ENVIRONMENTAL IMPLICATION OF FUELWOOD CONSUMPTION IN GORA AREA, KADUNA STATE.NIGERIA.

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Abstract
The over-dependence on fuel-wood for energy is chiefly because of its relatively low prices and easy accessibility. The Assessment of Fuelwood Consumption and its Implication on the Environment of Gora Area was investigated with the view to identify the types of the fuelwood consumed in the Area, identify the pattern of fuelwood consumption and examine the effects fuelwood consumption on the environment. Data for the study were obtained from a total sample of 150 randomly selected respondents through interviewed and application of structured questionnaires in the months of April, 2013. Data were analyzed using tables, frequencies and percentages. The results revealed that the fuelwood in Gora Area is been used majorly for sales and household cooking, 14 wood species were useful for fuelwood and out of these five were under threat of extinction. The massive exploitation of trees in the area results to soil erosion, flooding, occurrence of drought and increase in temperature rises at a threatening rate and there has been serious disappearance of many tree species within their surroundings. It was recommended that converting wood wastages (wood shavings and saw-dust) to briquettes and motivating the public to plant trees would improve energy supply and therefore reduce pressure on the natural forests. Policy-makers and other stakeholders should use the information to develop policies and strategies to preserve and sustain the species identified as threatened in the area.

Keywords: *Consumption pattern, Decertification, Fuelwood, Environmental Degradation, User groups,*

Background to the Study
Fuelwood is a source of energy derived by burning wood materials like logs and twigs and is common among the rural dwellers. It is a traditional source of energy, which has remained the major source of fuel for over half of the world's population (Ogunsanwo & Ajala, 2002). According to Aide (2002), the share of various energy sources in the total primary energy supply in Nigeria is made up of oil, 10.4%; gas, 6%; hydro, 0.6%; and commercial renewable energy, 83%. The greater portion of the commercial renewable energy is wood, while other agricultural wastes constitute the remaining smaller portion (Aide Memo-ire, 2002).

The over-dependence on fuel-wood for energy is chiefly because of its relatively low prices and easy accessibility (Adedayo et al., 2008). Other reasons are constraints in the supply of the conventional fuels and the growing population with a larger segment still falling below incomes that can afford the cost of conventional fuels (Aide Memo-ire, 2002). In South Asia where there is a large poor population, poverty is the most significant parameter that drives extensive traditional use of fuel-wood and residues (Aide Memoire, 2002). Fuelwood is consumed in diverse ways and at different levels and the life of the majority of

rural dwellers depends either directly or indirectly on fuelwood. However, meeting rural household fuelwood energy needs in the country has become a herculean task due to the enormous quantity of wood required. Daily consumption of firewood by the rural communities in Nigeria is estimated at 27.5 million kilogram per day (Aide Memo- ire, 2002). In the drive to satisfy fuelwood requirements, most lands have been stripped bare of vegetation cover. This has resulted in soil exposure and erosion thereby placing a heavy burden on the environment and on the resources base. The scramble for fuelwood has resulted in massive destruction of many wood resources leading to deforestation and increasing desertification in parts of Nigeria and other parts of sub-Saharan Africa (Adedayo, 2005). The rate of deforestation in Nigeria is estimated at 400,000 hectares per annum. Popoola (2000) observed that the country's forest reserve which was estimated to be at 10% of the total land area in 1970 has been reduced to just 5% as of 1999, which is alarming. In Katsina state, which is located in Northern Nigeria, it was reported that the major source of firewood is farm trees, whose density is diminishing (Aide Memoire, 2002).

Again, increasing industrial activities have led to increased environmental pollution through the release of green house gases (carbon dioxide and nitrous oxides) into the atmosphere by automobiles and other engines. The continuous burning of fossil fuels, fuelwood and bush burning have also contributed to environmental pollution (NEST, 2003). The increasing current demand on the natural purifiers (trees) for fuel wood without concomitant replenishment is an indication that the forest area will disappear fast, which makes the environmental situation more precarious. If no measures are put in place to check these threats, the environment might not be able to support life after a few years, particularly in the savanna ecological zone that is more fragile relative to the rainforest. It follows from the above that, the utilization of wood resources in the savanna lands should be done with caution.

Study Problem

Hassan et al., (2002) observed that due to high costs of electricity and electrical appliances, Nigeria's rural households are highly dependent on natural woodland and forest resources for fuel and as a source of income. These, coupled with open access, high levels of poverty, weak management regimes and lack of coordination between local and traditional governance on local woodlands and forests have led to overexploitation of woodland and forestry resources (Maphiri, (2009); Prasad and Visagie, (2005). According to the Port St Johns Local Municipality Integrated Development Plan (2007), only 17% of all the households had access to electricity within the municipality by 2001. Typical of the former homelands of Nigeria, Rural areas are characterized by poor social and physical infrastructure and low income levels. (Shackleton et al., 2001).

In the study area, similar situation has been observed that no single household have access to electricity, and other sources of energy are unaffordable. This has led to over-reliance on the local open areas forest resources for their source of energy and income and consequent deforestation related problems. Going through literatures it was observed that no related work has ever been carried out in the study area. Therefore, the need for this study can not be over emphasized.

Aim and Objectives of the Study

The study aimed at assessing the fuelwood consumption and implications on the environment in Gora Area in Atyap Chiefdom of Zangon Kataf Local Government Area, Kaduna State.

To achieve the aim the following objectives were observed:

1. To identify the types of the fuelwood consumed in Gora Area.
2. To identify the pattern of fuelwood consumption in Gora Area.
3. To examine the effects of fuelwood consumption on the environment.

Theoretical Framework

This study is anchored on the economic theory of environmental degradation. Meyeres (2005) held that the theory of environmental degradation posits that destruction of forested areas, wetlands and grasslands arises because of the difference between the discount rate of the individual and the society as a whole. As a result of the pressing need for fuelwood, fodder and land for cultivation, people of a lower economic status are subject to a larger share of these losses, assigning a higher discount rate to these resources than society as a whole.

According to the theory of environmental degradation, the private interests of the impoverished and the social interests of the broader society diverge. The interests of the local people in using these environmental resources are intense, immediate, and focused--food, fuel, fodder and cropland. They will, often unknowingly, incur almost any social cost to permit the immediate exploitation of these environmental resources to sustain their livelihood. The interests of loggers, commercial farmers, builders and others who exploit the forests, range and grasslands resources are equally intense, but driven more by immediate profit considerations rather than the need to survive.

Society, as a whole, has traditionally not placed a monetary value on the benefits derived from these resources since they are not marketable. When society has recognized these resources as having value, it has assigned a diffused, nonspecific value that has not been translated into market signals, such as financial incentives for preservation or disincentives for destruction of these resources. Thus, intense, focused private interests are permitted to discount the value of environmental resources, and thereby sacrifice the longer-term benefits to society. The costs of land clearance that arise from the exploitation of natural resources for financial gain highlight the problems clearly, as these resources provide a myriad of functional processes that go beyond the tangible areas of providing food and products for commerce. On the other hand, these functional processes do not correspond to a conservationist ideology, as they are not essential to a sound ecological balance. Rather, they are naturally occurring systems, on which the economic wellbeing of societies at local, national and international levels depends.

Cost of fuelwood and other commodities are primarily determined by the prices of inputs including time, labor, capital and technological advances (Samuelson & Nordhaus, 2005). Economic theory relates that an array of factors influence how much will be demanded of any given commodity at any given price: average levels of income, the size of the population (e.g. household size), the prices of and availability of related goods (in this case, kerosene, cooking gas and coal), individual and social tastes, special influences (e.g. distance of household to common forests and region), and season (Samuelson & Nordhaus , 2005; Reddy, Ram, Sastry & Devi, 2008).

The Study Area

Gora Area is situated Atyap chiefdom in Zangon Kataf Local government Area, Kaduna State. 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 32km2 (BLSK, 2010). In the 2006, the population of the area was estimated to be 3,407people. 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. The area is located in the slightly thicker wooded vegetation of the north guinea savannah. The activities such as overgrazing, bush burning, over cropping, tree felling for fuelwood have generally modified the vegetation to wooded shrub like-vegetation. The vegetation comprises of transitional

woodland, with species like Daniela, Oliverii, vitex, Domana, Diospyros, Mespiloformus, Khaye, Grandifohala and albizia Africana. The area is noted for having large quantities of fuelwood and consumers of wood all year round.

Methodology

Gora Area is located in a vast free forest area and was purposely selected because of the intensive fuelwood harvesting activities in the area. The data for the study were collected through questionnaire and existing Journal, electronic libraries and text books. The data collected include the socioeconomic characteristics of the respondents, the types of fuelwood species harvested, distance covered to harvest fuelwood, the quantity of the fuelwood consumed in a month and the effects of the fuelwood harvesting in the environment. The data for the study were obtained from a total sample of 150 randomly selected respondents in the four communities; Bafoi, Sagaza, Gan and Gora gida through interview schedule, application of structured questionnaires and personal observations. The data were analyzed 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 (44.7%).This was followed by the age group of 20 – 30years with 27.3%. The year group of 10 – 20 followed with the ranking of 14.7%. The list year group is 40 years and above with 13.3%. 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. From the above table, youths appear uninterested in fuelwood harvesting. However, the proportion of people engaged in these fuelwood harvesting and marketing with respect to age should favour income generation. The results observed that majority of the respondents 82.7% were females while 17.3% were males, which mean that fuelwood harvesting is more exclusive preserve of the females even though males are involved in harvesting of fuelwood in the study area. This might also be due to the fact that women are involved in domestic cooking and supplementing farm income in off season periods. This supports the finding of Ani, (2004) and Fedelia, (2005) that generally women have greater access to the cash economy from harvesting fuelwood. This can be agreed upon because from the result shown in the table, more females have access to forest products than males.

The results also show that majority of the respondents (76.7%) were married, 13.3% of the respondents are singles and 10% 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 harvesting of fuelwood is dominated by the married people unlike the case for the singles, who may not likely have other people to take care of beside themselves.

Most of the respondents (42.7%) in the result obtained secondary school, 29.3% of the respondents did not attend primary education, 24.7% of the respondents did not attended formal school and 3.3% of the respondents attended tertiary education. This depicts that educational level of the people is inversely proportional to the number in the fuelwood harvesting business, implying that those that are well educated are not many in the fuelwood business. This is not surprising since a great percentage of the people in the

communities have little education. This shows that literacy level among the fuelwood business in the study area is low. The preponderance of non-literates in high labour and demanding livelihood labour was reported by Amaza (2004), who stressed that practitioners' level of education is inversely proportionate to involvement in labour. This may be for the fact that education helps to liberate the mind and could expose practitioners to several alternatives and helps in efficient use of information which could lead to better output and income.

The result also indicates that majority (90%) of the respondents was farmers by primary occupation, 4.7% of the respondents were craftsmen, 4% of the respondents are civil servant and 1.3% of the respondents were traders. As observed fuelwood harvesting in the study area is dominated by farmers, it means that fuelwood harvesting in the area will markedly affect the farming season due to the attention and time given to fuelwood harvesting. Farmers spend substantial part of their time on the fuelwood business during the dry.

The result also shows that 41.3% of the respondents have been harvesting fuelwood in the area for about10 - 20years, 28% of the respondents have 30years and above of fuelwood harvesting experience and 20% of the respondents have fuelwood harvesting experience in the area for 1-10years. This indicates that majority of the fuelwood harvesting have the knowledge of the environmental problems from the fuelwood harvesting since they have been doing the business over 20years. The distribution of the household size revealed that the largest household 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	22	14,7
20 – 30	41	27.3
30 – 40	67	44.7
40 and above	20	13.3
Total	**150**	**100**
Gender	**No. of Respondents**	**Percentage %**
Male	26	17.3
Female	124	82.7
Total	**150**	**100**
Marital Status	**No. of Respondents**	**Percentage %**
Single	20	13.3
Married	115	76.7
Widow/Widower	15	10
Total	**150**	**100**
Years of informal school	**No. of Respondents**	**Percentage %**
No formal education	37	24.7
Primary education	44	29.3
Secondary education	64	42.7
Tertiary education	05	3.3
Total	**150**	**100**
Occupation	**No. of Respondents**	**Percentage %**
Civil Servant	06	4
Public servant	00	0
Farmer	135	90
Trader	02	1.3
Craftsmen/women	07	4.7
Total	**150**	**100**
Years of Fuelwood harvesting experience	**No. of Respondents**	**Percentage %**
1 – 10	30	20
10 – 20	62	41.3
20 – 30	16	10.7
30 and above	42	28
Total	**150**	**100**
Household size	**No. of respondents**	**Percentage %**
1 – 5	08	5.3
5 – 10	68	45.3
10- 15	24	16.2
15 – 20	26	17.3
20 – 25	08	5.3
25 – 30	08	5.3
30 and above	08	5.3
Total	**150**	**100**

The Respondents Sources of fuelwood harvesting

The frequency on the table gives the various sources of the fuelwood harvesting in Gora area. The results indicate that 86% of the respondents harvest their fuelwood in the free areas, 14% of the respondent's harvest the fuelwood in their farmlands, and since there is no government reserved area, the third option indicated nothing

Table 2: Source of fuelwood harvesting

Harvesting Source	No. of respondents	Percentage %
Reserved	0	0
Farmland	21	14
Free areas	129	86
Total	**150**	**100**

The Respondents Reason(s) for Harvesting Fuelwood

The result explains the reasons for the fuelwood harvesting. The result reveals that43.3% of the respondents harvest the fuelwood for sales, 42.7% of the respondents harvest the fuelwood for cooking, 12% of the respondents harvest the fuelwood for making charcoal and 2% of the respondents harvest the fuelwood for baking of bread and cake.

Table 3: Respondents reason(s) for Harvesting Fuelwood

Reason(s) for harvesting fuelwood	No. of Respondents	Percentage %
For sales	65	43.3
For cooking	64	42.7
For baking	03	2
For Hotel/Restaurant	00	0
For charcoal	18	12
Total	**150**	**100**

The List of Trees Species Used for Fuelwood in Gora Area

The frequency distribution in the table gives the various list and uses if the fuelwood species in the study area. The results indicate that most of the fuelwood originates from few species like Gmelina Aborea 93.3%, Mitryana Inermis 90%, Prosopis Africana 88%, Combretum Spp 86%, Khaya Sengalensis 81.3%, Daniella Oliveri 67.3%, Parkia Biglogosa 66%, Burkra Africana 64.7%, Pterocarpus Eminascerus 63.3% Terminalia Macroptera 62.7%, Terminalia Superb 59.3%, Vitex Doniana 52%, Acacia Spp 46%, and Vitellaria Paradoxa 43.3%.

Table 4: List of trees species used for fuelwood in Gora area

Species Name	Used More	Percentage %	Use Less	Percentage %
Prosopis Africana	132	88	18	18
Terminalia	94	62.7	56	37.3
Macroptera				
Burkra Africana	97	64.7	53	35.3
Daniella Oliveri	101	67.3	49	32.7
Vitellaria Paradoxa	65	43.3	85	56.7
Parkia Biglogosa	99	66	51	34
Khaya Sengalensis	122	81.3	28	18.7
Gmelina Aborea	140	93.3	10	6.7
Mitryana Inermis	135	90	15	10
Acacia Spp	69	46	81	54
Terminalia Superb	89	59.3	61	40.7
Combretum Spp	129	86	21	14
Vitex Doniana	78	52	72	48
Pterocarpus	95	63.3	55	36.7
Eminascerus				

The Quantity of Fuelwood Consumed (bundles/pickup) in a Month in Gora Area

The results below shows the quantity of the fuelwood consumed in the study area. 37.3% of the respondents consumed more than 2 pickups of fuelwood in a months, 33.3% of the respondents consumed 1pickup of fuelwood in a month, 21.3% of the respondents consumed 40 – 60 bundles of fuelwood in a month, 5.3% of the respondents consumed 20 – 40 bundles in a month and 2.8% of the respondents consumed 1 – 20 bundles of the fuelwood in a month.

Table 5: quantity of fuelwood consumed in a month in Gora area

Quantity consumed (bundles/pickup)	No. of Respondents	Percentage %
1 – 20	04	2.8
20 – 40	08	5.3
40 – 60	32	21.3
1 pickup	50	33.3
2 pickup and above	56	37.3
Total	**150**	**100**

The Environmental Effects of Fuelwood Harvesting Area

The results show that 18.7% of the respondents observed a reduction in the plant species, 17.3% of the respondents observed a reduction in vegetation cover and appearance of desert like condition respectively, 16.6% of the respondents observed the disappearance of animal, 14.7% of the respondents observed an increase in temperatures, 6.7% of the respondents observed the occurrence of flood in the area, soil erosion carries 4.7% and 4% of the respondents observed the occurrence of drought.

Table 6: Environmental effects of Fuelwood Harvesting

Environmental Effects	No. of Respondents	Percentage %
Reduction in Vegetation cover	26	17.3
Reduction in plant species	28	18.7
Appearance of soil erosion	7	4.7
Increase in temperature	22	14.7
Occurrence of drought	6	4
Occurrence of food	10	6.7
Disappearance of animals	25	16.6
Appearance of desert like condition	26	17.3
Total	**150**	**100**

Discussion of Findings

The results in table 4, reveals that majority of respondents in the study area harvest fuelwood for sales and for cooking energy. This finding partially corroborates that of Adedayo et al (2008), who reported that over 95% of the Nigerian population in the savanna region, depend on fuelwood as the main source of domestic energy supply. The greater proportion of fuelwood utilized for household consumption could be explained by the fact that most homes depended on fuelwood for sales and cooking since the cost of other fuels was higher (Sodimu et al, 2003). Similarly, other user and that the harvesting of these fuelwood groups also preferred fuelwood to other energy sources because of easy availability, cheaper costs and its high heat production capacity .are carry out in the open free areas (forest) without restrictions despite the government regulation against deforestation. It was observed that the occupant of the study area mostly poor farmers whose only source of income and cooking energy is from the fuelwood harvesting. These fuelwood are harvested in large quantity and are laid in heaps for customers to buy. It was observed in (table 6) that more than 2 pickups are sold out by individual fuelwood harvesters in the study area. In most cases

urban fuelwood sellers come to buy in bulk, large number of prepared-food vendors such as restaurants, vendors of barbecue (suya) and party event outfit that served as celebrations, and bakeries are regular customers of fuelwood harvesters in the area. Institutions such as hospitals, schools and prisons and industries such as blacksmiths are among the highest consumers of fuelwood. This result obtained affirmed the observation by Chukwu (2001) that over 70% of the total population of Nigeria relies on fuelwood as their major source of income to take care of their needs and energy for cooking and heating purposes.

Table 5 showed that the most utilized tree species were Prosopis africana, (65%), Terminalia macroptera (38.9%), Burkia africana (29.4%), Daniella olivera (27.8%), and Vitellaria paradoxa (25.6%). The reasons adduced for this were that these tree species have high heat capacities with hot amber, high combustibility, and production of quality fuel and charcoal. The least used tree species were Annona senegalensis (1.1%), Afzelia africana (1.1%) and Ficus thonnigii (0.6%) in that order. The reasons advanced for this low utility were that some of the species were scarce and others possess poor burning characteristics. Findings show that supplies from preferred species have almost been exhausted and are inadequate and selectivity interms of species has declined significantly. Harvesters in the area noted that species which in the past were not utilized, owing to less than optimal characteristics are now being burnt for fuel. This explained why the fuelwood harvesters would have to trek a distance of more than 3km to the source of fuelwood in search of the preferred species (table 3). Discussion with key informants supported by personal observations revealed that Vitellaria paradoxa, Prosopis africana, Terminalia macroptera, Afzelia africana and Pilliostigma thonnigii .were under threat of extinction; the reasons being that much pressure is being mounted on them for fuelwood production. More awareness is needed to sensitize the people about the imminent adverse social and environmental consequences that will arise if this situation is not reversed

The findings revealed that there has been considerable decrease in the vegetal (tree) cover in terms of number and species diversity due to the high rate of harvesting in the area (table 7). Over 90% of the respondents accede to the fact that this decrease was due to removal of trees for fuelwood, construction and agricultural purposes. Consequently, deforestation and its attendant effects; desertification, soil erosion, flooding, occurrence of drought and increase in temperature rises were being experienced in the area and at a threatening rate. At least 16.6% of the respondents attested that there has been serious disappearance of many tree species within their surroundings in the last 10years. This finding agreed with that of Jande, (2005) that over 50% of the forest cover in the southern part of Kaduna environments and suburbs have been deforested for fuelwood and timber production. Other activities that affected the environment negatively were the release of smoke or green-house gases (carbon dioxide and carbon monoxide) into the atmosphere from bush burning car fuel burning and other activities.

This research study reveals that a large amount of fuelwood is being utilized at both the domestic and commercial levels. However, little effort is being made in afforestation, which implies that in a short time, there will be acute scarcity of fuelwood also. In addition, the adverse effects of deforestation on the environment will be experienced greatly if measures are not put in place in time. Deliberate efforts are required to curtail the present level of deforestation and disappearance of plants.

Conclusion and Recommendations

Fuelwood is the major source of energy for the inhabitants of Gora area. It is utilized for a variety of purposes both domestic and industrial activities. There is a widening demand for fuelwood, with increasing pressure on the remaining trees. The supply of fuelwood within the metropolis is mainly from fuelwood dealers, who obtain it mainly from the free access forest areas and on farmlands.For the continued supply of wood and

protection of the forest, the traders and other user groups should be made to pay for research and establishment of the trees in plantations. Increased awareness and education on the environmental consequences of over-exploitation and poor management practices should be intensified, while joint management efforts are explored between forest managers, traders and other stake-holders.

a. Several species including Vitellaria paradoxa, Prosopis africana, Terminalia macroptera, Terminalia superba, Afzelia africana, and Pilliostigma thonningii are under threat of extinction. Adoption of improved harvesting techniques, reduced exploitation pressures, extensive silvicultural research and planting of these species in plantations as well as proper enforcement of forest regulations will protect these trees from extinction.
b. To ensure fuelwood supply and environmental sustainability, massive awareness should be created both at the grassroots and in the townships about the adverse effects of tree overexploitation on the environment. Stakeholders should encourage tree planting by providing incentives like seeds, seedlings, equipments, finance and materials for afforestation in order to meet the demand for fuelwood and curtail environmental hazards.
c. Government and other stakeholders should ensure the enforcement and prosecution of defaulters of forestry regulations. Furthermore, the increase in prices of other energy sources should be checked and kept on the minimum in order to shift attention from sole dependence on fuelwood.
d. In order to minimize losses and also reduce pressure on the tree species, special briquette production from sawdust generated from saw mills and other timber works should be encouraged. Again, research options on bio-fuel and other mineral resources like coal can be supported to supplement fuelwood.
e. Finally, trees are of immense importance to man, not only in maintaining environmental balance, but also for other uses, hence their preservation and conservation is essential for the present and future needs. Conservation and preservation strategies adopting community participatory approach should be harnessed

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