest resources [2] like woody trees. Faced with the need to develop, post independent African countries further extended exploitation of forest resources in their environment thereby reducing the hitherto luxuriant forest vegetation. Developmental projects and infrastructural facilities were provided at the cost of the immediate environment. In recent time, large areas of forest vegetation have been completely cleared out or opened up for urban expansion, industrialization and arable cropping leading to forest degradation. Other causes of forest degradation include some agricultural practices such as short fallow system, commercially logging of trees, poaching of wildlife and other forest fauna, bush burning, constructions (of roads, bridges and buildings), overgrazing as well as over fetching of firewood [4]. Firewood, which is usually obtained in large quantity from the forest, is one of the most important sources of energy in rural regions of most developing countries [15] as well as a major threat to forest health. Example is the sub-Saharan Africa where firewood supplies about 70% of total energy utilized [3] leading to high exploitation in the region. In Nigeria, deforestation and exploitation of forest resources for economic or social reasons is very common, subsequent increased degradation [16]. In 2011 forest contribution to gross domestic product (GDP) was only 0.51%, yet further decreased to 0.50% by the end of 2012 [12] and may continue to decrease due to increased dependency on forest and its resources. Between 1990 and 2005, the world lost about 5.3% of forest and country like Nigeria lost over 21% due to high deforestation rate which was recorded to be about 3-5% per year, translating to loss of 350,000-400,000 ha of forest land per year [16,17]. Forest land in Nigeria now occupy about 92,377km^2 which is about 10% of Nigeria's landmass and well below the FAO's recommended national minimum of 25% for forest landmass [16]. To encourage forest regeneration and conservation of the available resources sustainable management should be practiced.

Conservation of forest resources through sustainable practices ensures continues supplies of the resources in times of need and also enables the forest to adequately and continually perform its natural roles in the ecosystem. Recognizing forest as natural asset with economic and social value can help promote conservation and encourage responsible decision-making towards forest and its resources [6]. When a forest is undervalued it increasingly becomes susceptible to development pressures [6], thus sustainable management is needed. Sustainable management of resource is the simultaneous usage and maintenance of such resource to serve present and future needs. Sustainable forest management refers to environmentally appropriate, socially beneficial and economically viable utilization of forests and its resources for present and future generation [18]. Forest sustainability encourages the utilization of forest resources for present need with adequate consideration for other and similar beneficial use in the future. Management practices to ensure forest sustainability include selective exploitation, encouraging prolonged fallow system for adequate regeneration and replenishment of resources, the practice of planting two tree seedlings to replace one harvested forest tree, afforestation/reforestation and taungya/mixed farming system [2,11]. The felling of only matured trees in the forest can be enforced to reduce logging of young trees. Inter-planting of food crops alongside trees is a common practice referred to as taungya farming. Shade-loving crops like cocoyam and leafy vegetables can be planted in forest land, rather than completely clearing the forest land for cultivation. A major control and restriction to human behaviour towards nature and the environment is usually obtained through prohibition laws [19]. For effective forest management, the government of any nation can adopt rules restricting or limiting excessive harvesting of forest trees and its resource [2]. One of the pre-requisites for sustainable management of forest is the proper enabling of forest institutions. Third party certification is an effective sustainable management approach [20]. Forest institutions conduct research and make recommendations on sustainable activities while devising means for maximum utilization of forest and its available resources. Monitoring

felling of trees for timber and the various wildlife species present, whether any of them are endangered, is important in sustaining forest resources [20]. Trees for firewoods can be harvested in a way that does not destroy the overall health of the forest. This can be done by pruning forest trees for wood and charcoal production instead of felling entire tree, cutting down older trees to encourage diversity and growth, and thinning tree populations to promote healthier growth [20]. Controlled bush burning is a forest sustainable practice that can reduce death of forest seedlings by fire. Declarations made by some tradition and/or religious leaders in Africa and particularly in Nigeria are held to high esteem. Thus entrusting some local community leaders with forest access control could help to ensure forest regeneration and conservation, achievable by declaring access to some forests as taboo and tagging some evil [21]. However, a notable approach to resource sustainability is through public awareness and orientation of the public on proper resource usage. It is necessary that forest users (such as those in the Plateau state of Nigeria) are aware of the level of degradation and are made competent to practice sustainability at the local levels. It is also paramount that they are enlightened on the benefits of sustainable use. This will promoting their understanding of the benefits of conservation and will serve as a reason to enforce sustainable practices at the locality.

Forest sustainability in Plateau state of Nigeria aim to balance the economic benefits of forest-based resources and the long-term health of the forest. Plateau state is characterized by the presence of savanna and woodland forests, which the local users depend on for its resources both timber and non-timber materials such as wood for construction, food materials, fuel (wood), meat and medicine. Agriculture is the mainstay of the economy of the state as the major occupation of the large rural dwellers is farming, hunting for wildlife and harvesting of trees as firewood for domestic use and sales to generate income. In attempt to satisfy their basic needs from the forest, the rate of exploitation by the local users could lead to complete depletion of the abundance of forest trees and other resources. Thus the need for this study, posing the following research questions:

1. What are the practices leading to forest degradation and depletion of its resources in Plateau state of Nigeria?
2. What are the sustainable practices for forest and its resources in Plateau state of Nigeria?

2. MATERIALS AND METHODS

The study which spanned from July, 2013 to April, 2014 was carried out in the Plateau state of Nigeria and adopted descriptive survey research design. The population for the study was 794,388. The study purposively focused on five Local Government Areas (LGAs) rich in forest namely (with a population of about); Kanke (121,424), Langtang South (106,305), Qua'an Pan (196,928), Shendam (208,017) and Wase (161,714) [22]. The sample for the study was made up of 500 local forest users (most of them are rural dwellers) obtained through stratified random sampling method. 100 respondents were randomly selected from each LGA (strata). The instruments for data collection were a structured questionnaire and a structured interview guide, and were designed to collect information for answering the research questions. The instruments were face validated by three lecturers of Agricultural education, all at the Department of Vocational Teacher Education (VTE) at the University of Nigeria, Nsukka. The instruments were divided into two sections (A and B) corresponding to the number of research questions. The reliability of the questionnaire instrument was calculated using Cronbach alpha technique which yielded 0.81 co-efficient. The researchers with the help of two research assistants administered and collected the completed instruments. The instruments were physically administered to contact respondents (see Appendix A) who were available to respond and were knowledgeable in providing valid responses for answering the research questions. The completed instruments were collected on the spot. The research assistants were taught how to administer, moderate and collect the completed instruments from the respondents. Four hundred and eighty two (482) copies of the administered instruments were successfully retrieved representing 96% retrieval rate, though only 458 copies (representing approximately 92%) were well completed thus found useful for the study. Each item on the questionnaire had two response options of True and False. Statistical tools such as frequency (F) and simple percentage (%) were used to analysis data and interpret the result. Percentage cut off point of 50% was used for decision making as regards the responses to the items in the questionnaire instrument. Any item whose "True" responds

option is equal to or greater than the cut off percentage (50%) was regarded as "Agreed" while items whose "False" option are equal to or greater than the cut off percentage were regarded as "Disagreed" by the respondents as causatives of forest degradation as well as sustainable practice for forest in Plateau state. For the interview guide, similar responses were grouped to form a collective opinion of the respondents and were rated in percentage (%).

3. RESULTS AND DISCUSSION

The result of the survey showed a major difference in the respondents' perception of activities leading to forest resource depletion and degradation in the study area, which can be clearly classified into commercial or large scale and local or small scale. The respondents attribute causes of forest degradation to industrial activities such as harvesting of forest trees for charcoal production, felling of trees for pole and timber production (commercially logging of valuable trees), clearing of forest land for urban expansion, and clearing of forest land for excavation and mining of minerals. The small scale or local activities within the forest land is believed by the respondents to have little or no effects on the conservational status of the forest. See Table 1 below.

Organizing and analyzing the responses of the respondents to the questionnaire instrument reveal that eight items had their "True" response option percentage values greater than the cut off percentage point of 50%, indicating that the respondents agreed to the items as practices leading to forest degradation and depletion of its resources in Plateau state of Nigeria. However, Table 1 further revealed that four items had their "False" response option percentage values greater than the cut off percentage point of 50%, indicating that the respondents disagreed to the items as practices leading to forest degradation and depletion of its resources in Plateau state of Nigeria.

Most activities for controlling forest degradation and depletion of its resources require external/ governmental efforts as well as personal efforts of the forest users in their locality. More emphasis is placed on constituted authorities, in most literature, to restore forest to its sustainable state. The trend is observed in the result of the survey presented in Table 2 below.

Table 1. Frequency (F) and percent (%) distribution of respondents on practices leading to forest degradation and depletion of its resources in Plateau state of Nigeria

S/N	Causes of forest degradation and depletion of its resources	True		False		Decision
		F	%	F	%	
1.	Felling of trees for pole and timber production (commercially logging of valuable trees)	431	**94.1**	27	5.9	Agree
2.	Clearing of forest land for urban expansion, industrialization, housing scheme, constructions of roads, bridges and other infrastructures	458	**100**	-	-	Agree
3.	Clearing of forest land for excavation and mining of minerals	333	**72.7**	125	27.3	Agree
4.	Cutting down of forest trees for firewood	178	38.9	280	**61.1**	Disagree
5.	Uncontrolled non-timber forest resource harvesting	216	47.2	242	**52.8**	Disagree
6.	Harvesting of forest trees for charcoal production	279	**60.9**	179	39.1	Agree
7.	Expansion of cropped areas and pastures into forest lands	256	**55.9**	202	44.1	Agree
8.	Bush burning	310	**67.7**	148	32.3	Agree
9.	Hunting of wildlife and harvesting of forest fauna	224	48.9	234	**51.1**	Disagree
10.	Agricultural practices such as short fallow system	219	47.8	239	**52.2**	Disagree
11.	Cutting down and fetching of younger trees for firewood	231	**50.4**	227	49.6	Agree
12.	Overgrazing of forest leaves and young trees	247	**53.9**	211	46.1	Agree

N=458

Table 2. Frequency (F) and percent (%) distribution of respondents on sustainable practices for forest and its resources in Plateau state of Nigeria

S/N	Sustainable practices for forest and its resources	True		False		Decision
		F	%	F	%	
1.	Enforcing policies to control excessive felling of forest trees	454	**99.1**	4	0.9	Agree
2.	Establishment of forest institutions for research and recommendations in areas where forest is available	241	**52.6**	217	47.4	Agree
3.	Encouraging prolonged fallow system for formers who cultivate around forest lands	198	43.2	260	**56.8**	Disagree
4.	Carrying out massive afforestation by government and non-government agents in the locality	366	**79.9**	92	20.1	Agree
5.	Encouraging taungya and mixed farming system instead of completely clearing the forest land for agriculture	458	**100**	-	-	Agree
6.	Stipulating restrictions and limiting excessive harvesting of non-timber forest resources	231	**50.3**	227	49.6	Agree
7.	Practice of planting two forest tree seedlings to replace one matured tree harvested	402	**87.8**	56	12.2	Agree
8.	Felling of only matured trees in the forest instead of logging young trees	456	**99.6**	2	0.4	Agree
9.	Pruning trees for wood and charcoal production instead of felling entire tree	365	**79.6**	93	20.3	Agree
10.	Controlling or restricting bush burning	443	**96.7**	15	3.3	Agree
11.	Controlling or restricting excessive hunting of wildlife in the forest area	389	**84.9**	69	15.1	Agree
12.	Declaring access to some forests as a taboo	451	**98.5**	7	1.5	Agree
13.	Tagging some forests as evil forests to limit access	449	**98.0**	9	2.0	Agree
14.	Public awareness on degradation level and corresponding training in forest management for local forest users	453	**98.9**	5	1.1	Agree

N=458

Opinions of the respondents in response to items constituting research question two indicated that thirteen out of fourteen items had "True" response option percentage values greater than the cut off percentage point of 50%, indicating that the respondents agree to the items as adoptable sustainable practices for forest and its resources in Plateau state of Nigeria. Most of the agreed sustainable practices required governmental intervention more than personal efforts of the forest users. One item had "False" response option percentage value of 56.8%, indicating that the respondents disagree with the item as sustainable practices for forest and its resources in Plateau state of Nigeria. The "disagreed" sustainable strategy happens to be a personal effort of the forest users towards conservation.

Findings of the study in Table 1 revealed that the respondents agree to majority (8 out of 12) of the items as the causes of forest degradation and depletion of its resources in their locality. This finding is supported by [2,3,4,9] who outlined the causes of forest degradation and depletion of its resources to include bush burning, commercially logging of valuable trees, over fetching of firewood and construction of infrastructure such as roads, bridges, buildings among others. The respondents disagreed with the remaining items (4 out of 12) which are cutting down of trees for firewood, hunting of wildlife and harvesting of forest fauna, agricultural practices such as short fallow system and non-timber forest resource harvesting as causes to forest degradation in the study area. This could be as a result of poor awareness and orientation on forest resource and its management in the state, particularly in the rural areas where majority of the forest users

are found. However, the intermediate disturbance hypothesis permits harvesting of natural resources in the ecosystem but only to a level where replenishment is not affected. Forest exploitation at this level ensures maintenance and optimum utilization of forest for ecosystem services. On further probing, using the second research instrument, the interview guide, majority (about 88%) of the respondents explained that the few number of trees fell for firewood cannot possibly affect the large supply of forest trees. About 64% of the respondents explained that only what is needed is harvested for use, "no one goes to the forest to harvest what he/she would not use to solve a domestic or commercial need". This explains their disagreement with items 5 and 9 in Table 1. The respondents (about 51%) explained that most cultivated lands are not forest lands thus short fallow system on the lands have no direct impact on the health of the forest.

Findings (as presented on Table 2) showed that the respondents agreed with 13 out of 14 items, as the sustainable practices for forest and its resources in the study area. This finding is in line with that of [2,9,18,19] who outlined the sustainable practices for forest and its resources to include selective exploitation, afforestation/reforestation, taungya system, enabling of forest institutions and the use of prohibition laws to control human behaviour towards nature. However the respondents disagreed with prolonging of fallow system as a sustainable practice for forest and its resources in the study area. On further inquiry using the second instrument, about 79% of the respondents explained that "land is not as available as it was before, so long fallow period will affect cultivation/production, especially farmers who have small hectares of land". The respondents further explained that the same land under fallow will also be cleared for cultivation after the fallow period whether prolonged or short, thus affecting the same forest land that has been in protection through fallow system.

4. CONCLUSION

Forest is a very important gift of nature that should be properly utilized and maintained for present and future use. This study presents the perception of forest (rural dwellers) users on causes of forest degradation in Plateau state of Nigeria. The result of the study as well as the guided opinion of the respondents is subject to their understanding of forest and its resource management, their level of exposure as well as their knowledge of national or international efforts toward preserving forest. The biased response of the respondents on the interview is probably due to their knowledge being limited to the immediate environment with less understanding of the implication of their responses in a broader scale. The study thus recommends the organization of forest degradation awareness campaign especially at the rural and forest dominated areas in the state where some known causes of forest degradation activities were disputed as a result of poor orientation. The awareness can be incorporated into the agenda of local meetings held at town halls. A delegate from the Ministry of Agriculture (who is well informed on the status of forest in the state and knows the benefits of sustainability) can be sent to such meetings to enlighten the forest users. Awareness or orientation can also be carried out at the market squares on market days where majority of rural dwellers gather for exchange of goods. Workshops on forest and its sustainability can be organized for traditional leaders and district heads to enlighten them and their communities. The study encourages the government of the state to set up Sustainable Forest Initiative Programmes (SFIP). Activities of such programme should include organizing training or seminar for licensed timer harvesters on effective ways to harvest from the forest without endangering the general health of the forest. The study also recommends the adopting and implementation of the sustainable practices for forest and its resources in the Plateau state, as presented in Table 2 (especially transferring some forest conservation control to traditional leaders within the locality) by authorities such as the Ministry of Agriculture and Water resources.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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Appendix A

Frequency (F) and Percent (%) Distribution of the respondents (N= 458)

Classification		F	%
1. Sex	Male	216	47.2
	Female	242	52.8
2. Age (years)	Below 20	26	5.6
	20 – 40	247	54.0
	Above 40	185	40.4
3. Educational status	[a]NFE	189	41.4
	[b]NVE	217	47.3
	[c]HE	52	11.3

Note. [a] = No Formal Education, [b] = Not Very Educated, [c] = Higher Education

Peer-review history:
The peer review history for this paper can be accessed here:
http://www.sciencedomain.org/review-history.php?iid=682&id=37&aid=6399