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Adeniyi Gbadegesin¹, Felix Olorunfemi²

Abstract—Forests and forest products can play a significant role in mitigation of harmful effects of green house gas emissions. They can act as a “sink” to absorb emissions and store large quantities of Carbon for extended periods of time. Forests are also an important component of adaptation strategies needed to address continuing changes in the natural resource base that sustains our livelihoods. Sustainable forest management is thus a critical component of any policy and action programme that seeks to address the growing global concern about the impact of climate change. In this study, the socio-economic aspects of the fuel wood business is examined in selected states of the forest and savanna zones of Nigeria with a view to highlighting the effects of government policy of subsidy removal on petroleum products could have on forest sustainability and adaptation to climate change. The study was carried out in rain forest states of Osun and Ondo and the guinea savanna state of Niger in Nigeria. The study involved administering questionnaire on households, institution and small scale business enterprises, fire wood sellers and transporters. Results indicate that fuel wood remains the main source of energy for heating and cooking in the two zones. In addition, frequent increase in the price of petroleum products has pushed the price of the products beyond the reach of the poor with an attendant increase demand for fuel wood. Also, small scale business enterprise in the informal sector depend overwhelmingly on the use of the fuel wood. However, methods of fuel wood exploitation in the two ecological zones are unsustainable as people hardly plant trees to replace those removed. The implications of the government policy on forest sustainability and adaptation to climate change strategies such as community based forest management are discussed.

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I. INTRODUCTION

Approximately 2.5 to 3.0 billion people (40 to 50 percent of the world's total) rely on wood for fuel, both for warmth and food preparation. In Africa, wood is depended upon for upto 58% of all energy requirements and in many savanna areas, demand for wood supplies far exceeds the rate of growth (Williams, 2003). Regional analysis of the use of wood as a major source of energy requirements indicates that in Eastern, Western and Southern Africa, more than 90 percent of rural households depend on fuelwood, including fuelwood and charcoal. Nevertheless, it is pertinent to note that wood as other combustible and renewable resources were humankind's first energy sources. However, wood is more flexible than other known energy sources and thus gains supremacy over other fuel resources mainly because it costs less and in some circumstance obtained free from the environment.

In Nigeria, records of fuelwood consumption are relatively scanty and the available ones not reliable. Enabor, 1981; Onuaha, 1981; Ay, 1979 and Edu, 1981 among others have confirmed these inaccurate measures of fuelwood consumption. Most of them at best give estimates. Mendie and Sani (1991) reported that fuelwood is the most dominant and widespread source of energy used for domestic purposes in the Jos Tin mining region of Plateau State, Nigeria. And that dependence on fuelwood showed an upward trend, and is rapidly increasing since the introduction of Structural Adjustment Programme (SAP), which brought about high prices of other competing fuel sources such as gas, kerosene and electric stoves far beyond the reach of an average income earner.

Available records show that in northern Nigeria, the fuel consumption rate was given as 23.3 million cubic meters per year (Anderson and Fishwick, 1988). Although Nigeria has crude oil and gas

resources, the levels of gas and kerosene cookers and cooking stoves adoption are far below the levels that could make any impact. Available information in Table 1 indicate that at national level and most States in the federation shows that about 40% of heat and cooking energies are derived from fuelwood utilization in the country (FOS, 1992). The situation is worsened by the ever increasing prices of the alternative energy sources following the gradual withdrawal of subsidy on

petroleum products accompanied by the depreciated value of the Naira.

Although, the alternative energy sources are renewable and versatile, they have proven unacceptable to several households in Nigeria because the traditional fuels (especially firewood etc) are safe, convenient and more reliable in terms of supply. With the gradual removal of subsidy on petroleum products since 1986 in the country, the pressure on fuelwood has been so intense.

Table 1: Percentage distribution of households by type of commonest fuel used in selected States of Nigeria

State	Electricity	Gas	Kerosene	Wood	W
Anambra	-	8.3	62.0	2	
Kwara	1.2	-	33.3	9.7	
Lagos	-	0.8	99.2	6	
Niger	0.4	6.8	14.8	5.0	
Ogun	-	0.4	79.8	0	
Ondo	-	0.8	47.3	.0	
Oyo	-	0.7	68.2	7	
Rivers	-	5.4	40.1	8.0	
All Nigeria	1.5	2.7	56.0	1	
				9.9	4
				9.8	3
				0.4	5
				4.5	3
				9.7	

Source: Federal Office of Statistics (FOS), Lagos, 1992

Elkan, (1988) asserted that reforestation efforts have failed because commercial production of fuelwood cannot compete with 'free' wood from common lands. However, he maintains that prices of fuelwood will inevitably, rise as free fuelwood is exhausted and that only increases in incomes especially of the lower income groups will protect them from increase in the cost of cooking. In addition, literature on the economics of deforestation tend to suggest that economic growth which raises the income level of the population will induce a switch from fuelwood to kerosene or other higher forms of energy and thus reduce deforestation associated with fuelwood demand. Interestingly, today the cost of kerosene and some other alternative sources of energy both in the west and central Africa is not very different from the cost of fuelwood in the cities. Using data from Ghana and a simple linear model, Abakah (1990), investigated the link between real incomes, inflation and fuelwood consumption. His regression analysis

indicates that the quantity of fuelwood consumed is negatively correlated to real incomes and positively related to inflation levels.

The disturbing aspect of fuelwood extraction is that it can hardly be replaced. Farmers, research institutes and afforestation and reforestation programmes concentrate mainly on substitution of indigenous plants with exotic and economic trees, herbages, legumes and other shrub plants. Therefore, it is unusual to allow the regrowth or reestablishments of indigenous and naturally occurring plants. However, the role played by forestry as an important sector of the agricultural sector in providing fuelwood, industrial wood and other products is often not adequately captured by official statistics.

Climate change, biodiversity and forest loss are cross-cutting issues that need to be addressed simultaneously and urgently for adaptation in Africa especially with other emerging global challenges

fueling food crisis. The synergy between adaptation to climate change and biodiversity conservation requires a unifying strategy to enhance the sustainability of the forest resource pools on which poor communities directly depend for their livelihoods (Nkem et al, 2008). This approach has recently been acknowledged in discussions on cooperation between conventions within the Convention for Biological Diversity (CBD) and the United Nations Framework Convention on Climate Change (UNFCCC). Both of which have stressed the need for common approaches to their national implementation, which also provides a cost-saving option for African countries.

Effects of climate change on forests are clearly transboundary in nature. Several studies and predictive models have strongly emphasized the vulnerability of African tropical forest biodiversity to various climate change scenarios, and the resulting direct consequences on wildlife population and the livelihoods of humans. Protecting forests against them and adaptation of forest management should therefore be further explored. Adaptation strategies should encourage the conservation of habitats and biodiversity (fauna and flora) that underlies livelihood adaptation especially in rural areas. Also, there is need to provide and support participatory and open multi-stakeholders discussion platform that encourages the integration of biodiversity conservation into mainstream climate change adaptation strategies, and beyond protected areas. Given the rate of fuelwood exploitation in most developing countries, this study, therefore, becomes very relevant given the fact that for forests, several impacts of climate change are relevant and need consideration. Also, new calls for intensification of forest management, mainly for bioenergy development is crucial especially for African countries.

Therefore, this study focuses on socio-economic aspect of fuelwood business in selected states of forest and savanna ecological zones of Nigeria with a view to highlighting the effect of government policies of removal of subsidies of petroleum products and its effects on forest sustainability and adaptation to climate change. This study, a follow-up to the 1996 study by Akintola et al is justified in view of increasing rate of forest exploitation and its implications for forest sustainability and adaptation to climate change.

II. METHODOLOGY

The study utilized primary data collected by means of questionnaire administered to respondents in the two study areas Ijebu-Jesa/Efon Alaiye in Ondo State and Minna in Niger State). The questionnaires were of three types. One was administered to firewood sellers. Another set to households and the third set

were administered to institutions and small scale enterprises. The questionnaires were administered to both randomly and purposively to selected respondents. The analysis of the data in the two sampled ecological zones for 1983 and 1993 relied on an earlier study carried out by Akintola et al (1996). Although the data for 2007 were collected from the same sampled areas, the study did not use the same sampled population used by Akintola et al, (2007). In addition, secondary data on the prices of kerosene was collected from the Nigeria National Petroleum Corporation (NNPC).

For the households survey, a total of 200 questionnaires were administered in Ijebu-Jesa/Efon Alaiye while another 200 were administered in Minna. For the firewood sellers, a total of 50 were administered in Ijebu-Jesa/Efon Alaiye while 100 questionnaires were administered in Minna. The disparity in the number of questionnaires administered to this category of respondents in the two areas is due to the fact that there more firewood sellers in savanna ecological zone represented by Minna than forest ecological zone represented by Ijebu-Jesa/Efon Alaiye. For the third category of respondents used in this study that is the small-scale enterprises/institution 24 establishments were sampled in Ijebu-Jesa/Efon Alaiye while a total of 27 establishments were sample in Minna.

For the 2007 data, the same categories of respondents were surveyed similar to Akintola et al (ibid) study. However, smaller sample size was collected. For the household survey a total of 50 questionnaires were administered in each of the two study location as a follow-up to the earlier study by Akintola et al (ibid). For the firewood sellers, a total of 30 questionnaires were administered in Minna, while 20 questionnaires were administered in Ijebu-Jesa/Efon Alaiye. However, 10 establishments each were sampled in the two locations.

The data collected were analysed using the Statistical Package for Social Scientists (SPSS). The data and results were presented in tables composed of simple frequencies and percentages. It should be noted that only the questionnaires that were good enough for analysis were used for the study.

III. THE STUDY AREAS

The study was carried out in two areas namely: Ijebu Jesa and Efon Alaiye areas of Osun and adjoining Ekiti States and Minna areas of Niger State. The Ijebu Jesa and Efon Alaiye are in the rainforest region and Minna in the guinea savanna region of Nigeria. Ijebu Jesa (Lat 2°8'N Long 5°E) is located in Osun State while Efon Alaiye (Lat 2°8'N Long 5°3'E) in Ekiti State. Both areas are characterised by a rolling topography with fairly extensive ridges of quartzite

rising above the general land surface. The two areas are characterized by the same climate (tropical rain forest, Koppen's Af climate) and both areas are underlain by acid, crystalline rocks of the basement complex formation. The climate is characterized by wet and dry seasons with the former lasting from March or April to October. Annual rainfall generally ranges between 1300 and 200 mm with over 80% of the rains falling during the wet season. Temperature are high throughout the year with a n annual average of about 26.6°C.

The soils in the area are Ferruginous Tropical soils formed from crystalline acid rocks. Their main features include a sandy surface horizon underlain by a weakly developed clayey, mottled, and occasionally concretionary sub soil. These soils are generally considered to be of high natural fertility, although traditional management practices have caused some problems in their utilization for crop production. They are sensitive to erosion and occasional waterlogging as a result of the clayey sub soil. The soils are of medium productivity class and of good potentials (Agboola, 1979).

The natural vegetation of Ijebu Jesa area is moist semi deciduous rain forest (Hopkins 1974) Most of the original forest has been cleared to establish cocoa plantations and farms of field crops consisting mainly of cassava inter cropped with maize and yams. Today, the occurrence of natural forest is largely restricted to wet valleys, the landscape consisting mainly of a mosaic of cocoa plantations, cassava farms and regenerating bush fallow vegetation.

Minna (Lat 5°10'N, long 7°E) is located within the guinea savanna ecological zone of Nigeria. The area is characterized by igneous and metamorphic rocks of the Basement Complex formation. The climate of the area is sub humid tropical climate with marked wet and dry seasons. The wet season starts from April and lasts till September. The remaining six months of the year, that is, from October to March are characterized by the dry season. Highest rainfall is obtained in August and the annual rainfall usually ranges between 1000 and 1300 mm. Temperature is high throughout the year with no marked seasonal for monthly departure from the annual average of about 27°C.

As with the rainforest zone, the soils in Minna area are ferruginous tropical soils. Their general characteristics are broadly similar to those of Ijebu-Jesa/Efon Alaiye area having been formed from similar parent materials. However, because the soils in Minna area are formed under guinea savanna vegetation, they usually contain less organic matter. Consequently, their water holding and cation exchange capacities are

usually lower than similar ferruginous soils in the rainforest region of Ijebu-Jesa/Efon Alaiye.

The vegetation of Minna area is southern Guinea savanna characterised by tall grasses particularly those belonging to the genera *Andropogon*, *Hyparhenia* and *Pennisetum*. Typical trees include *Lophira lanceolata*, *Annogeissus leiocarpus*, *Azelia Africana* and *Daniellia oliveri*. In intensively farmed areas, particularly around large settlements, the vegetation is degraded into tree or shrub savanna. In areas where population pressure on land is not great, savanna woodlands are characteristic.

IV. RESULTS AND DISCUSSIONS

1) Socio-economic Characteristics of the People

Generally, the people in the two zones are largely rural. Over 40% of the people in both zones are concentrated in the rural areas. The survey conducted for this study indicates that majority of the households has 3-8 persons. This relatively large household size has implication on rural energy consumption pattern. A significant number of the men have more than one wife, presumably in order to provide more hands for agricultural activities. Besides majority have more than two children per household in both Niger and Osun/Ekiti States. Literacy level is, however, higher in Osun/Ekiti States than Niger State. This may probably affect the possibility of acceptance of alternative sources of fuel/energy.

Farming is by far the most important occupation in Niger State, with almost 60% of the respondents in the area engaged in the profession, while in the Southern (forest) zone, the bulk of the people (accounting for 46.2%) are engaged in services with only 21.1% being farmers.

In both the savanna and forest ecological zones, the traditional system of shifting cultivation is prominent. Simple farm implements such as the hoe, cutlass and axe are used in farming operations. In the forest zone, crops grown include cassava (*Manihot spp*), maize (*Zea mays*), cocoyam (*Colocasia esculenta*), yam (*Dioscorea spp*) and rice (*Oryza sativa*). Multicrop farming and intercropping systems are commonly practiced. In Niger State the common crops grown are sorghum, rice, some root crops such as yam and cassava.

Since a significant proportion of the people in the study areas are rural farmers, the rural income accruing to a family is low. Over 74 and 68.4% of the

households surveyed in Niger State and Osun/Ekiti States respectively earn less than N90,000.00 per annum (i.e less than \$800 per annum).

In terms of ethnicity, the Yorubas are the dominant ethnic group in Ijebu Jesa and Efon Alaiye areas. A number of migrants including Ibos, Urhobos and Ebiras live amongst the Yourbas to provide farm labour and also engaged in other activities such as

tapping of palm wine and collection of palm produce. The Gwaris are the dominant ethnic group in Minna although Hausa is the primary language of communication. A number of migrant communities of Yorubas, Ibos and other ethnic groups also inhabit the area. The socio-economic characteristics of the respondents are presented in Table 2.

Table 2: Socio-economic characteristics of the respondents (percentage)

No. of persons per household			
	Minna	Ijebu-jesa/Efon Alaiye	
1-2	4.5	15.0	
3-8	69.0	40.1	
<9	19.5	26.8	
No response	7.0	18.1	
Total	100.0	100.0	
Level of education	No formal education	26.0	19.1
	Quranic education	12.0	4.5
	Primary education	15.5	32.2
	Secondary education	29.5	21.6
	Post-secondary education	16.01	21.1
	No response	1.0	1.5
Total	100.0	100.0	
Occupation	Trading	3.5	9.0
	Farming	59.5	21.1
	Services	14.5	46.2
	Teaching	7.0	15.1
	Civil service	14.5	7.0
	No response	1.0	1.6
Total	100.0	100.0	
Farm sizes (Hectares)	<1	37.0	31.2
	1-5	31.0	20.1
	5-10	6.0	144.6
	>10	2.5	3.5
	No response	23.5	30.6
Total	100.0	100.0	
*Annual income (₦)	<90,000	4.0	9.0
	90,001-140,000	32.5	39.3
	140,001-190,000	3.5	20.1
	190,001-240,000	11.5	25.5
	>240,001	6.0	0.0
	No response	8.5	6.0
Total	100.0	100.0	

Sources: Akintola et al (1996) and 2007 survey by Authors

* Note – the current exchange rate is N118 to \$1

2) Household Energy Utilization

Table 3 shows the proportion of households using fuelwood, kerosene, electricity, gas and charcoal as their major sources of energy in Minna and Ijebu-Jesa/Efon Alaiye between 1983 and 2007. Major source of energy is defined here as the energy

consumed most and used most frequently. In the guinea savanna area of Minna, fuelwood is the most popular source of energy for domestic uses. Only a small proportion of the population utilize electricity, kerosene and gas (11.0%, 15% and 3.6% respectively) as their major energy source as depicted in Table 3.

However, the situation in Ijebu-Jesa/Efon Alaiye presents a scenario which sharply contrasts with that of Minna area respect to the pattern of household energy utilization. Unlike the guinea savanna zone, an overwhelming proportion of people in Ijebu-Jesa area do not depend on fuelwood as their major source of energy. The use of Kerosene is fairly popular in the in the forest zone with almost half of the respondents (46.2%) depending on kerosene as the major source of energy compared to only 15.0% in Minna as at 2007. The unusually low proportion of people using fuelwood in Ijebu-Jesa/Efon Alaiye area is presumably due to two reasons. First, the Ijebu-Jesa/Efon Alaiye is apart of the cocoa belt of south Western Nigeria. This area is one of the most agriculturally productive areas of Nigeria and for several decades cocoa production has been a

major source of wealth for the people. The people in the rural areas, although generally poor, are usually better off financially than rural dwellers in most parts of the country. As a result of the relative affluence of people in Ijebu Jesa area they can afford to use Kerosene as the dominant fuel for heating and cooking unlike those in the guinea savanna zone of Minna who do not produce any major cash crop. Second, owing to the dominance of cocoa in the agricultural economy of the Ijebu-Jesa/Efon Alaiye area, vast areas of rainforest have been cleared and replaced by cocoa plantations which are not a source of fuelwood. Most of the fuelwood supplies of the Ijebu-Jesa/Efon Alaiye area have to be obtained from distant places and this substantially increases the cost of the commodity relative to that of kerosene.

Table 3: Pattern of household energy utilization in Minna and Ijebu-Jesa/Efon Alaiye

	Minna			Ijebu-Jesa/Efon Alaiye		
	1983	1993	2007	1983	1993	2007
Fuel type	%	%	%	%	%	%
Fuelwood	69.6	68.1	70.2	38.9	24.1	34.5
Kerosene	16.8	16.8	15.0	39.5	49.2	46.2
Electricity	12.0	12.6	11.0	20.5	19.5	11.0
Gas	1.6	2.6	3.6	1.1	7.2	8.3
Charcoal	0.0	0.0	0.2	0.0	0.0	0.0
Total	100.0	100.0	100.0	100.0	100.0	100.0

Sources: Akintola et al (1996) and 2007 survey by Authors

While there was no significant change in the proportion of people using fuelwood in Minna area between 1983 and 2007, in the Ijebu-Jesa/Efon Alaiye area, there was a decline in the proportion of people using fuelwood as their major fuel in 2007 relative to 1983. This is despite the fact the prices of kerosene has increased several fold in the country due to the removal of subsidies on petroleum products by the federal government.

In relative terms, none of the households surveyed use charcoal as their major source of energy for heating and cooking. It is hardly surprising that households in our two study areas do not use charcoal as their main source of energy. This is because, although, charcoal can be more easily transported being lighter in weight, it is more expensive than fuelwood. Besides, charcoal has lost part of its original energy value during the process of converting fuelwood to charcoal. In addition, charcoal tends to heat more slowly than fuelwood or commercial fuels and it is not convenient to use charcoal for heating or cooking.

3) *Energy Utilization by Institutions and Small Scale Business Enterprises*

Institutions and the small scale enterprises including roadside foodstands (popularly known as “bukatarias”), ‘suya’ spots, bakeries, and blacksmithing make an important contribution to the total quantity of energy consumed in both the urban and rural areas. A single bukataria may cater for as much as 100 persons per day, that it about 10 – 15 times the size of an average household, implying that energy consumption by the informal sector is considerably high. Similarly, a single bakery using fuelwood may consume as much as a pick up load of firewood (about 500 to 800 kg) per week.

Table 4 shows the pattern of energy consumption by institutions and small scale enterprises sampled in the two ecological zones. Fuelwood is the major form of energy used by institutions and small scale enterprises in Minna (75.0%) and Ijebu-Jesa/Efon

Alaiye (91.5%) Given the widespread use of kerosine as the main source of energy for cooking and heating by households in Ijebu Jesa/Efon Alaiye area, it is rather surprising to note that fuelwood is the main source of energy utilized by small scale enterprises operating in the area.

Table 4: Pattern of energy utilization by institutions/small scale enterprises in Minna (in percentages)

Fuel type	Minna			Ijebu-Jesa/Efon Alaiye		
	1983	1993	2007	1983	1993	2007
Firewood	66.7	66.7	75.0	87.5	77.8	91.5
Charcoal	19.4	19.0	10.5	8.3	7.4	5.5
Electricity	8.3	7.1	2.5	0.0	0.0	0.5
Kerosene	0.0	2.4	8.0	4.2	11.1	1.0
Gas	5.6	4.8	5.0	0.0	3.7	1.5
Total	100.0	100.0	100.0	100.0	100.0	100.0

Sources: Akintola et al (1996) and 2007 survey by Authors

In spite of shortage of fuelwood in the cocoa producing area of the forest ecological zone, most of the small scale enterprises depended on fuelwood as their main energy source (Table 4). The unusually high dependence of informal sector activities on fuelwood rather than on commercial fuels in both the rain forest and savanna regions appear to be due to the following factors.

First, small scale enterprises in the informal sector are essentially profit oriented. In order to maximize profits, they tend to use the cheapest and most reliable fuels (in this case fuelwood). Second, as pointed out earlier, periodic and chronic shortages of commercial fuels such as gas and kerosene are experienced in the country from time to time. An entrepreneur such as 'akara' seller or one who operates a fast food stand (eg. Suya spot) or a bukararia who depends mainly on kerosene or gas will be forced to close his business from time to time when there is shortage of commercial fuels (Akintola et al, 1996). Third, although electricity is available in many urban and in some rural areas, blackouts sometimes lasting for days, weeks or even months are common. Hence, most small scale enterprises operating on a commercial basis, tend to depend overwhelmingly on fuelwood which is available throughout the year and can be bought in small or large quantities as and when required.

Unlike the pattern of household energy consumption, the high dependence of small scale enterprises on fuelwood is a major source of concern for forest sustainability and adaptation to climate change. This is due to the relatively high quantity of fuelwood consumed by small scale enterprises daily. This has a lot of implications on the existing high level of deforestation in the two zones. This informs further investigation into fuel wood business in the study areas.

4) *Socio – Economic Aspects of Firewood Business*

One of the primary objectives of this study is to evaluate some socio economic aspects of the fuel wood business in the study areas with a view to highlighting the effects of government policy of subsidy removal from commercial fuels on the trade and consumption of fuel wood. Owing to data problems very important aspects of the fuelwood business could not be evaluated. In particular, firewood sellers did not answer questions relating to the volume of firewood sold. Also, most of them did not provide quantitative answers to questions relating to price per unit of sale of fuel wood. These problems arose partly because fuel wood sellers do not normally keep records of sale of fuelwood. Similarly, fuel wood transporters were unable to supply quantitative data on the cost of transporting a unit weight of fuelwood. The implication of the foregoing is that it was difficult to assess whether or not the fuelwood trade has become more profitable since the gradual removal of subsidy on petroleum products over the years. This section considers some socio-economic aspects of firewood trade focusing on locational characteristics of fuelwood seller, how long they have been in the fuelwood business, units of selling fuelwood and who they sell fuelwood to.

5) *Locational Characteristics Fuelwood sellers*

There is ready market for firewood in both urban and rural areas. Villages which were self sufficient in fuelwood in the past, with each family meeting its firewood requirement from its farmland, are no longer so. This is particularly so in villages located near large cities or in areas in the rain forest zone where cash crops such as cocoa are grown on land which would have otherwise served as a source of fuelwood. Consequently, trade in fuelwood which used to be restricted to the major urban centres is now a feature of relatively small villages. Table 5 shows where firewood sellers are based in our two study areas.

Table 5: Location of fuelwood sellers in Ijebu-Jesa/Efon Alaiye and Minna

Location	Ijebu-Jesa/Efon Alaiye		Minna	
	Number of sellers	Percentage	Number of sellers	Percentage
Rural	16	40.0	49	55.7
Semi urban	12	30.8	8	9.1
Urban	11	28.2	31	35.2
Total	39	100.0	88	100.0

Sources: Akintola et al (1996)

In the rain forest region of Ijebu-Jesa/Efon Alaiye, only about 40% of firewood sellers are based in the rural areas while in the Guinea savanna region of Minna, most of the wood sellers are based in the rural areas. This discrepancy is presumably attributable to the fact that south western Nigeria, of which Ijebu-Jesa/Efon Alaiye are a part, is the most urbanized part of Nigeria. The area contains a higher proportion of

people living in towns than in any other part of the country. Since there is highly urbanized, with a relatively lower proportion of the people living in rural areas, it is not surprising therefore, that most of the fuelwood sellers in Ijebu-Jesa/Efon Alaiye are based in urban and peri urban areas. Table 6 shows the location of the fuelwood selling depots.

Table 6: Location of fuelwood – selling depots Ijebu-Jesa/Efon Alaiye and Minna

Location	Ijebu-Jesa/Efon Alaiye		Minna	
	Frequency	Percentage	Frequency	Percentage
Outside the village/town	3	7.2	8	8.5
Inside the town	12	28.6	20	21.3
Sellers' residence	10	23.8	42	42.0
In a market	1	2.4	4	4.3
Others	8	19.0	4	4.3
Non response	8	19.0	16	17.0
Total	42	100.0	94	100.0

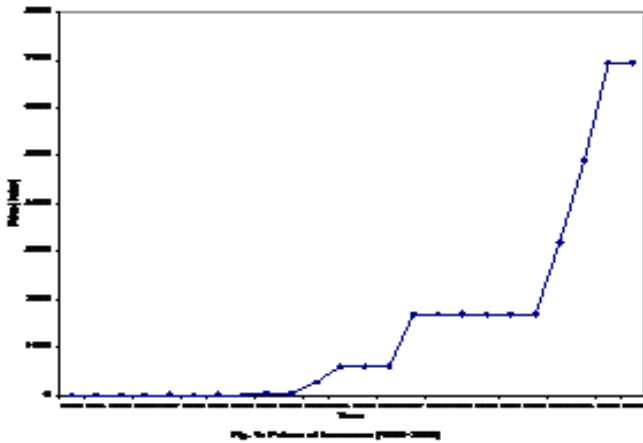
Source: Akintola et al (1996)

Most fuelwood sellers use depots located within their settlements where they can use stores or simply stack the bundles of fuelwood in front of their residence. By operating from within settlements or near their residence, fuelwood for sale is safeguarded against would be pilferers. Also, locating the fuelwood depot at or near owner's residence is a way of ensuring that at least someone is around to attend to buyers who may come at awkward times (eg. at night) to buy fuelwood when they run out of supply while cooking. This is also to ensure easy access to buyers Only a small proportion of fuelwood sellers operate from the market, usually less than 5% of sellers. Some fuelwood sellers do not have a fixed firewood selling depot. They are mobile vendors who sell fuelwood from house to house. These mobile vendors categorized as 'others' in Table 6 usually have some customers who they supply fuelwood at fairly regular intervals.

stable between 1983 and 1990 until it began to increase from 1992. By 2006, the price has increased by 6,519% of its 1983 value. The astronomical increase in the price of kerosene has implications for fuelwood consumption in the country as a whole and in the study areas in particular. For example, while the price of a bundle of fuelwood was N2.70 in Ijebu-Jesa and Efon Alaiye area in 1983, the price was N150 as at 2006. This represents an increase of 5,456%. In Minna, the price of a bundle of fuelwood was N2.40. This jumped to N110 in 2006 representing an increase of 4,483%. The increase in the price of fuelwood is largely attributable to the progressive devaluation of the naira since 1983 and government policy of periodically increasing the price of commercial fuels (including kerosene) which has brought about increased cost of transporting fuelwood to the points of consumption or sale.

6) *Effects of Subsidy Removal on the Prices of Fuelwood*

Figure 1 shows the official price of kerosene in Nigeria from 1983 to 2006. The price of kerosene was



less pressure on natural forests and savanna woodlands. For instance, in Burkina Faso, a sizeable proportion of the people in Ougadougou who use fuelwood as their main source of energy for heating and cooking, plant trees within and around the city to meet part or the whole of their fuelwood requirements (Pouya, 1994). In the present study, fuelwood users interviewed were asked whether they plant trees on their farms and the purpose of which they plant trees.

In the rain forest area, only 16% of the households using fuelwood admitted having planted trees on their farms. In guinea savanna area, the corresponding proportion of households that planted trees was 47.5%. This suggests that the people in the savanna region, where trees are smaller and fewer, generally appreciate the need to plant trees to combat the problems of environmental deterioration and possibly meet their fuelwood requirements more than those in the rain forest region. The purpose of planting trees in farmland is not necessarily to provide fuelwood or augment fuelwood supplies from secondary forests or tree savanna vegetation and savanna woodland as the Figure 2 clearly shows.

V. DO FUEL WOOD USERS PLANT TREES?

The answer to this question is crucial for assessing whether or not the exploitation of fuelwood in our study areas is sustainable. If fuelwood users in both the study areas have woodlot where they plant fast growing tree species for use as fuelwood, there will be

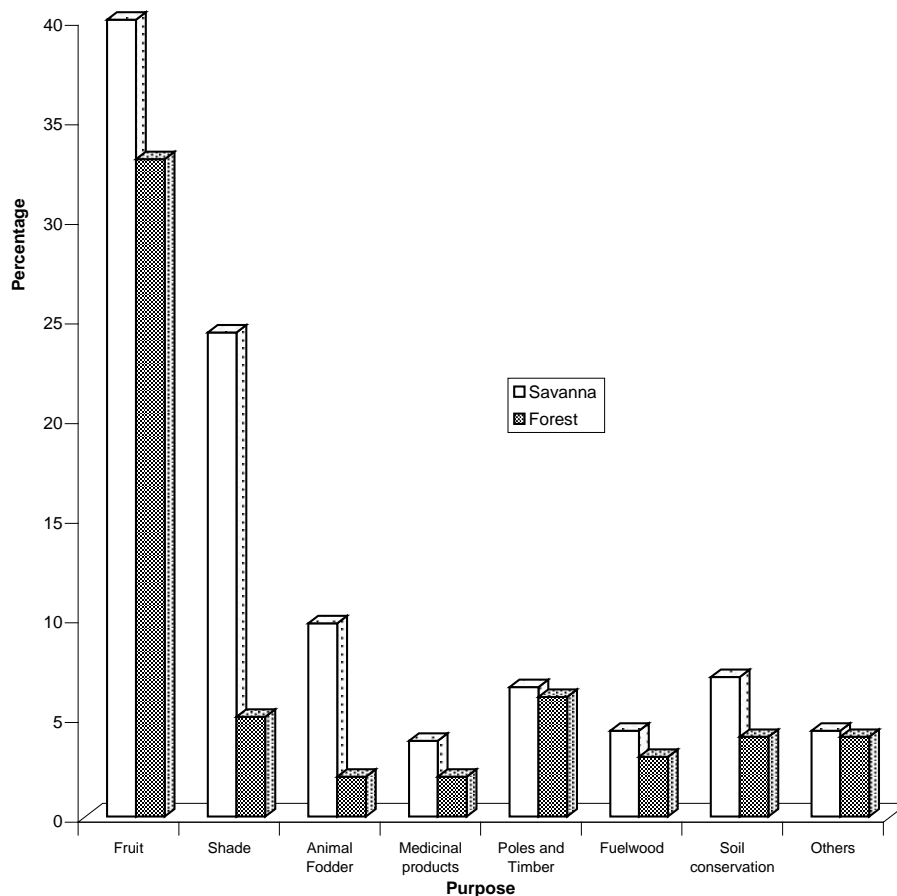


Fig. 2: Purpose of Planting Trees by Fuelwood Users i Savanna and Rain Forest Ecological Zones of Nigeria

Trees were planted mainly to produce fruits and to provide shade on the farm. Fuelwood production ranked among the least mentioned reasons for planting trees in both the guinea savanna and rain forest study areas. Fuelwood production accounted for less than 6% of the total responses in respect of the reasons for planting trees while production of fruits ranked highest accounting for 40.0% and 55.9% of the responses in the savanna and forest areas respectively. Since fruit, shade or medicinal trees are not usually felled for fuelwood, it follows therefore, that the vast majority of fuelwood exploiters do not grow trees for fuelwood and hence, the method of fuelwood exploitation is unsustainable. This is particularly so as there is no conscious attempt by fuelwood exploiters to plant trees to replace those felled for fuelwood. They regard fuelwood as a free gift of nature which they do not need to waste their time to produce in woodlot managed by them.

VI. IMPLICATIONS OF FIREWOOD BUSINESS FOR DEFORESTATION AND CLIMATE CHANGE

Some aspects and dynamics of the fuelwood business discussed above have implications for deforestation. It was observed that for both the rain forest and guinea savanna zones, the percentage of small scale enterprises using fuelwood has increased by more than 80% in both zones. This suggests a boom in the fuelwood business which is indicative of increased rate of deforestation.

The increase in the percentage of fuelwood users among small scale enterprises was more in the rain forest region than in savanna region. This presumably suggests that the rate of deforestation in the rain forest region may be higher than in the guinea savanna region. It was pointed out in the previous sections that the proportion of households using fuelwood actually declined in the rain forest region (Ijebu-Jesa/Efon Alaiye). Most likely, the increased deforestation in the area is due to the fact that small scale enterprises depend on fuelwood as their primary energy source. The implication of this is that measures designed to reduce the rate of deforestation should not only address fuelwood consumption by households but largely fuelwood utilization by small scale enterprises in the informal sector.

VII. CONCLUSION

Fuelwood is the major energy utilized for heating and cooking in the study areas with kerosene and electricity assuming secondary importance. Since 1994, government has increased the price of kerosene, gas and petrol several fold, relative to the price levels in 1993. These latter 'reduction' in energy subsidy has pushed the price of commercial fuels to outrageously high levels with the result that most of the urban poor and rural dwellers cannot afford to buy commercial fuels such as kerosene and gas. This is particularly so if the size of their households large. It may well be that since the 1994 rise in the price of commercial fuels, many people have resorted to the use of fuelwood which is relatively cheap compared to commercial fuels.

As Gbadegesin (1995), has rightly observed the gradual removal of subsidy on petroleum products has heightened the problems of environmental degradation in Nigeria. It seems that the informal sector which is profit oriented is more sensitive to the price of commercial fuels than individual households where convenience in the use of fuels may assume greater significance, subject to the proviso that the price of commercial fuels is within the range they can afford. Even in the rain forest part of the study areas where the use of kerosene is popular among households, small scale businesses depend predominantly on the use of fuelwood. As a result of an increase in population over time and the rising cost of commercial fuels, the demand for fuelwood has increased also. The amount of fuelwood produced in the whole country on an annual basis has increased substantially since the removal of subsidy. Fuelwood collectors now have to travel longer distances to obtain firewood than they used to do as the fuelwood resources of the areas around settlements are now largely depleted.

Fuelwood exploitation in both the forest and savanna regions is unsustainable as most fuelwood collectors do not plant trees to replace those removed from the vegetation for fuelwood. Less than 20% of fuelwood collectors/users in the rain forest region admitted they ever planted trees. In the guinea savanna region around Minna, the proportion of those who grew trees was considerably higher. Even so, those in the guinea savanna region do not grow trees for fuelwood but mainly for fruits and to provide shade on the farm. Growing trees for fuelwood accounted for less than 6% of the reasons given for planting trees in both ecological zones. This is a pointer to the fact that most fuelwood collectors regard firewood as a free gift

of nature. The obvious implication of this is that fuelwood exploitation will continue to lead to environmental degradation and consequently induce climate change unless government takes urgent steps to reverse the trend of a growing demand for fuelwood over time. This will necessarily involve policy measures that will encourage people to switch to the use of commercial fuels, especially kerosene. The periodic scarcity of commercial fuels especially of gas and kerosene, the epileptic supply of electricity and the frequent several fold increase in the price of commercial fuel will most likely militate against widespread switching to the use of commercial fuels by the people.

Deforestation, partly resulting from unsustainable fuelwood exploitation is exacerbating problems of environmental degradation especially desertification and soil erosion and loss of biodiversity in the more humid guinea savanna and rain forest regions. These environmental problems may ultimately result in soil impoverishment or outright loss of the productive topsoil with an attendant decline in vegetation cover of the areas. This will consequently cause forest ecosystems to change in various ways, such as in animal and plant species distribution, changes in tree physiology and stability. This will manifest itself in stand-level effects, as well as in major disruptions or disasters caused by more dramatic weather events. Therefore, forest protection and management will have to assure that these effects can be foreseen, managed and limited to the greatest extent possible, particularly due to the very long production and ecological cycle of forests.

Therefore, it is of utmost importance that government should address the problem of unsustainable fuelwood exploitation so that our land will continue to be productive and be able to support present and future generations of Nigerians. It is also important that government develops and encourages the people to use alternative sources of energy, especially biogas and solar energy. The development and utilization of solar energy at the household level in the Sudan and Sahel savanna zones will help to reduce and possibly reverse the trend of increasing desertification.

Adaptation strategies should encourage the conservation of habitats and biodiversity (fauna and flora) that underlies livelihood adaptation especially in rural areas. Also, there is need to provide and support participatory and open multi-stakeholders discussion platform that encourages the integration of biodiversity conservation into mainstream climate change adaptation strategies. Given the current global economic crisis, it would be very difficult to continue to

subsidize the consumption of commercial fuels. Therefore, all stakeholders should encourage the cultivation of woodlots in order to stem the increasing rate of depletion of natural forests given the fact that fuelwood remain the major source of energy in the rural areas.

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