HOUSEHOLD COPING STRATEGIES FOR DOMESTIC ENERGY PRICE CHANGES IN NORTHEASTERN NIGERIA

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ABSTRACT

In Nigeria, high cost of Domestic Energy (DE) has put untold hardship on households. Coping strategy is therefore imperative to meet household domestic cooking and heating needs. Investigating evolving strategies would better inform DE experts and policy makers. This study was therefore designed to investigate strategies devised by households in Northeastern Nigeria for coping with the escalating prices of DE. The domestic energy types considered in the study include Liquefied Natural Gas (LNG), Liquefied Petroleum Gas (LPG), kerosene, electricity, coal, solar energy, animal dung, agricultural residues and wood energy. Other potential energy sources in Nigeria include volcanic and refuse fuel, tidal and wind energy and geothermal, which are yet to be exploited.

Borno, Gombe and Taraba states were selected for the study through stratified random sampling that gave due cognisance to representative vegetation zone of Northeastern Nigeria. Twenty percent of the total number of Local Government Areas (LGAs) in Borno (27), Gombe (11) and Taraba (16) states respectively were randomly selected comprising urban, semi-urban and rural LGAs. Two wards were selected from each LGA making a total of 20 wards for the study. Four sets of questionnaire were administered, each on 25 household heads, six DE marketers, two heads of government forestry agencies and three community leaders in each ward. Information elicited focussed on DE price changes, factors determining choice of DE and coping strategies evolved by households between 2006 and 2007. Descriptive statistics, Chi-Square, Logistic regression and correlation tests were used to analyse the data at $p \leq 0.05$.

Eighty two percent of the household heads were male, 81.7% were married, and 33.2% had secondary school education while 54.2% were farmers. The mean age of household heads was 42.0 ± 3.0 years while the mean monthly income was ₦11,228 ± 2,345:00. Fuelwood, (90.0%), kerosene, (74.4%), charcoal, (83.2%), electricity (49.2%) and, cooking gas (13.6%) were DE severally identifiable by community leaders. Factors determining choice of DE among households were cost (94.8%), regular availability (94.4%), and ease of use (81.8%).

Mean monthly expenditure on DE in the urban areas was ₦12,300.00 ± 1000.00 compared to ₦4,345.00 ± 525.00 for those in semi-urban and ₦932.00 ± 178.00 in the rural areas. Fuelwood was the most popular DE (81.3%), followed by electricity (14.0%) and kerosene 5.7%. Findings from DE marketers indicated that kerosene had the highest price increase from ₦17.00/litre to ₦53.6/litre (215.5%), followed by fuelwood ₦20.00/33% of a cord to ₦45.3/33% of a cord (126.7%), charcoal ₦200.0/16kg to ₦412.0/16kg (106%) and cooking gas ₦7,500.0/12kg cylinder to ₦13,350/12.5kg cylinder (78%) between 1999 to 2005. The favoured household coping strategies on DE were reduction in the rate of DE use (40.8%), cutting expenditure on other household needs (21.2%), and suspension of capital projects (13.1%). Substituting of fossil-based energy with biomass (13.1%) and keeping of domestic animals (11.8%). Adoption of coping strategies varies significantly among households' characteristics. Gender and settlement type significantly influenced adoption of coping strategies. The price sensitive to adjust to price of fuelwood from that of kerosene are noticed in the semi-urban (r = 0.9729) and urban (r= 0.9623) areas of guinea savannah, urban areas of Sudan (r = 0.9616) followed by rural areas of guinea savannah (r = 0.9166), while the least price sensitive to adjust to prices of fuelwood from that of Kerosene are in the semi-urban (r = 0.7893) and urban (r = 0.7873) of Sahel zone areas and rural (r = 0.6670) areas of Sudan.

Ninety three percent of heads of government forestry agencies attributed the upsurge in the use of fuelwood by households to high cost of fossil-based DE and viewed it as a threat to forest conservation.

Fuelwood is the most popular alternative DE in the Northeastern Nigeria. This could have potential negative impact on the fragile savannah ecosystem. Increased efforts at afforestation will compliment fuelwood supply in the region and help in stabilizing the ecosystem.

Key words: Domestic energy, Energy Prices, Coping strategies, Households, Northeastern Nigeria
Word count: 490

DEDICATION

This work is dedicated to my wife Mrs Jummai D. Jatau
My children; Sakanchi,
Kadawaminwa,
Tahsanchi,
Japhet,
Mitakcha,
Yennessiyo,
Ngirfowunsi
Jeremiah and

My late niece HAPPY STANLEY JATAU who laboured with me in the pursuit of this scholastic excellence but could not live to reap of the benefits. May her soul rest in perfect peace.

ACRONYMS

ADB	Asian Development Bank
AfDB	African Development Bank
BKWH	Billion Kilo Watts per Hour
CBN	Central Bank of Nigeria
CNN	Cable News Network
DCC	Desertification Control Commission
DE	Domestic Energy
DME	Dimethyl Ether
ED	Educational Status
EFCC	Erosion and Flood Control Commission
EIA	Energy Information and Administration
ERA	Environmental Rights Agency
EW	Energy Watch
FAO	Food and Agriculture Organisation
FM	Forest Monitors
GD	Gender (male or female)
HS	Household size
ICT	Information and Communication Technology
IEA	International Energy Agency,
IL	Income level
LGA	Local Government Area
LNG	Liquefied Natural Gas
LPG	Liquefied Petroleum Gas
MKWH	Million Kilo Watts per Hour
MS	Marital status (Married or single)
Mtoe	Million tons oil equivalent
NFCC	National Forest and Conservation Council
NFSP	National Fuelwood Subsistence Programme
NGO	Non-Governmental Organisation
NLC	Nigeria Labour Congress
NNPC	Nigeria National Petroleum Corporation
OPEC	Organisation of Petroleum Exporting Countries

PEH	Poverty Environmental Hypothesis
PMS	Premium Motor Spirit
PPPRA	Petroleum Product Pricing and Regulatory Agency
RTI	Respiratory Tract Infection
SAP	Structural Adjustment Programme
ST	Settlement type (Urban or rural area)
UN	United Nations
UNDP	United Nations Development Programme
USA	United States of America
USD	United States Dollars
WEC	World Energy Council
WEO	World Energy Outlook
WHO	World Health Organisation
WRI	World Resources Institute

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JATAU, David Finchiwa, 2011

CERTIFICATION

We certify that this work was carried out by **Mr. David Finchiwa JATAU** in the Department of Forest Resources Management, University of Ibadan, Ibadan.

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CHAPTER ONE

1.0 INTRODUCTION

1.1 Background of the Study

Man's first economic revolution, the transformation from Palaeozoic to Neolithic age, was made possible as a result of the discovery of fire energy. Today, more than the capacity to perform functional processes, different forms of energy, have become the main sustainers as well as the live line of any modern economy. This indeed is the *sine qua non* of industrial stability and progress (Thomas, 1978). The presence of energy resources is used to measure the industrial capability of a nation and no economic progress can be achieved without its existence. Therefore, it will not be out of place to symbolically say that energy is to a country's economy, what blood is to man. Indeed energy is the foundation of wealth and power.

Domestic energy could be referred to as the energy consumed in the households mostly for cooking, heating, lighting, and operating appliances. Apparently, because of the prevailing tropical climate, energy for cooking takes a lion's share of the aggregate energy in most developing countries, including Nigeria. The methods of utilization of domestic energy vary from one household to another depending on the type. The common type of domestic energy sources include Liquefied Natural Gas (LNG), Liquefied Petroleum Gas (LPG), kerosene, electricity, coal, solar energy, animal dung, agricultural residues and wood energy. Other potential energy sources in Nigeria include volcanic and refuse fuel, tidal and wind and geothermal energy, which are yet to be exploited, (Thomas, 1978).

The quality and quantity of energy available for domestic use play a crucial role in the sustenance of households, as these determine the efficiency and comfort in their utilization.

The choice of the type of domestic energy by households is also determined by the affordability and the willingness of the consumers to pay for the use of the energy source.

In reviewing the energy crisis situation the world over, Carrillo (2002) reported that more than two billion people have no access to modern energy services. They thus, depend on fuelwood for cooking, maintenance of essential level of warmth and other uses. Similarly, the International Energy Agency (IEA, 2002) reported that 52 percent of the population of developing world is dependent on biomass fuels for their cooking and heating needs. This is not only due to population growth, but also due to rise in oil prices, which has continued since the energy crises of the 1970s.

In Nigeria, energy from petroleum products constitutes 78 percent of the national commercial energy consumption (Ayodele, 2003). Wood constitutes almost 70 percent of the total energy consumption for 80 percent of the Nigerian population, 30 percent to other sources of fuels – oil, coal, electricity and gas (Adesanya, 1998). In his recent studies on energy consumption and development, Ayodele (2003) confirmed that 98 percent of wood harvest in Nigeria is used as domestic energy. Similarly, Murray (2002) reported that 85 percent of the energy consumption in the developing countries, including Nigeria is residential and mostly for cooking compared to only 20 percent in the industrialized nations. He further reported that in sub-Saharan Africa, 89% of the total energy consumption is in the households. In Indonesia, domestic energy consumption constitutes 74% of the total energy consumption, but in Latin America, only 23% of the total energy consumption is used in the households. Murray (2002) therefore, concluded that cooking energy takes the lion share of the world's energy consumption.

Food and Agriculture Organization (FAO, 2001) and Raufu (2003) reported that majority of Nigerians rely on Kerosene stoves for domestic cooking, while only a few use gas and electric

cookers. However, one of the most disturbing and frustrating events in the Nigerian economic development scenario, particularly since the early 1990s, is the persistence of inadequate supply and distribution of petroleum products (Ayodele, 2003). This has terribly disrupted economic activities. In fact many rural and the poor urban settlers have severally abandoned their kerosene stoves and gas cookers for fuelwood, which is seen as a relatively cheaper and better substitute for cooking energy. This action of the energy consumers is further aggravated by the arbitrary price increases and the epileptic supply of kerosene, electricity and gas. For instance, in 1998 a litre of kerosene which was sold for ₦6.00, went up to ₦50.00 in 2005 and even over ₦100 in some locations, after the deregulation policy introduced in September of that same year. This led to more rampant felling of trees to bridge the demand gap for fuelwood created by scarcity and high cost of other domestic energy types.

Another problem of energy scarcity is that users spend a lot of their valuable time in search of substitutes. Sometimes buyers could spend up to 10 hours waiting to buy kerosene from legitimate sources, but most times end up buying from the black markets at exorbitant prices which at most times double or triple the official prices. Most Nigerians have totally no access to fossil-based domestic energy. This hampers their ability to undertake productive activities so as to escape from the vicious cycle of poverty. Security, reliability and quality of supply of this commodity become increasingly unimportant to the people as they have to overcome the more basic problem of accessibility.

The case of electricity is worse; it is characterized by rampant outages for long periods, ever increasing tariffs and exorbitant costs of electrical appliances. Jane & Gunter (1994) and Murray (2002) reported that in Nigeria, only 20 percent of urban households and 10 percent of

the rural households have access to electricity and fewer still can afford the high costs of electric energy for cooking. They also maintained that approximately 40 percent of the total population of Nigeria has access to electricity. It is absolutely imperative that the problem of availability and accessibility of domestic energy for the ever-increasing population be resolved as a matter of urgency.

The resultant increased demand for, and the supply of fuelwood and the environmental consequences associated with these increases have generated much interest both locally and internationally. The Federal and State governments, conservationists and environmentalists in Nigeria are even more concerned. Consequently, the National Forest and Conservation Council (NFCC), a Non-Governmental Organization (NGO) in Lagos, embarked on a crusade for the use of coal for domestic energy, so as to conserve trees (Daily Trust, August 26th 2003). This action was one of such that prompted the Federal Government to start the National Fuelwood Subsistence Programme (NFSP) to promote the use of coal as domestic energy alternatives.

As a result of hardships caused by shortage in supply and irregular fuel price increases, households tend to evolve and adopt a variety of coping strategies to cushion the effects exerted on the forests and the household economy. A study of coping strategies adopted by residents in the United States of America (USA) due to sky-rocketed electric bills (Metcalf, 2002) reported that, some resorted to hanging laundry out to dry, stop using room heaters, and air conditioners; turning off extra storage freezers and replacing light bulbs with fluorescent tubes to reduce the electricity bills. Some put off all non-essential appliances like radios, water heaters, television sets when leaving the house; some use smaller ovens while others fix meals that require little cooking time, to mention a few.

Specifically, coping strategies are activities engaged in by households to ensure that the needs of the households, including domestic energy are met (Asanwana, 2001). Some of the most important strategies used by rural and poor urban households to meet their essential needs in Nigeria include the following:

- ✓ Land lease to engage in some form of food production which is used in households and for sale;
- ✓ Trading in primary products such as fruits, cereals, and vegetables in order to earn more money;
- ✓ Keeping of domestic animals for home consumption and for sale;
- ✓ Mushroom, snails and other forest products gathered for consumption and sale;
- ✓ Adoption of other sources of income such as crafts and cottage industries, provision of various services such as laundry, catering services among others.

1.2 Statement of the Problem

Every country prefers to have energy resources under its direct control for security and strategic reasons, but all countries are not equally endowed in resources. Those countries, which are not endowed with certain resources within their boundaries, import such resources. The pattern of energy usage should be understood to promote efficiency in its usage and appreciation of its roles in economic development. The World Resources Institute (WRI, 1988-89) estimated that oil accounts for 43 percent of global energy production while fossil fuels accounts for 30 percent and natural gas accounts for 20 percent. Electricity accounts for the remaining 7 percent. In Nigeria, oil constitutes 78 percent of the national energy consumption (Ayodele, 2003), but due to the faulty distribution process there has been disruption of economic activities and social life in the country.

Domestic energy is an indispensable factor in household management and takes significant portion in the family budget (Sokona, 2002). Murray (2002) supported this claim when he reported that 83 percent of the total energy consumption is residential in developing countries. Again, this could be the reason why the perpetual price increases of domestic energy in Nigeria are often felt by majority, sometimes resulting in series of protests.

FAO (2001) estimated that more than 60 percent of the people in the developing countries depend mainly on wood for their household energy. In most rural areas, the forest as the source of fuelwood is fundamental to everyday life of the inhabitants. Ayodele (2002) reported that 70 percent of the 130 million Nigerians reside in the rural areas, with 90 percent of them relying on fuelwood for cooking. Wood fuel will therefore, continue to be of utmost relevance in the context of high price increases of commercial sources of domestic energy and the environmental implication of meeting such a huge demand for biomass.

In the advent of these unprecedented price increases of domestic energy, Nigerians have evolved some sort of coping strategies which will in turn stabilize the household economy and reduce the pressure on forests. In discussing these coping strategies, it is very important not to limit the discussion to the situation in urban areas alone. This is because in many countries, including Nigeria, regional disparities in income, employment opportunities and social conditions are large and persistent. This necessitates catering for the needs of the different income strata of the society not only in the rural areas but also for the urban and particularly the poor urban dwellers.

The high demand for fossil-based fuels that manifested and which have persisted, since 1973, had raised crucial problems for developing countries. One of the problems is the impact of rising energy prices on special groups among which are the urban poor and the rural dwellers.

This problem is worsened by the "removal of subsidies" on fossil-based energy, which led to sharp increases in the prices of commodities and service; as well as fuel appliances.

Similarly, where these commercial fuels are available, their high prices discourage people from using them. The persistent scarcity of domestic gas and kerosene is another consideration that enhances the popular demand for wood fuel. The scarcity has driven educated urban dwellers in Lagos and other cities in Nigeria more into the use of fuelwood (Ojediran, 1991). The situation in the semi-urban areas and villages, is not better as most dwellers, are petty traders, artisans and/or subsistent farmers. The use of fuelwood was more intense in the arid zone particularly from latitude 10^{o} N upwards (Popoola, 1992) and this has been on the increase due to increase in cost and scarcity of the alternative sources particularly kerosene, electricity and cooking gas.

Generally, some people want to use the fossil-based energy for their domestic needs despite the persistent price increases at the expense of other household non-energy dependent tasks as a coping strategy. There is an indication that energy prices will further go up with full deregulation of the downstream sector of the petroleum enterprise in Nigeria. Whenever, this is implemented, the vegetation cover of the country and its associated equilibrium would be disturbed, if no concrete coping strategies are identified and aggressively adopted.

Coping strategies vary from society to society, from household to household and over a given period of time. The variation could be determined by external and internal factors. Among these factors could be: household incomes and sizes, seasons of the year, availability of the energy source, price of other energy types and the prices of stoves and cookers. The price of kerosene, for instance, has been on the increase since 1988. Despite these increases, kerosene has remained quite important for several reasons. These include its use in lanterns for

illumination when there is no electricity supply, for domestic cooking, for fuelling of refrigerators and ovens. The current price of ₦50.00 in 2008, which the government claimed to be subsidizing, stands to be reviewed upwards anytime the next phase of deregulation is implemented. An aspect of the impact is the large-scale destruction of the forest for fuelwood. Kontagora (1989) had warned about the environmental consequences, which may arise from massive deforestation. Similarly, Popoola (1992) had described the continuous withdrawal of subsidies from petroleum products, particularly kerosene and gas as the greatest threat to the Nigerian forests.

The consumers of cooking gas, kerosene, coal, charcoal, fuelwood and electricity, would therefore, have to undertake series of commodity substitution, evolve coping strategies as they are faced with energy-use challenges. These include income/budget constraints and utility optimization in the face of spiralling inflation. Henderson and Quant (1980) noted that change in prices or income level alters the consumer expenditure pattern. The current situation in Nigeria is a stagnation of income and price hikes. The consumers of goods and services are, therefore, at the receiving end, no matter the level of goods, and services they consume. This situation results in the reduction of the quantity of the commodities that will be consumed leading to diminishing welfare.

The circumstances surrounding the availability of the household energy sources are factors that usually impact on household expenditure pattern. Given the foregoing observations, it is imperative that domestic energy consumption pattern should shift not too heavily to fuelwood as it now seems apparent. This is because of arbitrary price increases and shortage in supply of fossil-based energy resources, especially kerosene and cooking gas. Therefore, the determination of the appropriate coping strategies that can reverse the situation by stabilizing the family economies and reduce the rate of forest resources depletion is pertinent.

1.3 Objectives of the Study

The main objective of the study is to evaluate household coping strategies in the face of ever increasing prices and scarcity of domestic energy. The specific objectives of the study are to:

(i) identify the domestic energy sources at the disposal of the respondents,

(ii) assess the factors that determine the choice of household energy,

(iii) determine the occurrence of domestic energy price changes and how it affects households' economy within the study period- 1999 - 2005

(iv) identify coping strategies evolved by households due to hardship caused by domestic energy price changes in the study area.

1.4 Research Questions

The following questions were addressed:

(i) What are the household energy sources in the study area?

(ii) How do the respondents access the energy sources?

(iii) Are the respondents actually responsible for providing their household energy?

(iv) Do characteristics of the heads of household (age, marital status, educational attainment, income level) affect the type of domestic energy used in the household?

(v) Do the price changes of domestic energy have any impact on the demand for wood fuel?

(vi) Do the price changes of domestic energy affect the consumption patterns?

(vii) Is there any difference in the pattern of domestic energy consumption among

(viii) the rural, semi-urban and urban respondents?

(ix) Do households' socio-economic characteristics have any influence on the quantity and variety of domestic energy they utilized in the households?

(x) How do households react to incessant increases in domestic energy prices?

1.5 Justification for the Study

The shortage in supply and incessant price increases of commercial energy in Nigeria is a matter for concern. Various environmental groups and individual conservationists in the country have taken a stand regarding the negative consequences of fuel price hike on the country's depleting forest. Thomas (1978) and FAO (2001) reported that households consume more than half of the energy generated in developing countries.

Similarly, Jeffery and Joseph (1990) asserted that 90 percent of wood harvests are used for fuelwood and are the source of up to 60 percent of all the energy of the developing world. United Nations Development Programme (UNDP, 2001) therefore, warned that the high rate of deforestation in Nigeria is actually due to high cost of energy, particularly domestic energy.

Energy is very important in human life. The demand for and supply of energy will therefore, remain a challenge to researchers and policy makers. The rates of energy consumption vary from one person to the other depending on the energy dependent activity. Most of the energy is obtained from both fossil-based and traditional energy types e.g. kerosene, cooking gas and electricity. However, the traditional sources include fuelwood, charcoal, sawdust, animal dung, process residue and plant residues. The scarcity of kerosene causes long queues and confusion at filling stations. Deregulation of the downstream sector of the petroleum industry in September, 2003 has worsened the economic capabilities of most Nigerian households. The outcome of the deregulation has been the complete "removal of government subsidies" from all fossil-based energies provided by government agencies. Most households have felt the effects of this deregulation across the economy. The impact of the price increases usually include reduction in the quantities of products purchased by households. People will probably shift from the purchase of costly domestic energy types to wood fuels; making wood, the

dominant source of household energy. Moreover, fuelwood consumption does not require the use of complex gadgets, as in the case of kerosene, gas and electricity, whose gadgets have become unaffordable for the ordinary man.

Therefore, the demand for wood fuel will escalate, which in turn, implies an intensified pressure on the forest resources of the country. The supply of wood fuel has been a dominant area of research in the forestry sector for some time now, and the impact is yet to be felt. The tendencies are that fuelwood will continue to dominate the supply of wood from the forests if no efforts are made towards reversing the trend. This continuing domination of wood as a source of household energy will escalate the deforestation rates. As deforestation increases, it will result to desertification and subsequently expose the rural life to ecological hazards. This study hopes to provide an enduring remedy to this problem.

Studies on household energy situation by Nadoma (1988), Ayodele (2002) and Famuyide (1995) concentrated on the demand and supply of wood as fuel, but did not look into coping strategies, which could be adopted to evaluate the dramatic shift to the use of biomass as the ultimate alternative household energy and suggest the best cost-effective and environmentally friendly line of action. In the past, researchers had suggested that emphasis should be on sourcing for alternatives to fuelwood in order to conserve forest resources. This study, however, dwells much on the analyses of coping strategies adopted by households particularly those that support the sustained use of commercial energy sources, despite the continual price increases. This could reduce the pace of environmental degradation and its devastating consequences.

1.6 Scope of the study

This study was carried out in Northeastern Nigeria, and covered three states (Borno, Taraba and Gombe) out of the six states in the region. From these states, 20 percent of the local

government areas in each of the three selected states were randomly picked for questionnaire administration.

The effect of domestic energy price changes on the forest resources and household economies in the region was determined in the case of kerosene and cooking gas only. Electricity was also considered even though it is only available in very few of the urban areas. Coping strategies considered adopted were those that have direct bearing on the identified domestic energy types available in the study area. The study involved mainly the field survey through the use of structured questionnaires to conduct interviews on the urban, semi-urban and rural dwellers who are the major users of the domestic energy sources.

CHAPTER TWO

2.0 REVIEW OF LITERATURE

2.1 Conceptual Framework

The concept of household domestic energy comprises of a chain of interrelated variables which tend to link to one another. These are the independent, intervening and dependent variables. Fig 2.1 presents a schematic overview of the three broad typologies. Each of these is disaggregated into its various elements, which clearly show the multi-dimensional nature of household energy use. The chart showing the corresponding variables of different sorts. A comprehensive survey of the household energy use should be of necessity, with its recognised multi-dimensionality. By so doing, the degree of household energy choice can be differentiated on the basis of the socio-economic characteristics of the heads of households. The choice of household energy is dependent on the first sector of the variables which are personal and non-personal characteristics of heads of households and socio-cultural environments.

Based on the independent variables, the choice of household domestic energy is made with intervening variables in place. The choice of the type of household energy will then determine the method of utilisation.

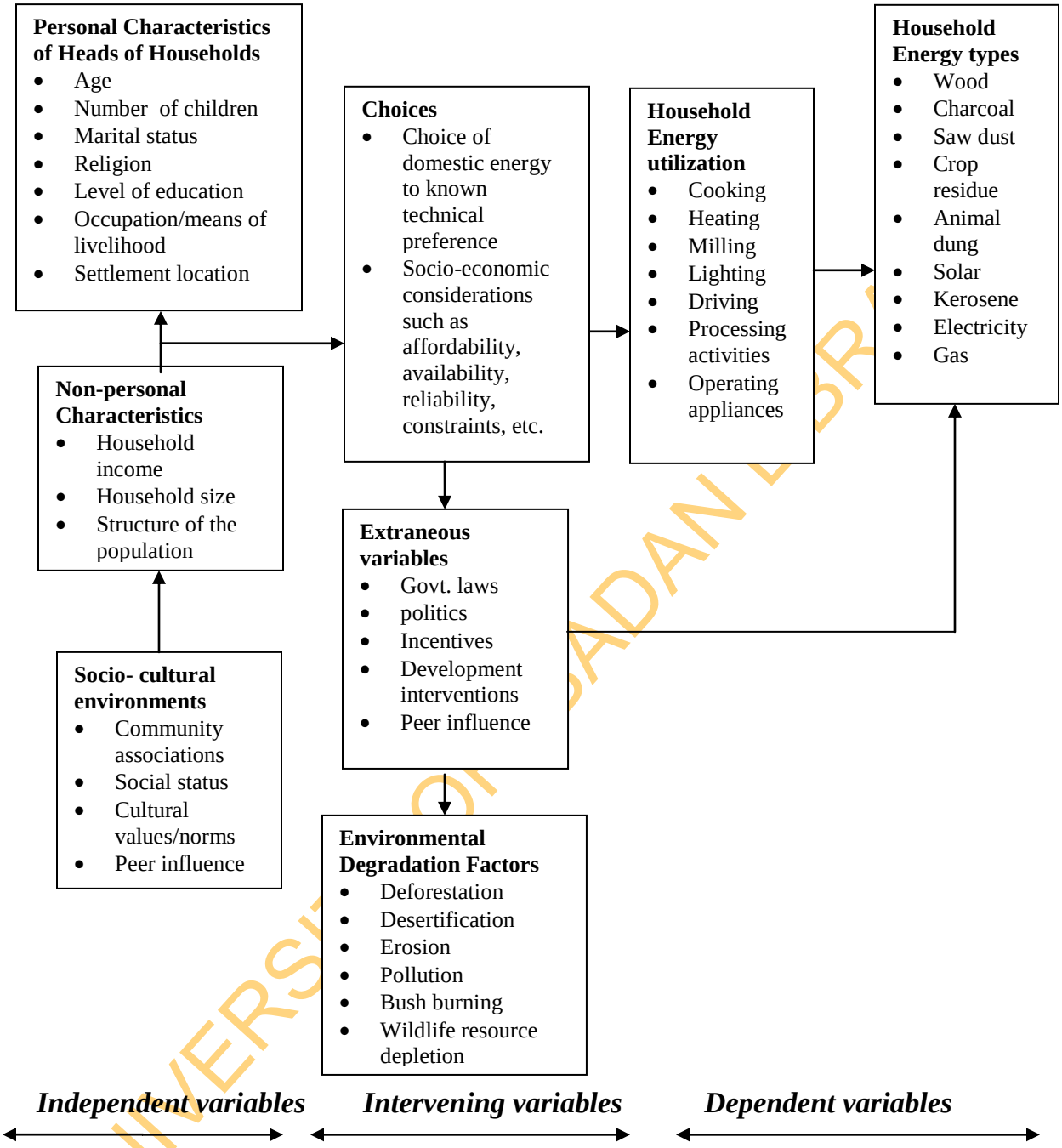

Fig.2.1 Conceptual framework for Household energy use in the study Area.

Adopted from Asawana, 2001

2.2 Access to Energy and Impact on People's Lives

Energy generation facilitate the production of light, heat, mechanical power and electricity from the use of fuels, including fossil fuels such as coal, gas and kerosene, plus renewable energy sources such as solar power, wind power, hydropower and biomass; and fuel technologies ranging from traditional "three-stone or tripod fire technology" to efficient, clean electricity systems. World Energy Outlook (2002) described household energy as indispensable items in the sustenance of the households. Demand for energy is a 'derived demand arising from the services it can provide. The wide range of 'energy services' such as cooking, water heating, lighting, refrigeration, water pumping, transport and communications made possible by fuels and fuel technology can have a major impact in facilitating sustainable livelihoods, improving health and education and significantly reducing poverty. Conversely, the absence of adequate, affordable, reliable, safe and environmentally benign energy services can be a severe constraint on sustainable economic and human development (Andrew, 1999). Poor people often have a limited choice of technologies that convert energy to useful services. The technologies most readily available to them are typically inefficient or of low quality, so they end up paying much more per unit of useful energy service than the rich.

No country has substantially reduced poverty in modern times without massively increasing the use of energy, replacing human and animal labour with more convenient and efficient sources of energy and technology. Different income groups have different requirements for which they use energy and, as income rises, they meet their needs with different energy sources and different conversion technologies. Some energy sources are better suited for a particular use than others: electricity, for example, is much sought after as the most effective source of lighting and for powering motors and communication technologies; but is rarely used

by poorer people for cooking. Energy Information and Administration (EIA, 2003) reported that in most of sub-Saharan Africa, less than 10% of the population is connected to electricity. The basic needs of the poor, are jobs, food, health services, education, clean water and sanitation. Energy plays an important role in ensuring these services. The more accessible it is, the higher the consumption by human beings. The poorest people, who cannot afford to pay anything for energy services and rely on energy sources that they can collect free of charge. For example, where it is cost-effective to provide electricity (through the grid or via decentralised systems) or other energy services to remote communities, providing other facilities such as schools, hospitals and trade at community centres can benefit a wider cross-section of the community, even if they are unable to afford household energy services themselves.

At a local level, energy services help improve the quality of life and facilitate sustainable livelihoods. At a national level, they help to facilitate stable economic development, attract foreign direct investment and allow access to global markets. Furthermore, they can have impact on the national and global environment as well as affect national budget allocations. At the same time, lack of access to energy can cause conflict.

Energy services are essential ingredients of all three pillars of sustainable development - economic, social and environmental. In the past, there was greater emphasis on technical and economic issues and more recently, on the environmental aspects of energy, with social concerns receiving less attention. To redress the balance, it is important to take a people-centred approach, looking at how energy affects peoples' lives directly and ensuring that all three pillars of human needs (food, shelter and energy) are considered in parallel.

Energy supports economic development at the national level by underpinning industrial growth and, via transport and communications, providing access to international markets and

trade. But, while there is clearly a strong relationship between growth in energy use and national income, the causal connection probably works both ways, greater energy use supporting higher incomes and those with higher incomes being able to afford more energy.

Energy facilitates economic development at the local level by improving productivity and enabling local income generation through improved agricultural development (irrigation, crop processing, storage and transport to market) and through non-farm employment, including micro-enterprise development. An emphasis on productive uses of energy services is important in helping people out of poverty (UN, 1996). As an indicator of local recognition of the importance of energy for businesses, Ugandan manufacturers, who were asked to rank the constraints on their firms' activities, identified power breakdown and voltage fluctuations as their top two problems (Booth, 2000)

A number of statistics showed a very strong association between increasing commercial energy consumption and human welfare, as measured by indicators like the Human Development Index which measures life expectancy and educational achievement as well as income (Carlos, 1995). Energy services help facilitate basic survival activities, for example, approximately 95% of staple foods (such as rice, grains and green bananas) need cooking before they can be eaten. Indeed, equity of access to basic energy services for cooking, space heating and lighting, like access to water, could be considered a human right. The rights-based agenda highlights inclusion of poor people, their participation in decision-making about their development, and the responsibility of government, as well as the poor, to fulfil obligations. A recent study on energy and poverty in China found out that access to electricity made people and communities feel included in the modernising process of the national economy (Rijal and Harunori, 2002).

Energy contributes towards social capital, by powering transport and communications so that the poor people can maintain contact with their extended families and peer groups. Energy is also used to prepare meals used in celebrating special events, which are important for maintaining social capital. Poor households draw on their social capital in order to cope better at times of shock or stress. A flexible approach that recognises that 'one solution does not fit all', should have greater success in providing energy services to meet people's needs. A full menu of energy options should be considered since in some cases, efficient, clean wood fires will be the best option, while in others, Liquefied Petroleum Gas (LPG) or kerosene may be preferable.

Energy interacts with people's lives in many ways, from the basic survival activities to increasing productivity. Productivity can be increased by extending the working hours of the days with lighting and by mechanisation, for example, for irrigation and processing crops and raw materials. When communities gain access to energy services, it can have a marked effect on their lives, particularly with respect to freeing up their time, improving their health and well-being, and opening up opportunities.

Most poor people currently meet the bulk of their energy needs by collecting fuelwood and other biomass (World Energy Council, 2002). This costs very little in cash terms, but is hugely expensive in terms of the time it takes. Patterns of time-use typical of South Indian villages illustrate the impact of the absence of energy services. Typical families spend 2-6 hours each day collecting 10 kilograms of wood over distances of 4-8 kilometres. In the Drass region of Leh in the Himalayas, women sometimes have to camp overnight when collecting fuelwood, as the distances they need to go are getting longer (World Energy outlook, 2002).

Access to alternative forms of energy may also affect people's health. Use of biomass fuels for cooking and space heating creates indoor air pollution, which has been linked with increased rates of Acute Respiratory tract Infection (ARI) in children (WHO, 2002).

Energy services can contribute in a number of ways to the efficient performance of this system, for example, through ensuring reliable heating, lighting, sterilisation and refrigeration, as well as safe disposal of medical waste.

Energy for lighting allows study at night and facilitates access to learning materials through radio, the internet and other ICTs. There are at least 1.2 billion people in the world that cannot read and write, with the number of women far exceeding the number of men. Literacy can improve people's employment prospects, enabling them to increase household income. Access to energy services also opens up opportunities for income-generating activities, access to markets through transport and communications, and thus a way out of poverty. An example of the importance of energy comes from West Africa, where fish processing and trading at the artisan level provide diversified employment opportunities, especially for women in fishing communities

2.3 History of Oil Price Changes in Nigeria

Since the global energy crisis of 1972/73, petroleum has become the single most important source of revenue, particularly foreign exchange earnings for Nigeria. This significant contribution explains why an energy analyst described the petroleum sector as the engine of growth fuelling the entire Nigerian economy and society (Ayodele, 2002).

Nigeria National Petroleum Corporation's (NNPC) argument on the non-profitability in the production of petroleum products for domestic consumption was aggravated by the poor state of the local refineries and petro-chemical complexes, which necessitated the massive importation of petroleum products to augment consumption. It was in response to the

economic realities of the NNPC's argument that the Federal government, in 1993, arbitrarily raised the prices of petroleum products in Nigeria (Ayodele, 2003). The same arguments were also advanced in 1995, 1997, 2000, 2001, 2002 and 2003 when the prices of these products were increased and finally the implementation of deregulation policy of the downstream of the oil sector in October, 2003 (Table 2.1). In 1986, the Structural Adjustment Programme (SAP) was introduced as a tool for revamping the economy by gradual withdrawal of the oil subsidy and full deregulation of the energy sector.

The price increase of petroleum products generates considerable consumer resistance, characterized by social unrest and sometimes violent industrial action lead by Nigeria Labour Congress (NLC) in 1998, 2000, 2003, 2004 and 2007, forcing government to concede some price adjustments. Owing to the external debts accumulated in Nigeria and serious economic decline as a result of the global economic crisis of the early 1990's, the government decided to remove subsidy on oil products.

Table 2.1. Trends of Price Changes of Petroleum Products in Nigeria

Year	PMS (Gasoline) ₦/Litre	N/Litre % Δ	Kerosene (House) ₦/Litre	Kerosene (Aviation) ₦/Litre	Ago (Diesel) ₦/Litre	Fuel Oil (Low Pour) ₦/Litre
1973	0.095		0.081	0.15	0.088	0.026
1975	0.1	5.3	0.081	0.18	0.1	0.026
1980	0.125	25.	0.1	0.225	0.12	0.05
1983	0.15	20.	0.1	0.3	0.15	0.1
1985	0.2	33.	0.1	0.4	0.15	0.2
1988	0.42	110.	0.1	0.8	0.3	0.3
1989	0.42	-	0.15	1.0	0.35	0.3
1990	0.6	43	0.4	1.0	0.5	0.4
1991	0.7	17	0.5	1.05	0.55	0.5
1992	0.7	-	0.5	1.05	0.6	0.55
1993	3.25	364	2.75	5.0	3.0	2.5
1994	11.0	238	6.0	7.0	9.0	7.0
1995	11.0	-	6.0	7.0	9.0	7.0
1996	11.0	-	6.0	7.0	9.0	7.0
1997	11.0	-	6.0	7.0	9.0	7.0
1998	11.0	-	6.0	7.0	9.0	7.0
1999	20.0	82	17.0	24.4	19.0	12.4
2000	22.0	10	17.0	30.0	21.0	12.4
2001	26.0	18	22.00	Na	24	Na
2002	26.0	-	22.00	Na	24	Na
2003	40.0	54	34.00	Na	34	Na
2004	42.0	4.7	40.0	Na	Na	Na
2004	50.0	16	40.0	Na	Na	Na
2006	65.0	23.1	50.0	Na	Na	Na
2007	70.0	7.1	50.0	Na	170	Na

Sources: NNPC, 2007.
Na – Information not available
Note: %Δ = Percentage Change; 1973/2007 %Δ of PMS = 73,582.2%

%Δ = Percentage Change; 1973|2007 %Δ of Kerosene = 61,628.4%

2.4 The Resultant Effect of Domestic Energy Price Increases

Every energy crisis with its relative cost increases has direct repercussion on timber consumption in the third world countries. The increase in oil product prices therefore, obliges a large part of the poorer population to substitute these fuels with others that are cheaper, namely, fuelwood, agricultural residues and cow dung (Carrillo, 2002). The consumption of timber resources for energy needs has grown enormously in developing countries, not only because of the population increase, but also because of the rise in oil prices which has continued since the 1970s. The insecurity of supply and high prices of petroleum products, made it unattractive for households to continue with the use of these energy sources, thus they usually turn to wood fuel and charcoal (Jane and Gunter, 1994). The unending fuel price increases in Nigeria is said to have always exacerbated social problems in the country and have for some time been experiencing high poverty and crime rates, decay of infrastructures and corruption. The inability of government to resolve Nigeria's energy problems heightens the country's inflation problem since energy is a factor of production, used in the production of basically everything.

Environmental groups have persistently complained about the negative consequences of the domestic energy price hikes on the nation's severely depleting forest (Raufu, 2003). From past experiences, increases in price of kerosene have often forced rural and the urban poor dwellers to abandon their kerosene stoves in favour of the comparatively cheaper fuelwood, which is seen as substitute source of energy. Usually, this often leads to rampant felling of trees as the fuelwood business thrives due to sharp increases in demand and high cost of kerosene. Umar (2000) in a key note address to a conference regretted that the rate of deforestation in the country is quite alarming where about 34.85 million cubic meters of wood were extracted in

the year 2000 from the savannah region alone. Environmental Rights Agency (ERA), a non-governmental organization in Nigeria described kerosene as a luxury item and only few Nigerians can presently afford it. Thus, the dramatic shift from the use of kerosene to wood, would lead to the reduction of forest cover of the country from 600,000km^2 at the beginning of the 20th century (UNDP, 2001) to 38,620km^2 (5%) in the 21st century. FAO (2001) warned that if this rate of deforestation continues, the remaining forests in Nigeria would disappear by the year 2020. The World Bank estimated the annual cost of deforestation in Nigeria to be $750m (USD). Butler (2005) tagged Nigeria as having the highest rate of deforestation in the world for losing 55.7 percent of its primary forest between 2000 and 2005 alone.

The uses of wood energy as a source of household energy have been proved to cut short the lives of poor children and women in the rural areas. The World Health Organisation (WHO, 2002) estimated that 2.5 million women and youngsters die prematurely each year in the developing countries, particularly from specific emissions due to indoor combustion of biomass fuels. If kerosene stoves were used instead of tripod fires, the estimated risk level would come down by six points, and even by a hundred points in the case of liquefied petroleum gas stoves. In addition, UNEP (2006) reported that indoor air pollution causes about 36 percent of lower respiratory diseases in developing countries with high rates of biomass consumption.

UNDP, (2001) in its reports on the state of natural resources in Nigeria also maintained that the annual rate of deforestation is as high as 400,000 hectares and only 26,000 hectares are reforested annually. The report linked the increased deforestation to the high cost of energy particularly cooking energy, and estimated that 3/4 of households (83% in the rural and 30% of the urban populace) depend on fuelwood for their household cooking requirements. Popoola (1992) reported that in Nigeria, 82% of the total population depend on fuelwood for their

source of household energy and the dependency rate is higher in the northern states. For many Nigerians, struggling to feed families in a harsh economic environment is enough a problem to contend with, the energy price increases is an additional stress, particularly on poor households (CNN, 1998).

The systematic deregulation of the downstream sector of the petroleum industry being embarked upon by the Federal Government of Nigeria, through the Petroleum Product Pricing and Regulatory Agency (PPPRA), is gradually ushering in an era of monopoly with the major and independent petroleum marketers emerging as the beneficiaries to the detriment of the average Nigerian. Price deregulation policy also tends to decrease the real income of workers and therefore tends to encourage increased consumption of the cheapest domestic energy source, i.e. wood (Ayodele, 2003). He therefore, stressed the positive correlation of inflation rate in the 1990s with the arbitrary increases in the prices of petroleum products, implies that Nigeria will continue to face unlimited inflation rates.

To curb the negative environmental impacts, Braide (2003) suggested the establishment of appropriate agencies for monitoring and enforcing standards as a crucial step.

2.5 Nigeria's Energy Profile and Trends

Nigeria has substantial energy resources. The array of these resources include: oil, gas, coal, tar sand, uranium, solar, wood, and hydroelectric power. However, these energy sources differ sharply in their relative importance. Table 2.2 gives estimate of the available energy resources in Nigeria.

Table 2.2. Energy Resources Estimates in Nigeria: Production and Consumption

Resource	Reserves	Production	Consumption	EXPORT
Crude Oil	36.2 Bb	2.5 mmBD	297,000 BD	2.2mmBD
National Gas	182 Tcf	800 Bcf	325 Bcf	475 Bcf
Coal	209Mst	0.02 Mst	0.02 Mst	Nil
Electric Power	5.9 giga watts	19 bkwh	18 bkwh	Nil
Bitumen	159 mst	Na	Na	Na
Solar	16.23 mj/cm^2	Na	Na	Nil

Source: Energy Information Administration, (EIA) 2007.
Na = Not available
Bb = Billion barrels, mmBD = Million barrels per day, BD = Billion barrels per day, Tcf = Trillion cubic feet, Bcf = Billion cubic feet, Mst = Million square tons, bkwh = Billion kilowatts per hour, mj/cm^2 = mega joules per square centimetre

2.5.1 Petroleum

This is presently the most important energy resource in Nigeria. Shell BP Development Company of Nigeria first discovered petroleum in 1956, at Oloibiri field in the present Delta State. Shell-BP; had monopoly over oil prospecting in Nigeria, until independence when several other oil companies such as Gulf, Mobil, Elf, Agip, Safrap and Texaco were also granted concessions. However, for a very long time, shell continued to maintain its leadership position in the industry, with a share of crude oil production of 48.3 percent of the total production in 1986. Gulf maintained a distant second position with production share of 16.8 percent.

The proven crude oil reserve is 24 billion barrels, with the current production rate of 2.12 mmBD, Nigeria oil would probably last for 29.01 years. Nigerian oil comes in various types such as Bony light and medium; Forcados blend; Escravos light; they however, fall mainly into the medium and heavy range with a density of 34.09^0 AP. Because of its low sulphur content, Nigerian oil is attractive in Western Europe and North America energy markets.

2.5.2 Natural gas

Nigeria at various times has been described as more of a gas rather than oil-rich country. This is because of the immense quantity of gas deposits. Nigeria's proven gas reserves stood at 124 trillion cubic feet (TCF). Nigeria's production of gas rose from $46mm^3$ in 1958 to $27,593mm^3$, in 1990 and to 245BCF in 1999 and was 0.55TCF in 2002. Natural gas normally comes in either associated or non-associated forms. The non-associated gas is estimated to contribute about 80 percent of total production. The chemical composition of Nigerian gas constitutes a major advantage to the country. It has low calorific value and it can be used directly without being processed in gas turbines.

2.5.3 Coal

Coal was the first commercial energy discovered in Nigeria. It was discovered in commercial quantities in 1909 in Enugu. The commercial mining of coal however, started a decade later. The industry's production level reached its peak in 1958 when the output was almost a million tons. It later declined due to change in the fuelling systems of electricity generating plants and locomotives. The civil war also led to the closure of the industry. Record indicated that Nigeria has proven coal reserve of 209 trillion short tons, production stood at 0.07 million short tons while consumption is at 0.08 million short tons (Table 2.2)

Until recently, activities in the coal sub-sector were dominated entirely by government. The private and foreign participation in the production is currently being encouraged. The present coalmines in Nigeria are Onyeama and Okaba in Enugu State; and Owuka in Benue State.

2.5.4 Hydro-electricity

Among all the commercial energy sources, hydro-power is the only renewable source of energy. The country began to exploit this source of energy from 1923 in Jos, Plateau State for the production of cassiterite and colombite. Hydroelectric generation enjoyed priority status in electric generation until recently; the major reasons that accounted for this are that it was a renewable electricity supply source, it is free from pollution, its use will free other energy sources like oil for export to generate additional revenue for the country; and its flexibility allow for low operating and maintenance cost. This advantage is however counter balanced by its high capital cost disadvantage.

On the strength of the foregoing, hydroelectric power generation received favourable attention in Nigeria's first three development plans. However due to formidable problems associated

with inadequate rainfall, the high evaporation rate in the hydro energy locations and the need to promote domestic consumption of gas, the fortune of this source has changed.

2.6 Trends in Energy Production in Nigeria

For over two decades (1915 – 1935), coal was the only commercially exploited energy resource in Nigeria. The production of coal reached its peak in 1958 with a production level of about 900,000 tons. Thereafter, the fortune of this resource suffered a setback and its production began steady decline such that only 323,000 tons were produced in 1972/73. It further declined to 249,500 tons in 1976/77 and by 1980/81 only 114,875 tons were produced in the country. In 1986, the production rose to 151,214 tons, and later declined to 80,973 tons in 1989. This was due to obsolete and malfunctioning equipment, inadequate infrastructural facilities and sharp decline in demand of its output due to discovery of other energy sources.

In 1937, another commercial energy source, hydro electricity became part of the energy sector profile. The production of hydroelectric power continued to increase from 1852.77 mw in 1973/74 to 3550.76 mw in 1986. This later declined to 3201.99mw and 3159.332mw in 1987 and 1988 respectively and again rose up to 3581.78mw in 1989. There was a sharp increase in the production of electric power in 1992 to 18.78mkwh and declined to 18.70mkwh in 1999 and up to 16.67bkwh.

The discovery of oil in commercial quantities in 1956 and its subsequent exploration a year later changed the configuration of the sector. Oil production rose from 5,100mbd in 1958 to 1.083mbd in 1970 the average production rate rose to 1.93mbd in 1992 and to 2.24mbd in 2001, which later declined to 2.12mbd in 2002 (OPEC, 2003).

Natural gas was the next major commercial energy source that came into prominence with the discovery of petroleum in 1958. Its output rose from 46mm^3 in 1958 to 24,551mm^3 in 1980

before declining to 15,170mm^3 in 1987. In 1990 the production was 27,593mm^3. In 1999, 245b cubic feet of gas was produced and in 2002, 0.55 million cubic feet. Over this period, almost all of Nigeria's gas production was flared by the oil companies due to lack of market outlet and huge available costs of collecting and recycling of the gas.

2.7 Domestic Energy Consumption Trends

WEC (2002) reported that the aggregate energy consumption in Nigeria increased by 80.5 percent between 1950 and 1960. It however, increased by only 61.6 percent between 1960 and 1970. Energy consumption doubled or even more between, 1970 and 1975. By 1980, energy consumption was 2.22 times the 1975. By 1992 the aggregate domestic energy consumption was 22.57 million tons of oil equivalent (mtoe) (0.75 quads BTU), from 1992 to 2001, the consumption steadily increased to 26.62 mtoe (0.92 quads), (Table 2.3). Petroleum products consumed by Nigeria include, Liquefied Petroleum Gas, Aviation Spirit, Premium Motor Spirit, dual-purpose Kerosene and fuel oil.

Table 2. 3. Nigeria Primary Energy Production and Consumption Quadrillion (10^{15}) BTU

YEARS	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
Production	4.40	4.43	4.45	4.53	4.57	4.85	4.90	4.89	5.18	5.48
Consumption	0.78	0.80	0.74	0.83	0.85	0.85	0.81	0.81	0.81	0.92

Source: World Energy Council, 2002

2.8 Review of Energy Consumption Patterns

Energy is used in the running and operation of industries, commerce and households. Distortion in the supply of energy depresses the economy of a locality, state or country. Increasing oil prices have stimulated interests in alternative energy sources in developing countries as well as in the industrialized world. The impact of higher energy prices on the balance of payments and economic growth of many developing countries has been severe (World Resources Institute WRI, 1989). According to World Energy Council (WEC, 2006), household energy use in developing countries totalled 1 090 Mtoe in 2004, almost 10% of world's primary energy demand. Household use of biomass in developing countries alone accounts for almost 7% of world primary energy demand. In many countries, biomass is said to account for over 90 percent of household energy consumption. The proportion of people relying on biomass is reported to be highest in Sub-Saharan Africa (Table 2.4) in parts of this region more than 90 percent of the rural population rely on fuelwood and charcoal.

In the absence of policies that can reverse these trends, the number of people relying on biomass is expected to increase to over 2.6 billion by 2015 and 2.7 billion by 2030 (WEC, 2006) because of population growth. There are evidences that, in areas where local prices have adjusted to high international energy prices, the shift to cleaner, more efficient use of energy for cooking has actually slowed down and even reversed.

There are enormous variations in the level of consumption and the types of fuels used. While a precise breakdown is difficult, the main use of energy in households in developing countries is for cooking, followed by heating and lighting.

Table 2.4. People Relying on Biomass Resources as Their Primary Fuel for Cooking, 2004

	Total population		Rural		Urban	
	%	million	%	million	%	million
Sub-Saharan Africa	76	575	93	413	58	162
North Africa	3	4	6	4	0.2	0.2
India	69	740	87	663	25	77
China	37	480	55	428	10	52
Indonesia	72	156	95	110	45	46
Rest of Asia	65	489	93	455	35	92
Brazil	13	23	53	16	5	8
Rest of Latin America	23	60	62	59	9	25
Total	**52**	**2 528**	**83**	**2 147**	**23**	**461**

Source: World Energy Outlook, 2006

Households generally use a combination of energy sources for cooking that can be categorised as traditional (such as dung, agricultural residues and fuelwood), intermediate (such as charcoal and kerosene) or modern (such as LPG, biogas, ethanol gel, plant oils, dimethyl ether (DME) and electricity). Electricity is mainly used for lighting and small appliances, rather than cooking, and represents a small share of a total household consumption in energy terms.

The pattern of energy consumption worldwide varies from region to region and from country to country, depending on their developmental stages. In the developed countries only 20 percent of their total energy is used for residential purposes, compared to the developing countries that use 85 percent for residential purposes (Murray, 2002).

Similarly, fossil-based energy consumption is much higher in the developed countries while in the developing countries, traditional energy sources (wood) are consumed much more. In Africa, for instance, the energy consumption pattern is strikingly characterized by over-consumption of low-grade traditional energy sources (fuelwood, charcoal and non-woody biomass), on the other hand, and under-consumption of high quality modern fuels (coal, liquefied petroleum gas, natural gas) on the other.

Though large disparities exist among countries, Sokona (2002) reported that Nigeria is one of the five countries accounting for 70 percent of the total modern energy consumption in sub-Saharan Africa. Enormous disparities also exist among poor urban and rural users, as well vary among income groups. Ayodele (2003) confirmed that petroleum represents over 78 percent of the national energy consumption in Nigeria. Similarly, Adesanya (1998) confirmed that wood fuel constitutes almost 70 percent of the energy consumption and forming the main energy source for 80 percent of the total population of Nigeria. In India, Ailawadi and Bhattachayya (2004) reported that the use of kerosene, despite its inefficiency, as an alternative to electricity for lighting, is common among the poor households.

In the sub-Saharan Africa 68 percent of the total energy consumption is in the households. Commercial energy consumption in this region is about the lowest in the world (Sokona, 2002). This is a reflection upon the low level of economic activity in the region (Table 2.4).

A number of factors influence what sort of energy source is used by households, the most important being the household income. In general, the higher the income the more likely it is that a household will use modern fuels (Oleg & Ralph, 1999; and Omorah, 2000). Households with higher socio-economic status and levels of education consume more energy and are better disposed to acquire fuels as liquefied petroleum gas and electricity. This correlation is largely manifested in urban areas. In rural areas, the same trend can be discerned, although blurred by the degree of social homogeneity, the non-diversification of fossil-based energies and the unchallenged dominance of fuelwood.

The poor may also face difficult trade-offs in their search for livelihoods: in the words of a resident of Ha Tinh, Vietnam, 'We know that cutting down trees will cause water shortages and that making charcoal can cause forest fires, but we have no choice, because we lack food, we have to exploit the forest (Deepa, *et al*, 2000).

Table 2. 5. Typical Energy Consumption in Sub-Saharan Africa (Million Tons Oil Equivalent-mtoe)

	INDUSTRY	TRANSPORT	RESIDENTIAL	TOTAL
Solid Fuels	3.8	0.2	1.2	5.2
Petroleum Products	12.5	21.1	11.9	45.5
Gas	4.7	-	0.02	4.7
Electricity	1.9	-	1.3	3.2
Total Conventional Energy	22.9	21.3	14.5	58.7
Biomass	3	-	93.0	96.0
Total	25.9	21.3	107.5	154.7

Source: ADB Energy Sector Policy, 1996.

Percentage of residential energy in the total energy consumed in Sub-Saharan Africa 69.5 mtoe; Percentage Biomass in the residential energy in Sub-Saharan Africa 86.5 mtoe

Considering that 70 percent of the population in Nigeria live in rural areas, this implies that only 30 percent of the population has access to fossil-based domestic energy. Record has also shown that only 10 percent of the rural households and approximately 40 percent of Nigeria's total population have access to electricity (WEC, 2006).

Households spend a substantial portion of their income for acquiring domestic energy. Despite the fact that of the primary fuels, wood costs least expensive in rural areas, a far higher proportion of the household income is allocated to domestic energy in Africa (Table 2.6)

Table 2.6. Share of Energy Expenditure in Households' Income per Sub-regions in Africa in 2001

sub-region	energy expenditure (% of income)
East Africa	12.7
South Africa	11.9
West/Central Africa	14.06
North Africa	7.9

Source: World Energy Outlook, 2002.

2.9 Determinants of Household Energy Choice

The question of meeting the sustainable household energy demands against current erratic supplies has become a global issue. Energy scarcity is one of the factors that are currently threatening economic growth in Nigeria. For instance, in many parts of the country, acute fuel scarcities make meaningful economic growth difficult. Worst affected are the rural communities and urban slums, where many households are unable to grow past their subsistence levels. Apart from sluggish economic growth, fuel scarcities make household fuel choice a complex economic and social function. For many households, the decision over which fuel to use or how much of the fuel to use, requires consideration of several important factors. Such factors may include a number of household characteristics and social class, which is a function of wealth and defined by factors such as the type and ownership of the dwelling unit, money income, household size and place of residences.

Increasing fuel shortages compels two broad reactions by households: first, some households will switch to other fuel alternatives available. Second, the households that are not able to switch (for whatever reasons) may have to adjust their cooking patterns to the prevailing levels of shortages (Cecelski, 1987; Misana, 1988). However, some of the coping techniques may entail dietary and health consequences.

Although fuel shortages are common in many regions of the developing world (Rijal and Harunori, 2002; Srinivas, 2000; Sharma, 2000; Mahendra *et al* 1992; Cecelski, 1987; Ekholm, 1975), the nature and magnitude of the factors that affect household cooking fuel choice are not yet clearly understood or reported in households in Nigeria. However, regional experience suggests that market prices are insufficient indicators of fuel choice in this region since some fuels can be consumed without being bought in the market.

In this study, the factors considered are: cost, availability, ease in operation, cultural beliefs, societal influence, reliability of the energy types and type of residence.

Theoretically, the above social factors are expected to influence household fuel choice in the following manner:

2.9.1 Cost

Cost of energy type is expected to influence the choice of domestic energy by households. The household energy types vary in their prices, depending on their efficiency. The more efficient the energy type is, the more it costs. For instance kerosene cost more than biomass energy, while liquefied natural gas (LNG) and liquefied petroleum gas (LPG) costs much more than kerosene. Households also vary in their characteristics (size, education and income) therefore their ability to acquire the energy type tends to vary as well (Heltgerg, 2005). The educational level of the head of household is expected to have a positive effect on the choice of household energy alternatives. The level of education improves knowledge of fuel attributes, taste and preference for better fuels and income, which then can be used to acquire the fuels which are comparatively expensive. The initial cost of using certain energy types also make poor household not to patronise them. According to CBN (2007), Northeastern Nigeria has the highest poverty level among the regions (Table 2.7). Moreover, four out of the six of the states of the region are among the first ten with highest poverty incidences in the country; therefore, this factor could affect the adoption of better household energy.

Table 2.7. Percentage Trends in Poverty Level by Regions in Nigeria (1980- 2004)

Region	1980	1985	1992	1996	2004
South-South	13.2	45.7	40.8	58.2	35.1
South-East	12.9	30.4	41.0	53.5	26.7
South-West	13.4	38.6	43.1	60.9	43.0
North -Central	32.2	50.8	46.0	64.7	67.0
North -East	**35.6**	**54.9**	**54.0**	**70.1**	**72.2**
North -West	37.7	52.1	36.5	77.2	71.1

Source: Central Bank of Nigeria, 2007

Table 2.8. Ten States with Highest Incidence of Poverty in Nigeria in 2006

	States	Incidence of poverty
1.	Jigawa	95.0
2.	Kebbi	89.7
3.	Kogi	88.6
4.	**Bauchi**	**86.3***
5.	Kwara	85.2
6.	**Yobe**	**83.3***
7.	Zamfara	80.9
8.	**Gombe**	**77.0***
9.	Sokoto	76.8
10.	**Adamawa**	**71.7***

Source: Central Bank of Nigeria, 2007. * States located in the Northeastern Nigeria

Household's size is theoretically expected to negatively affect choice of fuelwood alternatives. This is because larger household sizes may mean larger labour output, which is needed in fuelwood collection. It is also assumed to be cheaper to cook for many people using fuelwood than its alternatives. This is because per unit price of fuelwood is lower than per unit prices of its alternatives.

2.9.2 Availability

Not all energy types are available to all households at all locations and season of the year. It is expected that the place of residents of households would have effects on the availability of domestic energy type at their disposal. It was reported that most rural residents adopt biomass as source of household energy due to unavailability of other types (Asawana, 2001).

2.9.3 Cultural beliefs

The upbringing of individuals tends to have influence on their behaviour. Cultural beliefs may keep working women to a common culture and societal lifestyle of using fuelwood. World Energy Outlook (2002) reported cases in India where traditions determine household energy choice regardless of energy availability and income. Nigeria and Northerneastern region in particular exhibit multicultural behaviour. It is expected that these cultural differences will affect their choice of household energy and adoption of coping strategies during energy crisis.

2.9.4 Societal influence

At a particular point in time, one is influenced by the society in which he lives. In the choice of household energy it is expected that one's position in the society should restrict energy choice to certain levels, i.e. households that are considered to be highly placed in the society are expected to patronise the efficient energy type (Adebayo,2006).

2.9.5. Reliability of the energy type

Reliability is an issue in the choice of domestic energy. Reliability could be in the form of assurance of regular supply or quality of the energy types.

2.9.6. Type of residence

If a household does not own the main dwelling unit, the household is more likely to use alternatives to fuelwood. Such houses are likely to be rented and tenants must adhere to landlord's occupancy rules. One disadvantage of fuelwood (which makes it less preferred in rented houses) is that it produces smoke that can stain walls and roofs. Likewise, if the dwelling unit is modern type house, the household is most likely to use fuelwood alternatives because these fuels are cleaner. In addition, richer households who may afford the fuelwood alternatives most likely own modern type houses.

2.10 Coping Strategies

The term 'coping' is usually used to refer to those personal, and/or social strategies which people use in dealing with situations that are perceived as causing stress or psychological distress. It should be noted that coping is regarded as a voluntary and conscious effort, rather than an automatic or instinctive act. Susana, *et al (2004)* defined coping as a constantly changing cognitive and behavioural effort to manage specific external and/or internal demands that are appraised as tasking or exceeding the resources of a person. Contextual and personal factors influence how people appraise life events, which coping strategies they choose to use and how effective these proved to be.

Similarly, Compass, *et al* (1988) defined coping strategy as the process through which the individual manages the demand of the environmental relationship which are appraised as stressful, and the emotions they generate. Coping is an individual's secondary appraisal of what can be done in the presence of a threat or challenge (Bakare, 1986), while Stone and Neal (1984) described coping as efforts, both action oriented and physic, to manage (i.e. master,

tolerate or minimize) environmental and internal demands and conflicts, which task or exceed a person's resources. While Bakare, (1986) looked at coping strategy as specific efforts both behavioural and physiological, that people employ to master, tolerate, reduce or minimize stressful event. Compass, *et al* (1988) indicated that coping skills are those resources available to individuals for solving problems or meeting the needs of these individuals. They felt that coping skills are discrete themselves but yet, some depend on others to solve problems. This means that some coping skills can solve the need in the presence of a stress factor, while some might work in combination with other coping skills.

Coping is not just a question of knowing what to do, but implies a flexible use of cognitive, social and behavioural skills in managing situations that are ambiguous, unpredictable, or stressful. Therefore, coping includes traits, skills or means, both human and material, which can be used to meet the demand of a situation. Coping strategies could be problem focused or emotion focused; active or avoidant. In problem coping, efforts are made to act on the source of the stress to alleviate or change the stressful circumstances, while in the emotion focused coping, efforts are made to regulate the emotional consequences of the stressful or protecting stressful event. Stone and Neal (1984) summarised active coping strategies to be either behavioural or psychological responses designed to change the nature of the stressor itself or how one thinks about it, whereas avoidance coping strategy leads people into activities such as alcohol use or mental state such as withdrawal that keep them from directly addressing the stressful event.

Right from the world energy crisis of 1972/73, petroleum product prices have been on the increase. Between 1973 and 2007, the percentage increase of Premium Motor Spirit (PMS), for example is 73,582.2%; that of kerosene is 61,628.4% and that of diesel is 1930.2%. These increases in price of these energy types are bound to have profound effect on the demand and

supply of forest resources, particularly fuelwood and invariably the prices (Popoola, 1992). Consequently, this increases expenditure on domestic energy in the households while increasing pressure on the forests. Worse still, the fossil-based domestic energy sources are not readily available, particularly in the rural areas, and especially settlements around the country's' borders due to rampant smuggling activities.

How has the public been coping with these incessant domestic energy price increases? How can the ever-increasing pressure on the dwindling forest resources be reduced? The public must have adopted some ways of surviving, which could have differed from one household to another. Some reduce the frequency of use of the household energy; some families cook food that takes less time to cook; while some families acquire the energy required in the household at the expense of other household needs.

Metcalf (2002) reported that when electric bills sky rockets in Russia, some of the consumers resort to hanging their laundry out to dry, turning off their extra storage freezers, turning off security lights, heaters and air conditioners in order to reduce the bills as coping strategies. Others use the black curtains to maintain the temperature of residence. In Nigeria, experience has shown that households abandon their gas and kerosene cookers when they can no longer afford the kerosene and gas prices. They then go for cheaper a fuel, which in most situations is wood (Energy Watch, 2007). This has adverse effect on the environment. Strategies that can provide additional income to the households to enable them acquire domestic energy could be an option.

2.11 Alternative Domestic Energy Sources

As the world population increases, the rate of dependency on the fossil fuel also increases. Therefore, the need for alternatives to fossil fuels is inevitable. As a country, Nigeria depends greatly on the use of oil as a source of energy and because it is a finite resource, the use of

alternative sources of energy must be explored (Bradley, 2003). It is obvious that in a country like Nigeria, having up to 70 percent of its population residing in the rural areas, coupled with the situation of skyrocketing prices and shortages of energy sources, the alternative source is obviously wood energy.

Garba (2003) confirmed that most Nigerians resort to felling of trees for domestic cooking when they cannot afford energy types as methane gas and kerosene. Consequently, Garba (2003) suggested that the geographic advantage of Nigeria's position in the tropics should be taken to harness sunshine to provide solar energy as an alternative to the fossil fuels. Similarly Jane and Gunter (1994) lamented that solar energy would have been a better source of alternative energy, but are expensive relative to other energy resources. Takase (2003) reported that less than 10 percent of the rural households in Nigeria have access to electricity and fewer still can afford the high cost of electricity for cooking. This assertion was made by several other energy researchers including Oboho, (1986); Even and Soussan, (1992); Omorah (2000); Ayodele (2002); and FAO (2001).

CHAPTER THREE

3.0 MATERIALS AND METHODS

3.1 Description of the Study Area

Northeastern Nigeria was one of the twelve states created in 1967. With the continual creation of states, the former Northeastern State now consists of Adamawa, Bauchi, Borno, Gombe, Taraba and Yobe states (Fig. 3.1). Adamawa State consists of 21 Local Government Areas (LGAs), Bauchi has 20, Borno has 27, Gombe has 11, and Taraba has 16, while Yobe has 17.

3.1.1 Location

Northeastern Nigeria is one of the six geo-political zones in Nigeria. The region is located between longitude $8^{o}40^{`}$ and $14^{o}30^{`}$ East; and latitude $6^{o}20^{`}$ and $13^{o}40^{`}$ North (Fig.3.1). The region has international borders with the Republics of Chad and Niger to the North, and the Republic of Cameroon to the east and south. Furthermore, it shares borders with Jigawa State to the Northwest, Kano and Kaduna States to the west and Plateau and Benue States to the southwest.

3.1.2 Temperature

The temperature of the study area ranges from $30^{o}C$ – $40^{o}C$ in the central and far northern parts between February and October; and from $21^{o}C$ – $30^{o}C$ between the months of November and January. Also in the south, the temperature ranges from $24^{o}C$ to $27^{o}C$ between February and October; and from $21^{o}C$ to $24^{o}C$ between November and January. In the Mabilla and Biu Plateau areas the temperature range is as low as $17^{o}C$ – $21^{o}C$ in the cool February to $21^{o}C$ in wet June to August (Adebayo and Tukur, 1999).

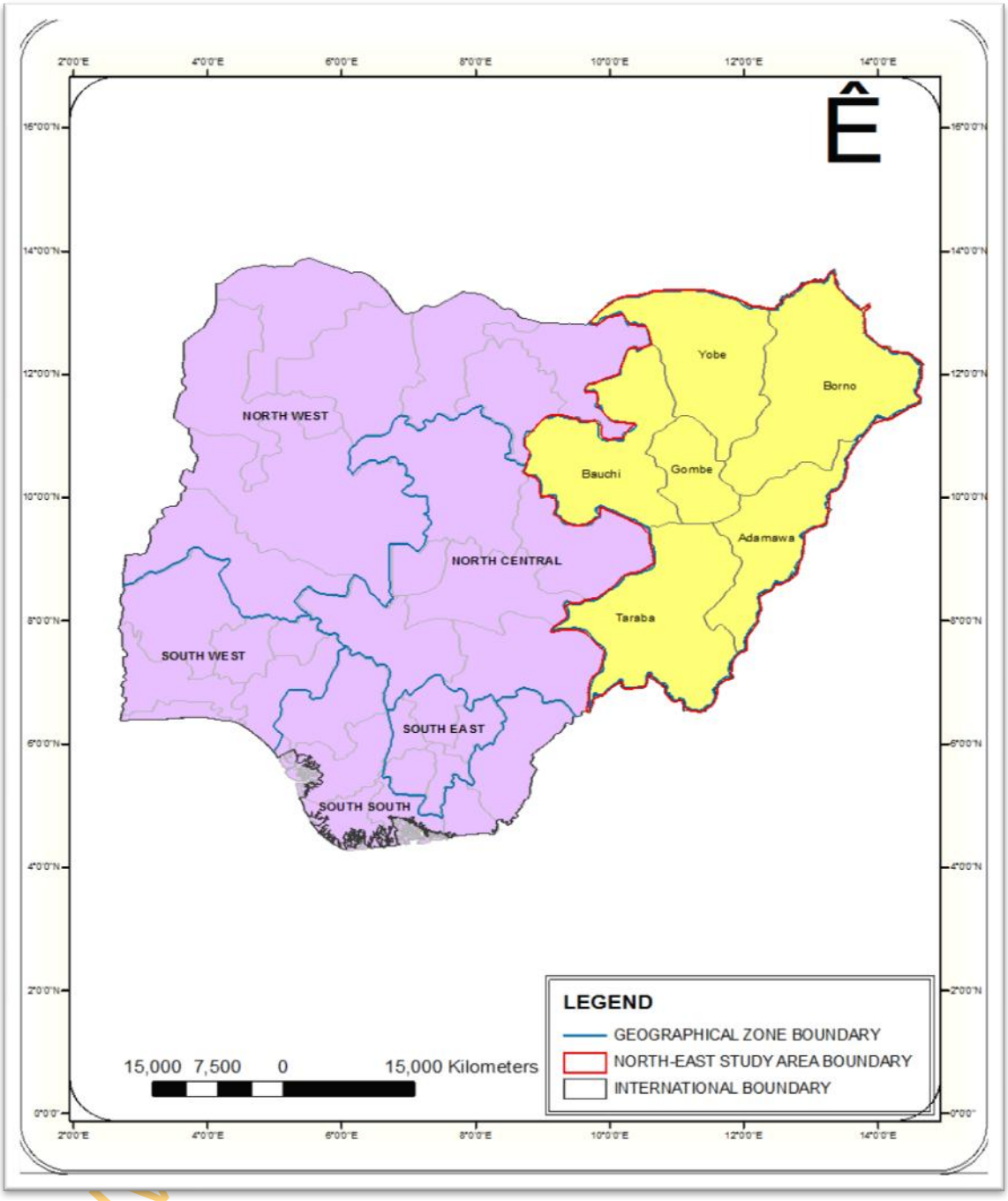

Fig. 3.1: Map of Nigeria Showing Northeastern Region

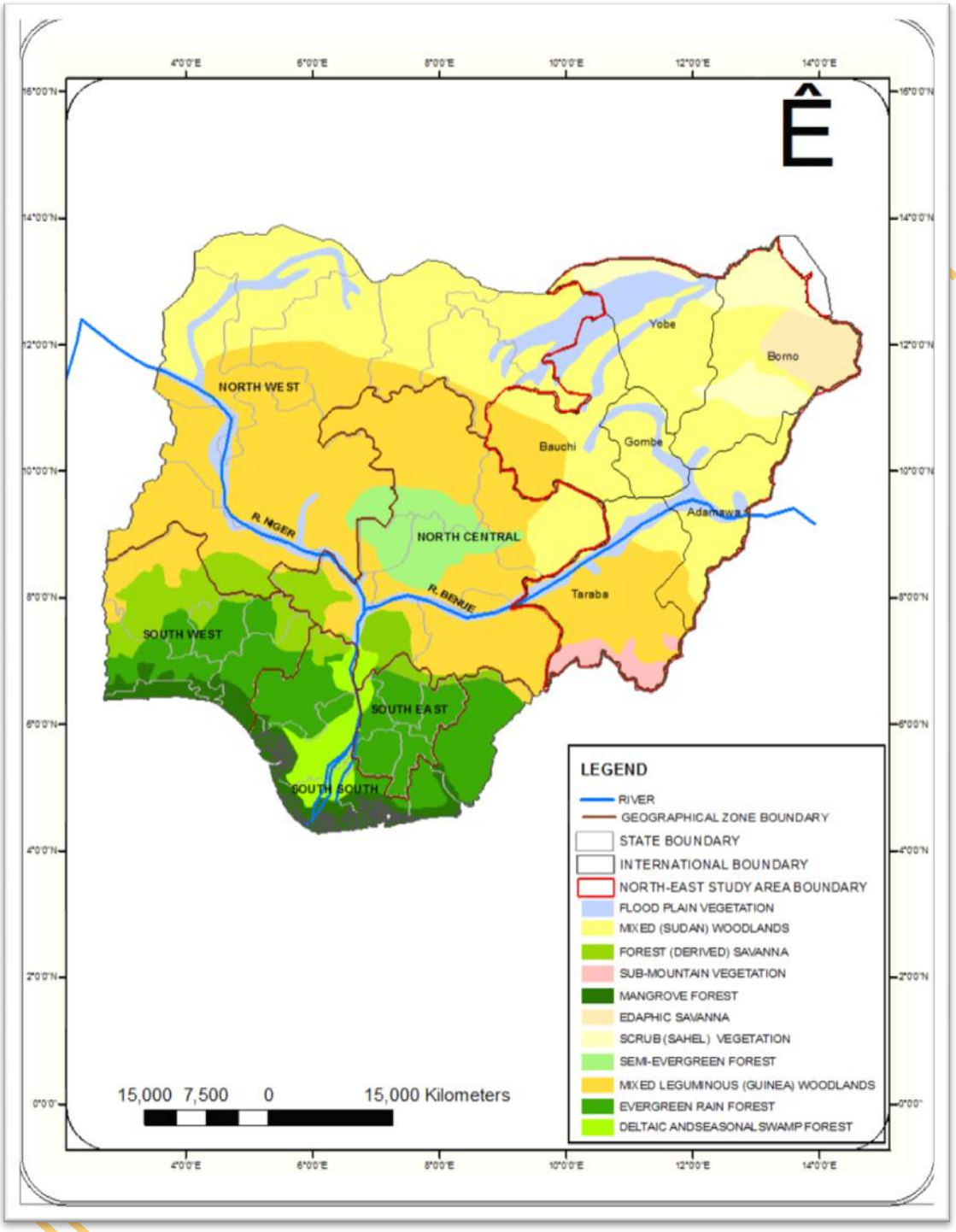

Fig. 3.2. Vegetation Map of Nigeria Showing Northeasten Region

3.1.3 Rainfall and relative humidity

The annual precipitation in the study area has a very wide range from 400mm/annum in the far north to 2200mm in the extreme south (Table 3.1). The relative humidity ranges from 15 to 35% in the north, 35 to 55% in the central and 55 to 75% in the southern parts.

Table 3.1 Mean Annual Rainfall in Northeastern Nigeria

Range (mm/annum)	Area	States Located in the Area
400 – 600	Far North	Borno
600 – 800	North	Yobe
800 – 1,000	Central	Northern Adamawa, Gombe and Northern Bauchi
1,000 – 1,400	South	Adamawa, Bauchi Northern Taraba
1,400 – 2,200	Far South	Taraba

Source: Federal University of Technology Yola and University of Maiduguri weather stations 2009.

3.1.4 Vegetation distribution

The study area exhibits three prominent vegetation types; these include the Sahel savannah in the far north into which the northern parts of Borno and Yobe states fall. The Sudan Savannah is found in the central part of the region consisting of northern Adamawa, Gombe and northern Bauchi states, while the guinea savannah is located in the Southern portion of the region consisting of Taraba and southern Bauchi states. Other vegetation types found in the region are the plateau grassland found in the Mambilla Plateau area and pockets of moist rain forest in Donga area in Taraba State (Fig 3.2).

3.1.5 Soil types

The major soil types found in the study area are the alluvial soils and red-brown bottom land at the Chad Basin and the Benue River Valley; red-brown soils of dry tropical zones around Yobe, Borno and northern parts of Bauchi, Adamawa and Gombe States; red laterites in the southern parts, including southern Adamawa and Taraba States, while the ferrallitic soils of the humid tropical mountain zones are on the Mambilla Plateau-southern Taraba.

3.1.6 Geology

The study area consists of quaternary sediments in the north (Borno, Yobe) tertiary sediments also in the north and east central parts (Borno South and Adamawa); cretaceous sediments along the Benue River valley; Precambrian (ancient basement rocks) in the south (Taraba), and some patches of lavas also in the southern part of the region.

3.1.7 Relief and drainage

The relief of the northeastern region consists of river valleys, plains and mountains. The Benue, Taraba, Gongola River valleys, the plains of Borno and the Chad Basin have relief range between 0 – 200m above sea level. The Mambilla and Biu Plateau between 400 – 800m,

and the Gotel mountains, Shebshi and Mandara mountains in the east of the region ranging from 800m above sea levels.

Northeastern Nigeria is drained by the Benue, Taraba and Gongola Rivers to the south draining into the River Niger and by Komadugu-Gana and Hadejia Rivers in the north draining into the Lake Chad (Gill, 1979 and Duze, 1980).

3.2 Population and People

The population of the region was given at 18,961,965 (National Population Commission, 2007). The people of this region are farmers, mostly subsistent farmers and livestock keepers of mostly cattle, sheep, goats, camel and birds. More than 80 percent live in the rural areas. A few are into domestic and international business. Unlike most geopolitical regions in Nigeria, northeastern region is heterogeneous when it comes to ethnic groups. For instance, Adamawa State alone consists of over 85 ethnic groups. Similarly, the other states in the region have many ethnic groups, but the major ones include Hausa and Fulani, which are found in all the states, while Kanuri, Shuwa Arab, Margi and Bora are in Borno State. Tangale and Waja are in Gombe State, while Karekare and Kanuri are in Yobe State. Higgi, Kilba, Chamba, Bachama, Margi Dera Lunguda and Ga'anda are in Adamawa State, while Tera and Fulani are in Bauchi. Finally, Mumuye, Jukun, Kutep, Mambilla, Chamba, Ndoro and Wurkun are in Taraba.

Table 3.2 Population of Northeastern Region by States

State	Population
Adamawa	3,168,101
Bauchi	4,676,465
Gombe	2,353,879
Borno	4,151,193
Taraba	2,300,736
Yobe	2,321,591
Total	**18,961,965**

Source: National Population Commission, 2007

3.3 Road Network

The region is connected to the other parts of the country by three major trunks '**A'** roads. These include the road into Benue State through Wukari in the southwest, into Plateau State through Bauchi in the west and into Jigawa through Bauchi in the northwest. There are several roads from the region leading to some African countries. The major ones include the one connecting Yobe to Niger Republic in the northwest of the region through Nguru; Borno to Chad and Cameroon through Ngala, Banki, Ngoshe in the northeast; Adamawa to Cameroon through Mubi, and Gurin in the east, while Taraba to Cameroon through Gembu and Mayo-Daga in the southern part of the region.

Two international Airports located at Yola and Maiduguri link the northeastern region to other parts of the world. Occasionally, lightweight ships sail to Yola through the Benue River from the seaports, and more often ships come from Cameroon. The zone has only one railway line linking Jos to Maiduguri through Bauchi.

3.4 Data Collection and Analyses

3.4.1 Sampling design

Stratified sampling procedure was employed. The first stratum consists of the northern part of the study area characterized by the Sahel savannah vegetation. The states located in this area are Borno and Yobe. The second is the central part, characterized by the Sudan savannah comprising most parts of Bauchi, Gombe and Adamawa states; while the last part in this stratum is the southern part which comprises Taraba and some parts of Bauchi state.

One state was randomly selected from each of the vegetation zones (Table 3.1). Having selected three states through stratified random sampling, each state was stratified into urban,

semi-urban and rural areas. The state capitals were considered to reflect the urban areas, the local government headquarters outside the state capitals to represent the semi-urban setting, while the council wards outside the LGA head quarters represented rural areas.

Twenty percent of the Local Government Areas (LGAs) in each of the selected states were randomly selected (state capitals inclusive) and in each LGA, 20% of the council wards were selected for the study. Similarly 25 households were randomly selected from each of the council wards for the interview. Equivalent numbers of interviews conducted in the rural areas were also conducted in the LGA headquarters (semi-urban area) and the state capitals (urban area).

Table 3.3 Spatial Distribution of Questionnaire Administered in the Study Area

S/No	Ecological zones	States in the Zone	Total No. LGAs	Selected States & LGAs	Total No. of Council wards	Selected council wards	Sampled Respondents by categories			
							Heads of Households	Heads of Govt. Agencies	Community leaders	Domestic Energy Marketers
1.	Guinea savannah	*Taraba	16	Jalingo	10	Jalingo	25	4	3	6
						Kona	25		3	6
				Ibi	10	Rimi-uku	25	2	3	6
						Nwango	25		3	6
				Sardauna	11	Gembu	25	2	3	6
						Nguroje	25		3	6
2.	Sudan Savannah	Adamawa Bauchi *Gombe	11	Gombe	11	Gombe	25	4	3	6
						Bajoga	25		3	6
				Billiri	10	Billiri	25	2	3	6
						Bare	25		3	6
3.	Sahel	*Borno Yobe	27	Hawul	10	Hazhi	25	2	3	6
						Azare	25		3	6
				MMC	12	Jire	25	4	3	6
						Damaganari	25		3	6
				Gubio	10	Lawanti	25	2	3	6
						Ngetere	25		3	6
				Mobar	10	ZannaMarti	25		3	6
						Damasak	25	2	3	6
				Monguno	10	Munguno	25	2	3	6
						Abaganari	25		3	6
	Total	**6**	**54**	**9**			**500**	**26**	**60**	**120 = 706**

*-Selected states

Another set of structured questionnaire was administered on dealers/marketers of household energy types (kerosene, cooking gas and fuelwood). These include filling stations of major and independent petroleum product marketers, major and minor "black marketers"; and 6 randomly selected fuelwood sellers in each selected LGA. In all 706 copies of the questionnaires were administered.

3.4.2 Questionnaire design and validation

Four sets of pre-tested questionnaires were used for primary data collection for this study (Appendix 1). The first set of questionnaire was used to interview heads of households, and made up of three sections **A, B** and **C**. Section **A** was used to obtain information about the demographic characteristics of respondents. Section **B** of the questionnaire was used to obtain information on the type and quantity of domestic energy used in the household, periodic expenditure on domestic energy, attraction to the domestic energy in use, description of the nature of domestic energy supplies within the study period, effect of price increases on the household consumption and budgets; any alternative sources of domestic energy when it becomes necessary.

The last Section **C** of the questionnaire was used to solicit information on the usual actions taken by households in situations of exorbitant price increases and/or scarcity of domestic energy, as a survival technique to suppress the devastating impact on household's economy. An array of options was provided and space for inclusion of those not on the list.

The second solicited information about the availability and utilization of all sorts of domestic energy types from community leaders. The third set of questionnaire was administered on heads of government forestry agencies, including the Federal, State and

Local Government Directors of Forestry or Natural Resources Departments, while the fourth sought information on the types of domestic energy marketed by energy marketers in the sampling units.

3.4.3 Conduct of interview

Research assistants were trained on the techniques of conducting the interviews and recording of responses on the questionnaire. The research assistants in company of the researcher made reconnaissance visits to the study sites before the day of the commencement of the interview.

3.5 Analytical Procedure

Descriptive statistics such as frequency distribution, histograms, and table were used in data analysis of the results. Also, Chi-square (χ^2) test was used to determine if the choice of coping strategies depends significantly on socio-economic characteristics and settlement type (urban semi-urban and rural areas) of respondents using the model:

$$\chi^2 = \frac{1}{G} \sum_{i,j} \{(Go_{ij} - S_iT_j)^2\}, \text{ with (r-1)(c-1) degree of freedom} \qquad (1)$$

Where: G = Grand total of the observations
oi,j = Observed values of ith treatment at the jth column
S_i = Row total for ith (treatment i= 1-n coping strategies)
T_j = Column total for jth column (j = 1-3 location of residence (Urban, semi-urban and rural)
(Adesoye, 2004 and Freese, 1984)

Student t-test was employed to verify the existence of significant differences in the domestic energy price increases among the various vegetation zones in the study area.

$$t = \frac{\bar{X}_A - \bar{X}_B}{\sqrt{\frac{S^2\left(n_{A+}\, n_B\right)}{(n_A)\,(n_B)}}}. \qquad \textbf{(2)}$$

Where:

$\bar{X}_A$ = the arithmetic mean of the domestic energy price increases in location A

$\bar{X}_B$ = The arithmetic mean of the domestic energy price changes in location B

n_A = Number of observations in location A

n_B = Number of observations in location B

S^2 = Pooled within – group variance for the two locations.

Logistic regression analysis was employed to determine the influence of socio-economic characteristics of the heads of households on the adoption of coping strategies. The opinion of the respondents as to whether they adopt the strategies were framed as binary choice models which assume that individuals are faced with the choice between two alternatives (adopt or not) and the choice depends on identifiable characteristics (vegetation zone, gender, educational attainment, household size, occupation and location of place of residence).

Let $\mathbf{T_i}$ represent a dichotomous variable that equals to**1** if the respondent is in favour of the adoption of the coping strategy and **0** otherwise. $\mathbf{P_r(T_i = 1)}$, is a cumulative density function **F** evaluated at $\mathbf{X_i\beta}$, where $\mathbf{X_i}$ is a vector of explanatory variables and **β** is a vector of unknown parameters. The density function can be modelled using logistic probability function in the following form as described by Gujarati (2005).

$$P_{r(Adoption\ of\ coping\ strategy)} = P_{r(T_i\ =1)} = \frac{exp(Xi\beta)}{1+exp(Xi\beta)} \quad \textbf{.....(3)}$$

The estimation form of the logistic transformation of the probability of the respondents' opinions in favour of a coping strategy $\mathbf{P_r(T_r = 1)}$ is represented as:

$$Ln\left[\frac{P_r(T_i=1)}{1-P_r(Ti=1)}\right] = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \ldots\ldots\ldots\ldots + \beta_n X_n \qquad \textbf{(4)}$$

β_0 = Regression constant
β_1 = Estimate of the unknown parameter (i = 1, 2, ..., n.)
X_1 = Explanatory variables (socio-economic characteristics of heads of households; gender, settlement type etc.) (Gujarati, 2005)

In order to estimate the parameters of the variables influencing respondents in favour of a coping strategy, likelihood estimation was used as shown in equation (5)

$$Ln\left[\frac{P_r(T_i=1)}{1-P_r(Ti=1)}\right] = b_0 + b_1(GD) + b_2(ED) + b_3(AG) + b_4(HS) + b_5(MS) + b_6(IL) + b_7(ST) \qquad \textbf{(5)}$$

Where
GD = Gender
ED = Educational status
AG = Age group
HS = Household size
MS = Marital status (Married or single)
IL = Income level
ST = settlement type (Urban or rural area)

Correlation analysis was used to determine the existence and types of relationships between the price of fossil-based domestic energy and the price of fuelwood within the given period of the study.

$$Correl(X,Y) = \frac{\sum(x-\bar{x})(y-\bar{y})}{\sqrt{\sum(x-\bar{x})^2\sum(y-y)^2}} \ldots\ldots\ldots\ldots\ldots\ldots\ldots \qquad (6)$$

where**:**

XY = variability due to xy (kerosene price and fuelwood price.)

X_i= Variation due to X (independent variables –price of kerosene)

Y_i= Variation due to Y (dependent variables _ price of fuelwood.)

(Wahuwa, 1999)

3.6 Hypotheses Tested

(i) H_o *= There exists no significant difference in the adoption of coping strategies among households in the study area.*

(ii) H_o*: socio-economic characteristic of respondents do not significantly influence adoption of coping strategies among households.*

(iii) H_o *= The price changes of kerosene do not significantly affect that of fuelwood in the study area*

(iv) H_o *= There exists no significant differences the domestic energy price changes amongst eco-vegetation zones between 1998 and 2005.*

CHAPTER FOUR

4.0 RESULTS AND DISCUSSION

4.1 Introduction

This chapter described the distribution of respondents based on the retrieved questionnaire. Four categories of respondents were issued questionnaire and/or interview schedules. These include heads of households, community leaders, heads of government forestry agencies and domestic energy marketers. In all 460 (72.7%) copies of the questionnaire were retrieved (Table 4.1). Based on the ecological zoning, 60.5% was retrieved from the Sahel zone, 77% from the Sudan and 91.3% from the Guinea savannah. Out of 21 heads of government forestry agencies 15 (71.4%) were accessible, while 64.8% of domestic energy marketers and 75% of community leaders returned their questionnaire.

Table 4.1. Spatial Distribution of Questionnaire Retrieved from the Study Area

S/No	Ecological zones	States in the Zone	Total No. LGAs	Selected States & LGAs	Total No. of Council wards	Selected council wards	Retrieved questionnaires by categories			
							Heads of Households	Heads of Govt. Forest Agencies	Community leaders	Domestic Energy Marketers
1.	Guinea savannah	*Taraba	16	Jalingo	10	Jalingo	24	3	3	2
						Kona	23	0	2	3
				Ibi	10	Rimi-uku	23	2	0	4
						Nwango	21	0	2	5
				Sardauna	11	Gembu	23	1	3	6
						Nguroje	22	0	3	4
2.	Sudan Savannah	Adamawa		Gombe		Gombe	20	1	3	6
		*Bauchi			11	Bajoga	17	0	3	3
		Gombe	11							
				Billiri	10	Billiri	20	1	0	5
						Bare	20	0	2	6
3.	Sahel savannah	*Borno	27	Hawul	10	Hazhi	13	0	3	4
		Yobe				Azare	14	2	2	4
				MMC	12	Shuwari	14	2	2	3
						Damaganari	14	0	0	2
				Gubio	10	Lawanti	10	1	3	3
						Ngetere	10	0	3	3
				Mobar	10	ZannaMarti	12	0	2	0
						Damasak	12	2	3	4
				Munguno	10	Munguno	11	0	1	2
						Abaganari	10	0	1	2
	Total	6	54	9	94		334(74.22%)	15(71.42%)	41(75.92%)	70(64.81%)

4.2 Socio-Economic Characteristics of the Sampled Heads of Households.

This section describes the various socio-economic characteristics of the heads of households, which are likely to influence the type of domestic energy choice and the adoption of coping strategies. Adebayo (2006) reported the existence of correlation between socio-economic characteristics of households and the type of domestic energy used by householders, as well as the adoption of coping strategies. Therefore, there is the need for a close look at these relationships in this study. The socio-economic characteristics considered in this study include educational status, gender, age distribution, marital status and household size, number of spouses, monthly income and means of livelihood. Place of residence was also considered, whether urban, semi-urban or rural areas (Tables 4.2-4.12)

4.2.1 Gender distribution of heads of households

The result in Table 4.2 shows that 81.7 percent of the heads of households were male and only 18.3 percent were female. This is an indication that headship of households were dominated by the male folk in the study area. A closer observation of the gender distributions revealed that the female-headed households consisted mainly of young unmarried men and women. These were either career civil servants who live away from their homes of origin, or those who have lost parents and are expecting to get married soon. The other categories of female-headed households were widows and divorced women.

Table 4.2. Distribution of Respondents by Gender

	Sahel Zone		Sudan Zone		Guinea Zone		Northeastern Region	
Gender	Frequency	%	Frequency	%	Frequency	%	Frequency	%
Male	103	85.1	60	77.9	110	80.9	273	81.7
Female	18	14.9	17	22.1	26	19.1	61	18.3
Total	121	100	77	100	136	100	334	100

Source: Field survey, 2006

4.2.2 Marital status of respondents

Marriage is considered a sign of responsibility in this region; therefore, household heads in the three vegetation zones were mostly married. They constitute as much as 88.4 percent in the Sahel savannah zone, 77.9 percent in the Sudan Savannah and 78.5 percent in the guinea Savannah. In all, 81.6 percent of the heads of households were married; while their single counterparts constituted only 11.3 percent. (Table 4.3)

This distribution could be attributed to the unified culture of the communities in this region, who believe that young people have to marry early in life as a sign of responsibility and to be able to pro-create heirs of the family names.

Table 4.3. Marital Status of Respondents

Zones	Sahel		Sudan		Guinea		Northeastern region	
Status	Frequency	%	Frequency	%	Frequency	%	Frequency	%
Married	107	88.4	60	77.9	108	78.5	275	81.7
Single	7	5.8	8	10.4	24	17.6	39	11.4
Widowed	6	5.0	5	6.5	3	2.2	14	4.6
Divorced	1	0.8	4	5.2	1	0.7	6	2.3
Total	121	100	77	100	136	100	334	100

Source: Field survey, 2006

4.2.3 Age distribution of respondents

Age is arguably significant in explaining the ability of heads of household to earn enough income to cater for the family; it is also associated with wisdom and experience of realities of life. It is expected that age should have impact on productivity; hence the capability to cope with hardships that one might come across in life could be determined by the age of the head of household. The result in Table 4.4 shows that heads of households within 38 – 47 age brackets make up the highest percentage (37.0%) in the region, while the heads of households within 28 - 37 age brackets followed with 29.9%. The mean age of the respondents is 42±16 years; the eldest was aged 77, while the youngest was 18 years. This suggests that majority of the heads of households are in their productive ages. This is evident in the adoption of some active coping strategies. It reveals therefore, that there is high tendency of adoption of environment friendly strategies in curbing forest resources depletion in the region.

Table 4.4. Distribution of Respondents by Age Groups

Zones	Sahel		Sudan		Guinea		Northeastern Region	
Age Group	Frequency	%	Frequency	%	Frequency	%	Frequency	%
18-27	8	6.6	2	2.6	17	12.5	27	7.2
28-37	29	24.0	21	27.3	50	36.8	100	29.9
38-47	40	33.1	35	45.5	44	32.4	119	37.0
48-57	26	21.5	11	14.3	21	15.4	58	17.1
58-67	14	11.6	6	7.8	4	2.9	24	7.1
68-77	4	3.3	2	2.6	0	0.0	6	2.4
Total	121	100	77	100	136	100	334	100
Mean age	44±11		43±9		39±13		42±16	

Source: Field survey, 2006. NB: values after ± are standard deviation of the means

4.2.4 **Household size and the number of wives in households**

Household size is significant in determining the choice and amount energy type utilized in a household. The type of domestic energy adopted for use in a household, to some extent, is dependent on the population of the family. In the advent of domestic energy crisis and other unprecedented social and economic hardships, it is expected that larger households with low income levels tend to adopt the cheapest energy types in order to sustain the family. In this study, variation in household size was observed. The result in Table 4.5 shows that household size ranging between 5-8 members has the highest percentage in the Sudan savannah zone, it constitutes 35.1 percent of the respondents in that zone. In the Sahel zone the 5-8 household range is 27.2 percent. Table 4.5 also shows that household size distribution in this region is concentrated in the lower categories. The mean household size is 9±8.

The number of women married to a head of household has direct bearing on the household size. The result in Table 4.6 shows that though the region is dominated by Islamic and traditional culture, respondents with one wife constituted the majority in all the three zones and among the locations. This might not be unconnected to poor economic realities of the region (CBN, 2007). In the Sahel savannah zone heads of households with one wife are the majority (58.7%); 53.8 percent in the Sudan savannah zone, while in the guinea savannah it is 62 percent. Respondents with two wives are the next largest, 17.4 percent in Sahel savannah, 13 percent in the Sudan savannah while 8.8 percent in Guinea. The zone that has recorded respondents with up to 4 wives (3.3%) is the Sahel savannah.

Table 4.5. Distribution of Respondents by Household Size

Zones	Sahel		Sudan		Guinea		Northeastern Region	
Household Size	Frequency	%	Frequency	%	Frequency	%	Frequency	%
1-4	17	14.0	20	26.0	32	23.5	67	21.1
5-8	33	27.3	27	35.1	30	22.1	90	28.2
9-12	31	25.6	15	19.5	37	27.2	83	24.1
13-16	20	16.5	12	15.6	18	13.2	50	15.1
17-20	8	6.6	1	1.3	5	3.7	14	3.7
<21	12	9.9	2	2.6	14	10.3	28	7.6
Total	121	100	77	100	136	100	334	100
Mean size	10±7		8±4		9±7		9±8	

Source: Field survey, 2006 NB: values after ± are standard deviation of the means

Table 4.6. Distribution of Respondents by Number of Wives

Zones	Sahel		Sudan		Guinea		Northeastern region	
Number of wives	Frequency	%	Frequency	%	Frequency	%	Frequency	%
0	19	15.7	23	29.9	38	27.9	80	24.5
1	71	58.7	43	55.8	83	61.0	197	57.8
2	21	17.4	10	13.0	12	8.8	43	13.0
3	6	5.0	1	1.3	3	1.5	10	2.6
4	4	3.3	0	0.0	0	0.0	4	1.1
Total	121	100	77	100.	136	100	334	100

Source: Field survey, 2006

4.2.5 Educational attainment

Education plays a significant role in skill acquisition, knowledge transfer, means of livelihood, and hence income generation (Ogundele, 2003). It enhances technology adoption and ability of individuals to adopt modern skills of energy use in the households. In fact, many studies including Adebayo (2006) have shown that the level of education helps individuals to be efficient in domestic energy utilization. Educational status also influences respondents' economic empowerment.

The educational status of the heads of households is shown on Table 4.7. The Sahel savannah zone had the highest percentage of those who had no formal education (11.6%), the bulk of which are residents of the rural areas. This is followed by Guinea savannah (5.9%) and the Sudan savannah zone (3.9%). In the whole of the study area those who have no formal education constituted 9.6 percent of the total number of respondents. The Sahel savannah zone also has more of its respondents having religious education, (30.6%). In the Sudan and guinea savannah, post-primary school certificate holders constituted the highest percentage, 33.8 percent and 43.4 percent respectively. Sudan savannah zone have the highest percentage of respondents that attended tertiary institutions (32.5 %) followed by guinea savannah zone (28.7%), while Sahel zone has 23.1 percent.

In the whole of the Northeastern region, secondary school leavers constitute the largest proportion of the respondents, (33.2%), followed by those who attended tertiary institutions (17.8%). Those who had religious education constituted 16.2 percent and primary school leavers formed 8.3 percent of the total respondents. Those who had no form of education (illiterates) constitute as much as 8.0 percent, while the least were those who attended adult literacy classes (7.0%). Generally, literacy level is very low in the region; this could have resulted in the high

incidences of poverty and the hindrances to the adoption of modern energy type in most households. This could also mean that income generation activities were limited to artisan and other unskilled and semi-skilled jobs. Therefore, most of them could not have afforded the fossil-based domestic energy types for use in their households.

Table 4.7. Distribution of Respondents by Educational Attainment

Zones	Sahel		Sudan		Guinea		Northeastern Region	
Status	Frequency	%	Frequency	%	Frequency	%	Frequency	%
None	14	11.6	3	3.9	8	5.9	25	8.0
Adult Ed	6	5.0	7	9.1	10	7.4	23	7.0
Religious Ed.	37	30.6	10	13.0	7	5.1	54	16.2
Primary Ed.	9	7.4	6	7.8	13	9.6	28	8.3
Post Pri. Ed.	27	22.3	26	33.8	59	43.4	112	33.2
Tertiary	28	23.1	25	32.5	39	28.7	92	17.8
Total	121	100.0	77	100	136	100	334	100

Source: Field survey, 2006

4.2.6 Distribution of respondents by means of livelihood and income

The choice of domestic energy for use in households is very much dependent on the means of livelihood of the household members, especially the head (World Energy Outlook, 2006). Subsistence farmers constitute 54.2 percent of the respondents; (Table 4.8) most of which are residents of the rural areas. Studies have shown that subsistence farming is an indication of poverty (FAO, 2001); this therefore means that most of the respondents are poor. The next group of people were the civil servants (28.4%) who were found in all the settlement types (rural, semi-urban and urban areas) and were mostly teachers; followed by petty traders (9.3%) and the artisans (8.1%). It therefore, indicates that income level in the study area remains very low particularly, in the rural areas.

The result in Table 4.9 shows the distribution of respondents according to their income levels. From this result, 67.7 percent of the heads of households have the highest monthly income of ten thousand naira (₦10, 000). In the Sahel savannah zone, this category of respondents constitutes up to 74.4 percent; 64.7 percent in the Guinea savannah, and 62.3 percent in the Sudan savannah. The second largest category of the respondents was those whose monthly income ranged ₦11,000 to ₦20,000, (13.1%) followed by those with income range from ₦21,000 to ₦30,000 (9.6%); the least category was those with incomes above ₦40,000 (3.9%). The mean monthly income for the region is ₦11.228±2,354.

Given this prominence of low income status among the respondents, together with poor means of livelihood, it is not possible that they can afford fossil-based fuels. The implication of this is that, dependence on wood from the forest for domestic energy will persist if nothing is done to either improve on the incomes of the respondents or subsidise the use of fossil-based domestic fuels.

Table 4.8. Distribution of Respondents by Occupation

Zones	Sahel		Sudan		Guinea		Northeastern region	
Occupation	Frequency	%	Frequency	%	Frequency	%	Frequency	%
Farming	70	57.9	31	40.3	80	58.4	181	54.2
Trading	11	9.1	10	13.2	10	7.4	31	9.3
Artisanship	15	12.3	6	6.5	6	4.8	27	8.1
Civil service	25	20.7	30	39.0	40	29.4	95	28.4
Total	121	100	77	100	136	100	334	100

Source: Field survey, 2006

Table 4.9. Distribution of Respondents by Monthly Incomes

Zones	Sahel		Sudan		Guinea		Northeastern region	
('000 ₦)	Frequency	%	Frequency	%	Frequency	%	Frequency	%
1-10	90	74.4	48	62.3	88	64.7	226	67.7
11-20	17	14.0	10	13.0	17	12.5	44	13.1
21-30	6	5.0	10	13.0	16	11.8	32	9.6
31-40	6	5.0	9	11.7	4	3.0	19	5.8
<40	2	1.6	0	0.0	11	8.0	13	3.9
Total	121	100	77	100	136	100	334	100
Mean monthly Income	₦7,311±1034		**₦12,403±2960**		₦14,044±2212		**₦11,228±2354**	

Source: Field survey, 2006. Values after ± are standard deviation of the means

4.3 **Available Domestic Energy at the Disposal of the Households.**

Access to modern energy types is a necessary requirement for economic development. Resource availability plays a vital role in the resources utilization and management. Decisions on what domestic energy type to use by households depend on the domestic energy types accessible to them. This study reveals that domestic energy types available to the households include fuelwood, charcoal, coal, kerosene, cooking gas and electricity (Table 4.10). The availability of these energy types varies in magnitude depending on the settlement type, whether urban, semi-urban or rural areas.

Based on the results from this study as presented in the Table 4.10, fuelwood was said to be available to 95.4 percent of the respondents at the urban, semi-urban and rural areas. This confirms Kate and Andrew's (2002) assertion that fuelwood is the commonest domestic energy at the disposal of households in the sub-Saharan African region. Charcoal was the second most available (86%), followed by kerosene (74.3%) to the respondents in the study area. The next is electricity (22%); (28.1%); cooking gas (7%) and the least is coal (3%).

This therefore, implies that fuelwood is the major source of household energy and will continue to be if no concerted effort is made to reverse this trend, the remaining pockets of forests in this region will be exhausted in no distant period.

The results of the availability of the domestic energy types in Table 4.11, 92 percent of the community leaders claimed that fuelwood is readily available in the study area. Charcoal is indicated as the second most common energy type available (86%), followed by kerosene (73%), electricity, (22%), cooking gas, (7%) and coal (3%).

Table 4.10. Availability of Domestic Energy Types to Households in the Vegetation Zones

Domestic Energy Type	Status	Vegetation Zones											
		Sahel				Sudan Savannah				Guinea Savannah			
		Urban	Semi-urban	Rural	%	Urban	semi-urban	Rural	%	Urban	semi-urban	Rural	%
Fuelwood	Available	3	6	10	100	1	1	6	100	3	5	5	74.0
	Not available	0	0	0	0.0	0	0	0	0.0	2	1	0	26.0
Kerosene	Available	8	5	2	80.0	6	0	1	88.0	4	1	2	53.0
	Not available	1	1	2	20.0	2	1	0	12.0	1	2	3	47.0
Coal	Available	0	1	0	5.0	0	0	0	0.0	1	0	0	5.0
	Not available	2	8	8	95.0	6	1	1	100	1	1	10	95.0
Charcoal	Available	3	5	7	80.0	6	1	1	100	1	3	6	79.0
	Not available	0	4	0	20.0	0	0	0	0.0	2	1	0	21.0
Cooking gas	Available	2	1	0	15.0	4	0	0	50.0	1	0	0	5.0
	Not available	2	5	9	85.0	1	1	2	50.0	2	4	7	95.0
Electricity	Available	2	1	1	20.0	1	0	0	25.0	3	0	0	21.0
	Not available	2	4	9	80.0	2	2	2	75.0	1	4	5	79.0
			N=	19			N=	8			N=	13	

Source: Field survey, 2006

Table 4.11. Percentage Availability of Domestic Energy Types in Northeastern Nigeria

Domestic Energy Type	Available (%)	Not available (%)
Fuelwood	92	18
Kerosene	73	27
Coal	3	97
Charcoal	86	14
Cooking gas	7	93
Electricity	22	78

Source: Field survey, 2006

4.4 Factors Determining the Choice of Domestic Energy in the Households

World Energy Outlook (2002) categorised into three main groups the determinants of domestic energy choice; these are availability, affordability and cultural preference. If the energy distribution system is inefficient, households would not have access to them even if they are affordable. In the study area, factors influencing the choice of domestic energy vary greatly from one household to the other. Some of the factors considered in this study include cost, availability, reliability and cultural beliefs. Others are the types of residence of the households, the position of the heads of households in society and ease of use of the domestic energy.

4.4.1 Cost

The result in Table 4.12 shows that cost is a major factor influencing the choice of domestic energy in all the settlement types. In the Sahel savannah zone, it affects respondents in urban and rural areas more (100%) compared to 91.7 percent semi-urban areas. A close look at the response of the households on the same factor in the Sudan savannah zone showed similarity in the trend of the responses in all the settlement types (Table 4.13). However, households in the rural areas (100%) were mostly influenced by this factor, followed by urban areas (97.3%) and 65% in the semi-urban areas (Table 4.13). In his report, Nkomo (2004) maintained that poverty has a bearing on the type of energy consumed by households; therefore, the poverty level of households places them on the appropriate domestic energy to patronise. The probable reason for the effect within these settlement types could be due to variation in income between respondents residing in the various settlement locations.

In this study there is an indication that even when respondents could afford alternative fuels, households might not use them if they are much more expensive than traditional biomass. In rural areas, biomass is often perceived as priceless and readily available. Even when fuelwood is

purchased, it is likely to be cheaper than the cheapest alternative fuel. The affordability of energy-using equipment is just as important as the affordability of fuels. The initial costs of acquiring kerosene and gas stoves and cylinders may discourage some households from switching away from biomass.

4.4.2 **Availability**

A household may desire to use a particular domestic energy which is not available. Availability of these domestic energy types is a major factor that prompts their patronage. The results from this study presented in Tables 4.12, 4.13 and 4.14 revealed that the influence of this factor is prominent among respondents in all the settlement types in all the zones, ranging to 70 to 100 percent. However, in the guinea savannah, it influenced mostly respondents in urban areas. For this reason of unavailability, respondents were compelled to patronise the available energy resource, which in most cases is wood. Studies in other parts of the world revealed that this problem is not peculiar to Northeastern Nigeria. Pundo and Fraser (2003) and Douglas *et al* (2005) also reported that large proportion of the population in the developing world lack access to energy sources such as oil, gas and electricity, yet they still depend on biomass. They reiterated that this problem may worsen in the coming decades when rural population would have risen to three billion. Now that the world population is 6.7 billion, population depending on biomass energy would have been doubled also.

4.4.3 **Ease of use of energy types**

In the utilization of the various domestic energy types, some seem easier to use than others, particularly that some are used with equipment that requires some level of literacy level to be able to operate them. This therefore poses a problem especially to the rural dwellers because of the low literacy levels (Adebayo, 2006). The result in Table 4.12 shows that ease of use of

energy type is a major factor that determines the choice of household domestic energy in all settlement types in the study area. The highest acceptability of this is seen in the response from the semi-urban areas in the Sudan zone (100%), followed by those in the semi-urban and rural areas of the Guinea savannah zone (89.2 and 89.7 respectively). This might not be unconnected with their low literacy level compared to the other regions in the country. Therefore, adoption of the use of domestic energy types that uses sophisticated equipment could be difficult.

4.4.4 **Cultural beliefs**

The Northeastern Nigeria exhibits great variation of socio-cultural groups, it houses over 200 dialects which could translate into as many as 200 different social and cultural patterns. It is a common belief among communities particularly in the rural areas that kerosene, gas and electricity cannot cook well their staple food (tuwon dawa), while others belief that food cooked with kerosene stoves is contaminated with the kerosene.

Despite this belief, respondents in this part of the region of Nigeria could not attribute their choice of domestic energy to their cultural affiliations; rather, they are unanimous to prove that cultural beliefs do not influence their choice of household domestic energy.

4.4.5 **Societal influence**

In behavioural studies, it is known that peer group influences have a great deal of impact on the society. It is expected that the status of the heads of households in the society may influence the choice of domestic energy. In this study, the respondents did not indicate any effect of this factor in their choice of domestic energy. Other factors such as costs, and availability could have influenced the choice of domestic fuels in the study area.

4.4.6 **Reliability of the domestic energy type**

Reliability is an issue in the choice of domestic energy. Reliability could be in the form of assurance of regular supply and quality. In this study, the respondents in the semi-urban and rural areas did not see this factor to have influenced the choice of domestic energy for household use. In the Sudan zone 56.8 percent and 50.0 percent in the guinea savannah zone of the urban dwellers indicated reliability as having effect on the choice of domestic energy (Table 4.13 and Table 4.14). The implication of this result is that the most available energy type is considered as the most reliable.

4.4.7 **Types of residence of respondents**

In the conceptual framework, it was argued that if a household dwells in a modern type house, the household is more likely to use charcoal, kerosene, gas or electricity. Contrary to this, the results revealed that even when a household resides in a modern type house, does not guarantee their choice of these energy types. One theoretical assumption here was that a modern type house is an indicator of wealth or the availability of better resources to support purchases of the more expensive fuels. However, the wealth may be spent on more crucial needs like children's school fees. In addition, it was assumed that such households cook in the main dwelling unit, which is not always the case. A household may have a separate cooking place built to accommodate the requirements of fuelwood use so that smoke does not stain the main dwelling unit. If this is the case, the nature of the main dwelling unit may not be a good indicator of fuel choice.

In all the vegetation zones, most of the respondents did not relate their choice of domestic energy to their types of residences. This could be due to difficulties in the process of acquiring the domestic energy types, rather than other factors that may affect their choice.

Table 4.12. Determinants of Domestic Energy Choice by Households in Sahel Savannah zone

Variables	Settlement	Yes	%	No	%
Cost	Urban	32	100	0	0.0
	semi-urban	55	91.7	1	8.3
	Rural	30	100	0	0.0
Availability	Urban	32	100	0	0.0
	semi-urban	57	100	0	0.0
	Rural	30	100	0	0.0
Ease of use	Urban	25	73.5	7	26.5
	semi-urban	43	75.4	12	24.8
	Rural	21	70.0	12	30.0
Cultural belief	Urban	4	13.3	30	86.7
	semi-urban	5	9.1	50	90.9
	Rural	14	46.7	16	53.3
Societal Influence	Urban	14	43.8	18	56.2
	semi-urban	22	38.6	35	61.4
	Rural	5	16.7	25	83.3
Reliability of energy type	Urban	10	31.3	22	68.7
	semi-urban	10	17.9	46	82.1
	Rural	2	6.7	28	93.3
Type of residence	Urban	8	25.0	24	75.0
	semi-urban	6	10.7	50	89.3
	Rural	5	16.7	25	83.3

Source: Field survey, 2006

Table 4.13. Determinants of Domestic Energy Choice by Households in Sudan Savannah zone

Variables	Settlement	**Yes**	**%**	**No**	**%**
Cost	Urban	36	97.3	1	2.7
	semi-urban	13	65.0	7	35.0
	Rural	20	100	0	0.0
Availability	Urban	32	85.5	5	14.5
	semi-urban	14	70.0	6	30.0
	Rural	20	100	0	0,0
Ease of use	Urban	24	64.7	13	35.3
	semi-urban	20	100	0	0.0
	Rural	17	85.0	3	55.0
Cultural belief	Urban	6	16.2	31	83.8
	semi-urban	5	25.0	15	75.0
	Rural	7	35.0	13	65.0
Societal Influence	Urban	21	56.8	16	43.2
	semi-urban	17	85.0	3	15.0
	Rural	2	10.0	18	90.0
Reliability of energy type	Urban	21	56.8	16	43.2
	semi-urban	1	5.0	19	95.0
	Rural	5	25.0	15	75.0
Type residence	Urban	9	24.3	28	75.7
	semi-urban	2	10.0	18	90.0
	Rural	6	30.0	14	70.0

Source: Field survey, 2006

Table 4.14. Determinants of Domestic Energy Choice by Households in Guinea Savannah zone

Variables	Settlement	Yes	%	No	%
Cost	Urban	59	98.3	1	1.7
	semi-urban	36	97.3	1	2.7
	Rural	39	100	0	0.0
Availability	Urban	60	100	0	0.0
	semi-urban	36	97.3	1	2.7
	Rural	39	100	0	0.0
Ease of use	Urban	23	38.3	37	61.7
	semi-urban	33	89.2	4	10.8
	Rural	35	89.7	4	10.3
Cultural belief	Urban	5	8.3	55	91.7
	semi-urban	10	27.0	27	73.0
	Rural	10	25.6	29	74.4
Societal Influence	Urban	27	45.0	33	55.0
	semi-urban	11	28.2	28	71.8
	Rural	10	27.0	29	73.0
Reliability of energy type	Urban	30	50.0	30	50.0
	semi-urban	12	30.8	27	69.2
	Rural	5	12.8	34	87.2
Type residence	Urban	25	66.7	35	33.3
	semi-urban	10	27.8	26	72.2
	Rural	10	25.6	29	74.4

Source: Field survey, 2006

4.5 Trends in Domestic Energy Price Changes

Outcomes from this study revealed that there were changes in the price of domestic energy types within the period under study (1999 - 2005). These price changes varied with the domestic energy type, settlement type, year and availability. As shown in Table 4.15 the price changes for all the domestic energy types considered in this study are mainly increases and not downward changes. Fuelwood, for instance, has remained the cheapest domestic energy type, yet it experienced a price increase of up to 200 percent in the semi-urban areas of the Sudan zone between 1999 and 2005, while charcoal had 166 percent price increase. Kerosene which had the highest price increase of all domestic energy types increased by 333.3 percent in the urban areas of the Sudan zone while cooking gas increased by 100 percent. Energy Watch (2007) also reported a world wide price rises of 94 percent on energy between 2003 and 2006 alone.

For traditional domestic energy types, the study (Table 4.15) indicated that price increments were observed as one moves from the rural areas to the urban centres. This could be attributed to the fact that sources of traditional domestic energy types are from rural areas. For respondents in the rural areas the acquisition of the traditional energy types was directly from the forest at minimum or no financial cost. Unlike fuelwood and charcoal, the price of kerosene and cooking gas increased as one moves from the urban to the rural areas. The major marketers of these fossil-based domestic fuels were only found in urban areas and operated within a given limit of price range, while those who sell in the rural areas were hawkers who increased prices at their own will.

Figures 4.1 – 4.4 gave the graphic view of the trends in domestic energy prices changes in the study area between 1999 and 2005.

Table 4.15. Trends of Domestic Energy Price Changes in the Northeastern Region (%) between 1999 and 2005

Zones	Sahel			Sudan			Guinea		
Energy type	Urban	semi-urban	Rural	Urban	semi-urban	Rural	Urban	semi-urban	Rural
Fuelwood	150	100	100	150	200	100	140	100	100
Charcoal	100	140	100	100	67	33	166	150	100
Kerosene	250	260	233.3	333.3	240	200	160	150	112.5
Cooking gas	100	100	Na	67	67	Na	67	67	Na

Source: Computed from field data 2006, NB- Na = Not available

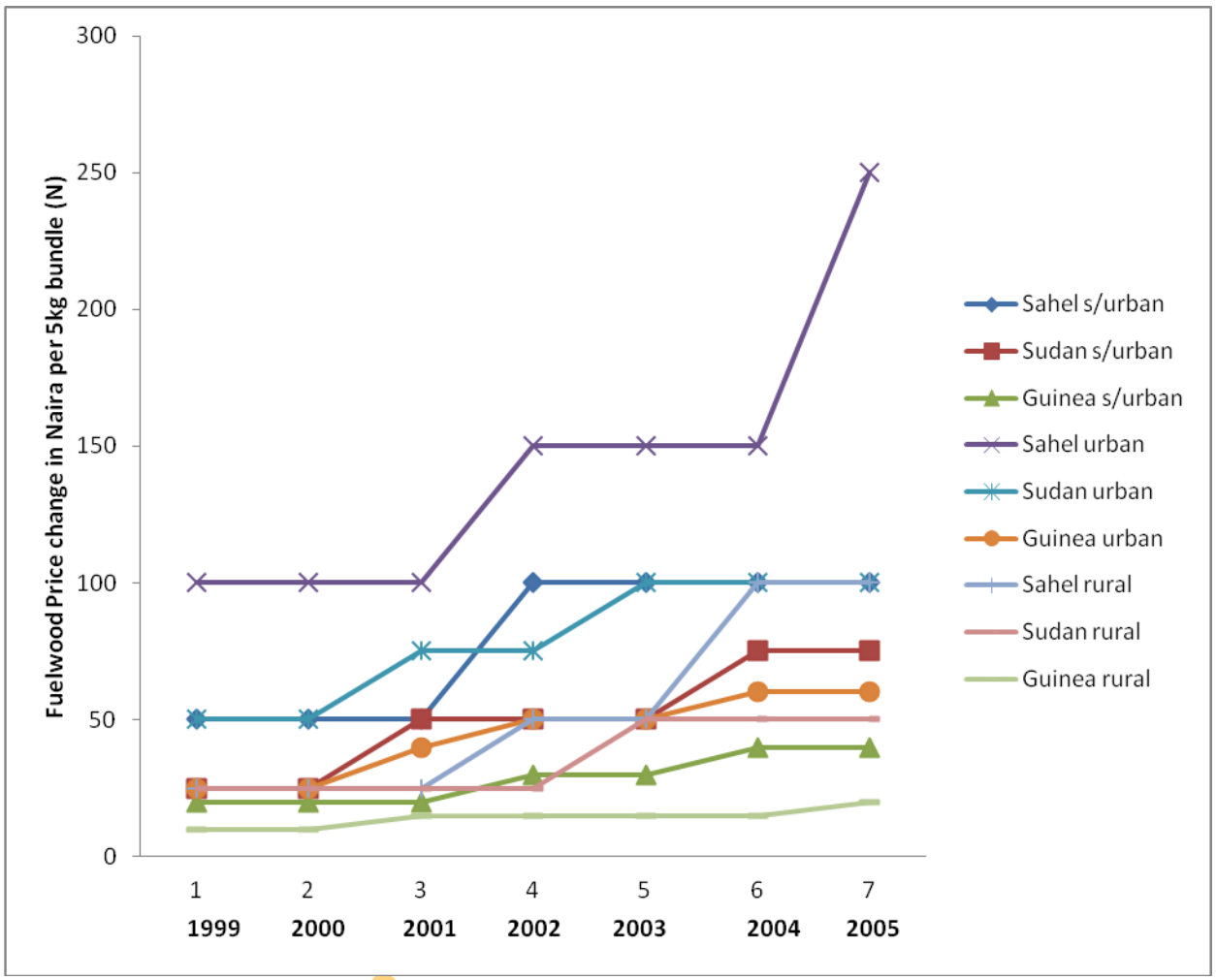

Fig. 4.1 Price Trends of Fuelwood in Northeastern Nigeria from 1999 to 2005

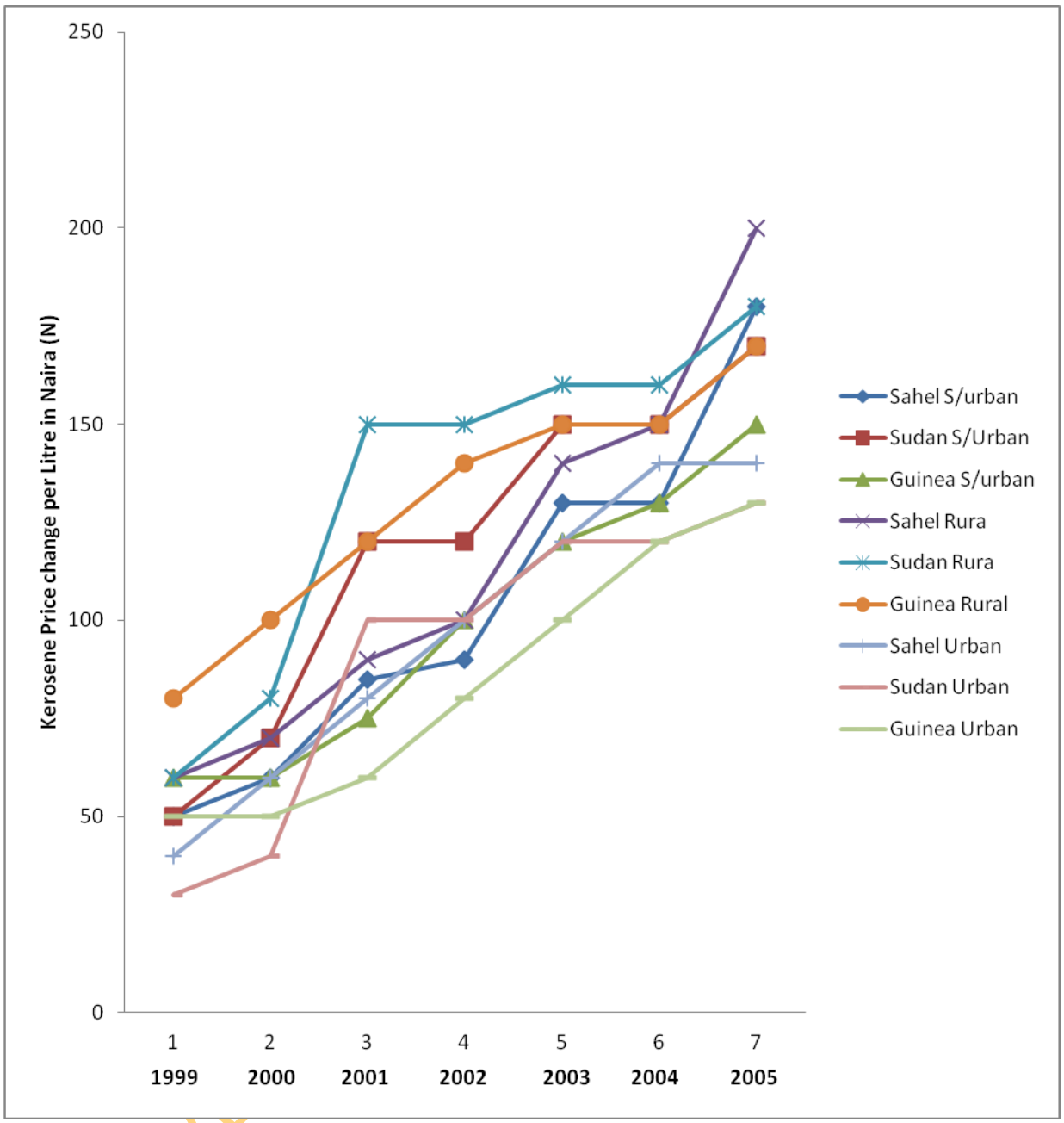

Fig. 4.2 Price Trends of Kerosene in Northeastern Nigeria from 1999 to 2005

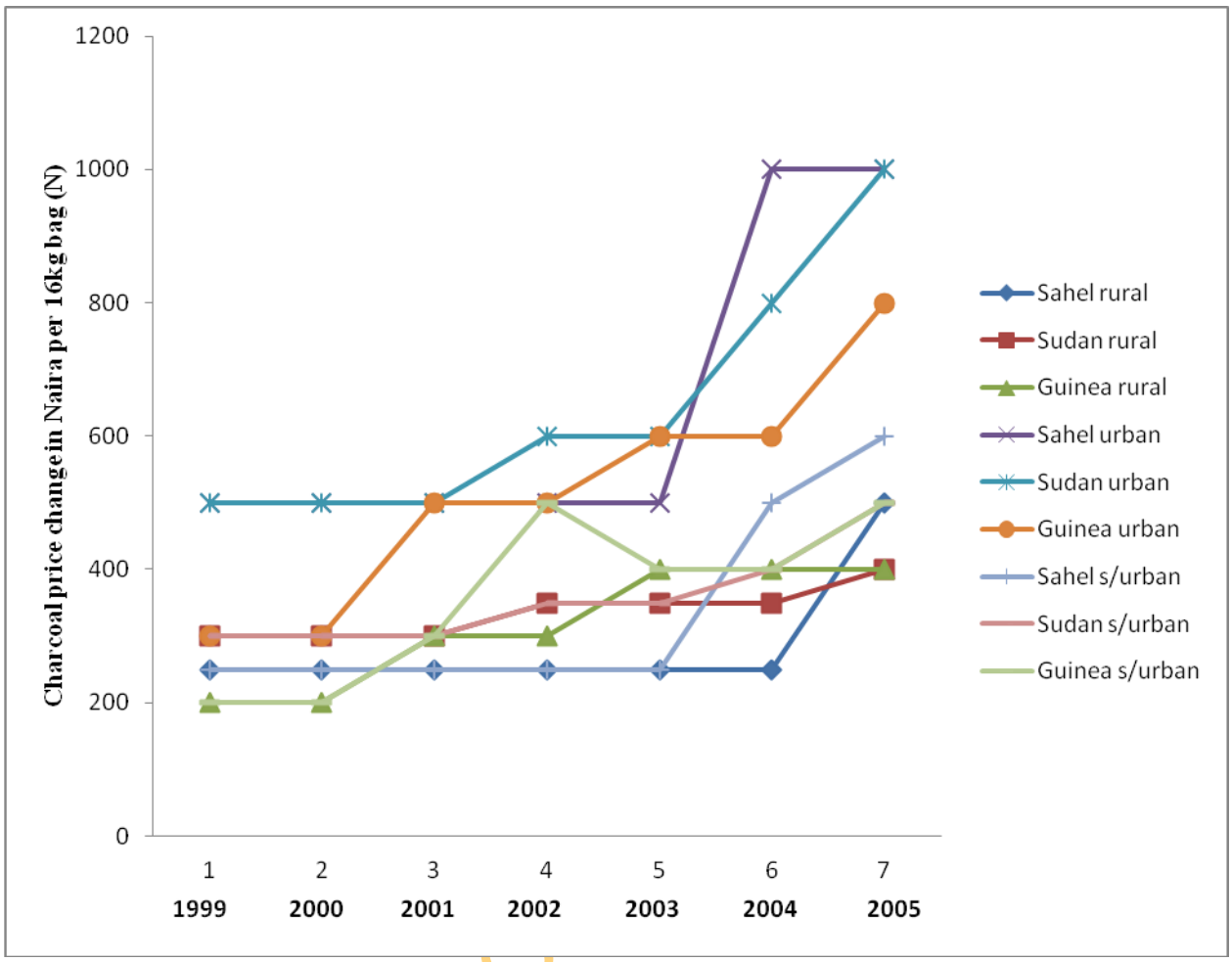

Fig. 4.3 Price Trends of Charcoal in Northeastern Nigeria from 1999 to 2005

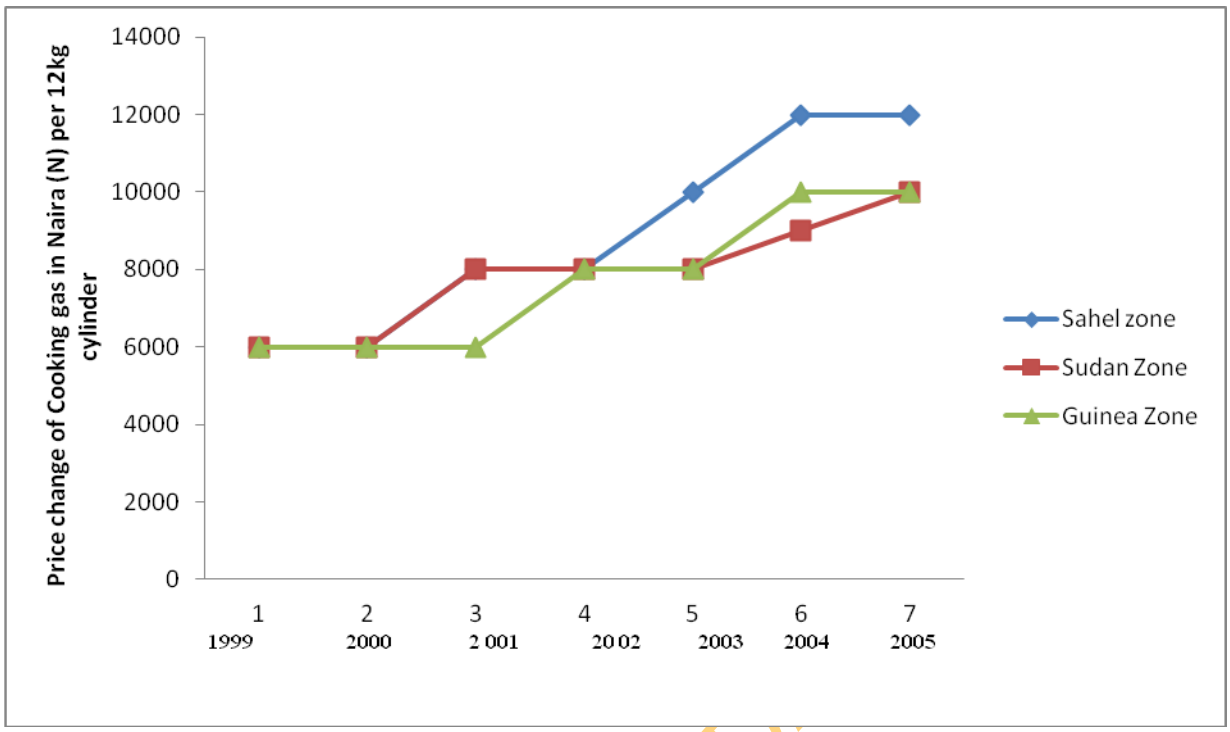

Figure 4.4 Price Trends of Cooking Gas in Northeastern Nigeria from 1999 to 2005

4.6 Causes of Domestic Energy Price Changes

The study revealed that the availability of different domestic energy types vary from one vegetation zone to another and among urban, semi-urban and rural areas; though at different magnitudes depending on the proximity to the sources (Table 4.10). The costs (price) of the domestic energy vary from one type to the other (Table 4.15), one season to the other, from year to year and from one settlement type to the other. From the foregoing, season/time can cause price changes. Furthermore, in the course of this study, changes in government policies, poor transport facilities and sabotage were found to be the major root causes of price increases, but in varying magnitudes. The results in Table 4.16 shows that in the Sahel zone, 58.7 percent of respondents attributed the hike in prices of commercial domestic energy to changes in government policy, 48.1 percent in the Sudan savannah and 62.2 percent in the Guinea savannah. The information on Table 2.1 revealed that there were eight upward price reviews of commercial domestic energy by government within the period of study alone (7 years). The price of Premium Motor Spirit (PMS) was reviewed from ₦20/litre in 1999 to ₦65/litre in 2006, giving the percentage price increase of 250 percent, for Kerosene it was 194.1 percent and Diesel 321.1 percent in the period. This scenario is worsened by another change in government policy for categorizing marketers into major and independent marketers where the latter sells at prices higher than the stipulated government prices adopted by the former. In most cases the price differences were more than ₦10/litre above the official price. Even so the described price increases were the official rates, and these marketers would have one reason or the other to increase the prices of the domestic energy they are marketing. Considering the above situation the respondents could be right by asserting (58.1%) that the changes in government policies were major contributors to domestic energy price hike (Table 4.16).

Price changes in fossil-based fuels have direct impact on the price of the other domestic energy types. For instance, an increase in price of PMS and Diesel will translate to an increase in transport fares, thereby pushing fuelwood marketers to review upwards the price of their products. Another important factor contributing to an increase in prices of domestic energy is poor transport facilities. This opinion was upheld by respondents in all the vegetation zones; (in the Sahel 5.1%, 5.2%, in the Sudan savannah and 8.8 % in the Guinea savannah). The road networks in the study area are not only scanty but are also death traps and do not allow for free movement of goods and services. All of the fossil-based domestic energy types are brought either from Port Harcourt, Warri or Lagos. It takes a tanker load of PMS or Kerosene or gas three to four days to arrive at Maiduguri, Gombe or Jalingo from the southern parts of the country, due to the distance and the poor nature of the roads. Sabotage was considered also a factor, because of regular incidence of pipeline breakage and diversion of concessions meant for specified filling stations by the black marketers and smugglers. This opinion was shared by only 1.7 percent of respondents in the Sahel zone, 6.5 percent in Sudan and 19.3 percent in the Guinea savannah. Where patriotism is lucking, individuals would want to enrich themselves at the expense of the majority. Incidences of bunkering, oil pipe vandalism, diversion of concessions, smuggling, vandalizing of power generating and transmission installations of domestic energy became the order of the day. These are enough to contribute to the erratic supply situation of the energy sector. For instance, NNPC (2005) reported 980 cases of pipeline breakage in the year 2000 alone; 800 cases in 2004, while in 2005, there were 2,225 cases.

It is true that the Nigeria's population is growing at a very fast rate (National Bureau for Statistics, 2007); therefore, scarcity of domestic energy is considered by the respondents as a factor that can affect prices of domestic energy types.

Table 4.16. Causes and Respondents' Rating of Domestic Energy Price Changes in Surveyed Area

Zones	Sahel		Sudan		Guinea		Northeastern Region	
Status	Frequency	%	Frequency	%	Frequency	%	Frequency	%
Change in government policy	71	58.7	37	48.1	86	62.2	194	58.1
Poor transport facilities	6	5.0	4	5.2	12	8.8	22	6.6
Sabotage	2	1.7	5	6.5	14	19.3	21	6.3
Scarcity	1	.8	4	5.2	2	1.5	7	2.1
Poverty	0	0.0	4	5.2	20	14.7	24	7.2
None	41	33.9	23	29.9	2	2.9	66	19.7
Total	121	100.0	77	100	136	100	334	100

Source: Field survey, 2006

4.7 The Effect of Domestic Energy Price Increases on Households

Improvement of welfare and production capacity through availability of reliable and sustainable infrastructure is regarded as one of the most important objectives of the governments, and a means to economic development. Nigeria has experienced a serious economic decline in the last three decades (Alaba, 2001). The case is ironically pathetic in the northeastern region, in spite of the rapid educational and political transformation coupled with a wide range of revenue base, it cannot boast of sustainable supply of domestic energy. Recently, more than seven multi-billion Naira companies collapsed in Borno State alone for reasons of inadequate power supply, as a result over, 30,000 workers lost their jobs. The increasing rate of unemployment and poverty in Nigeria emanated from the collapse of the country's economic structures due to poor power supply.

The region's population continued to grow geometrically, while the government's commitment to provision of basic needs remains low. Insensitivity of government towards improving the basic infrastructure including household energy may have caused the pressure exerted on the available ones whose maintenance is quite irregular leading to eventual breakdown and hike in prices beyond the reach of the low income earners in many instances. This might have accounted for substantial loss of productive time, low productivity and perpetual poverty in households. Apart from the general scarcity of domestic energy common in the entire region, rural areas are specifically worse. This may have accounted for poverty differentials between the rural and urban areas in the region as reported by CBN (2007).

The study revealed that the effect of price increases of domestic energy on the household are enormous; only two of the effects are considered here; effect on the household income and

energy consumption pattern. They are the major determinants of domestic energy choices by households.

4.7.1 Effect on household income

Three sets of factors jointly influence a household's willingness to use a particular domestic energy; the socio-economic characteristics of the household, including educational level of the head of household, family size and income. The other factor is the relative costs of the traditional and fossil-based domestic energy types, time required to acquire it, quality and health implication and lastly the household's attitude towards government's policy on domestic energy (World Energy Outlook, WEO, 2002). In developing countries, urban households, especially the poor families often spend between 20 to 30 percent of their income on fuelwood (Sharma, 1992). The result of this study as shown in Table 4.17 revealed a similar trend.

This study revealed that increases in the price of domestic energy affect the overall income of the households. The outcome of this study concurs with the report of Nwofor, Ogujiuba and Asogwa (2006) on effect of energy subsidy removal on the poor. Domestic energy is an indispensable household need, therefore, it has to be acquired through whatever means, particularly by adopting some coping strategies. For instance, Table 4.23 shows that 79.6 percent of households in the study area reduce their expenditure on non-energy goods in order to acquire the needed domestic energy, similar to the experience of poor households in Ghana (Meikle and Bannister, 2003). In all the vegetation zones, majority of the households assert this. In the Sahel zone 40.8 percent, 50.6 percent in the Sudan savannah and 68.3 percent in the guinea savannah (Appendix III). Only 14 percent in the Sahel, 13 percent in the Sudan savannah and 19.9 percent in the guinea savannah indicated that price increases of domestic energy have no effect on the household income (Table 4.19). The effects of these domestic energy price increases could lead

to decline in the standard of living of the households. WEO (2002) linked domestic energy consumption to poverty, that lack of access to electricity, gas and kerosene, and heavy reliance on biomass exacerbates poverty and contributes to its perpetuations, as it precludes most industrial activities and the jobs they create.

The result in Table 4.17 revealed variation in the proportion of household income expended on domestic among vegetation zones and settlement types. Generally, respondents in urban areas spend more of their income on domestic energy than rural and semi-rural dwellers. In the Sahel zone for instance, urban settlers spend an average of 19.4 percent of their income on domestic energy, while their counterparts in the semi-urban and rural areas use 14.9 percent and 5.2 percent respectively. Similar trends occurred in Sudan and guinea savannah vegetation zones. Comparing among zones, the Sahel zone has the highest percentage of income spent on domestic energy (13.2%), followed by Sudan (8.1%), while Guinea savannah had the least (6.9%). This trend might not be unconnected to the proximity of these zones to the source of fossil-based domestic energy sources (the southern parts of Nigeria) in addition to the vegetation structure of these zones.

The result of this is similar to the report of the WEO (2002) on the share of income expenditure on energy in the African sub-regions (Table 2.6). The Northeastern share of expenditure on energy stood at 9.4 percent which is only higher than that of North Africa (7.9%) but lesser than the sub-regional average for South Africa (11.9%), East Africa (12.7%) and West/Central Africa (14.1%).

At the centre of this region's development dilemma is the question of sustainable household and energy demands against supplies. Energy scarcity is one of the factors that currently threaten economic growth of the Northeastern Nigeria. For instance, in parts of the region, acute fuel

scarcity renders meaningful economic growth difficult. The worst affected are the rural and urban slums, where many households are unable to grow past their subsistence levels (fig.4.5).

Table 4.17. Percentage Share of Income Expended on Domestic Energy in Northeastern Nigeria

Zone location	Settlement type	Percentage range	Frequency	Percentage Used	Zonal mean
Sahel savannah	Urban	1-5	1	2.9	
		6-10	2	5.9	
		11-15	15	44.1	
		16-20	13	38.2	
		21-25	2	5.9	
		26-30	1	2.9	
		31-35	0	0	
	Mean			**19.4**	
	semi-urban	1-5	23	40.4	
		6-10	18	31.6	
		11-15	10	17.5	
		16-20	3	5.3	
		21-25	3	5.3	
		26-30	0	0	
		31-35	0	0	
	Mean			**14.9**	
	Rural	1-5	18	60	
		6-10	8	26.7	
		11-15	4	12.3	
		16-20	0	0	
		21-25	0	0	
		26-30	0	0	
		31-35	0	0	
	Mean			**5.2**	**13.2**
Sudan savannah	Urban	1-5	3	8.1	
		6-10	10	27	
		11-15	15	40.5	
		16-20	6	16.2	
		21-25	2	5.4	
		26-30	1	2.7	
		31-35	0	0	
	Mean			**12.1**	
	semi-urban	1-5	8	40	
		6-10	5	25	
		11-15	5	25	
		16-20	2	10	
		21-25	0	0	
		26-30	0	0	
		31-35	0	0	

	Mean				
				7.8	
	Rural	1-5	14	70	
		6-10	5	25	
		11-15	1	10	
		16-20	0	0	
		21-25	0	0	
		26-30	0	0	
		31-35	0	0	
	Mean			**4.3**	**8.1**
Guinea savannah	Urban	1-5	11	18.3	
		6-10	22	36.7	
		11-15	18	30	
		16-20	7	11.8	
		21-25	2	3.3	
		26-30	0	0	
		31-35	0	0	
	Mean			**9.8**	
	semi-urban	1-5	16	43.2	
		6-10	13	35.5	
		11-15	5	13.5	
		16-20	1	2.7	
		21-25	0	0	
		26-30	0	0	
		31-35	0	0	
	Mean			**6.2**	
	Rural	1-5	27	69.2	
		6-10	7	18	
		11-15	5	17.9	
		16-20	0	0	
		21-25	0	0	
		26-30	0	0	
		31-35	0	0	
	Mean			**4.7**	**6.9**
	Regional mean			**9.4**	

Source: Field survey, 2006.

Table 4.18. Household Income Expended on Domestic Energy Expressed in Percentages Across the Surveyed Region

Location types	Urban	Semi-urban	Rural
Zones	%	%	%
Sahel savannah	19.4	14.9	5.2
Sudan-Savannah	12.1	7.8	4.3
Guinea Savannah	9.8	6.2	4.7
Northeastern region	13.8	9.6	4.7
Monthly expenditure on domestic energy (₦)	12300±1000	4345±525	932±178

Source: Computed from field survey, 2006. Overall mean income expenditure on energy = 9.4%. NB Value after ± are standard deviation of the means.

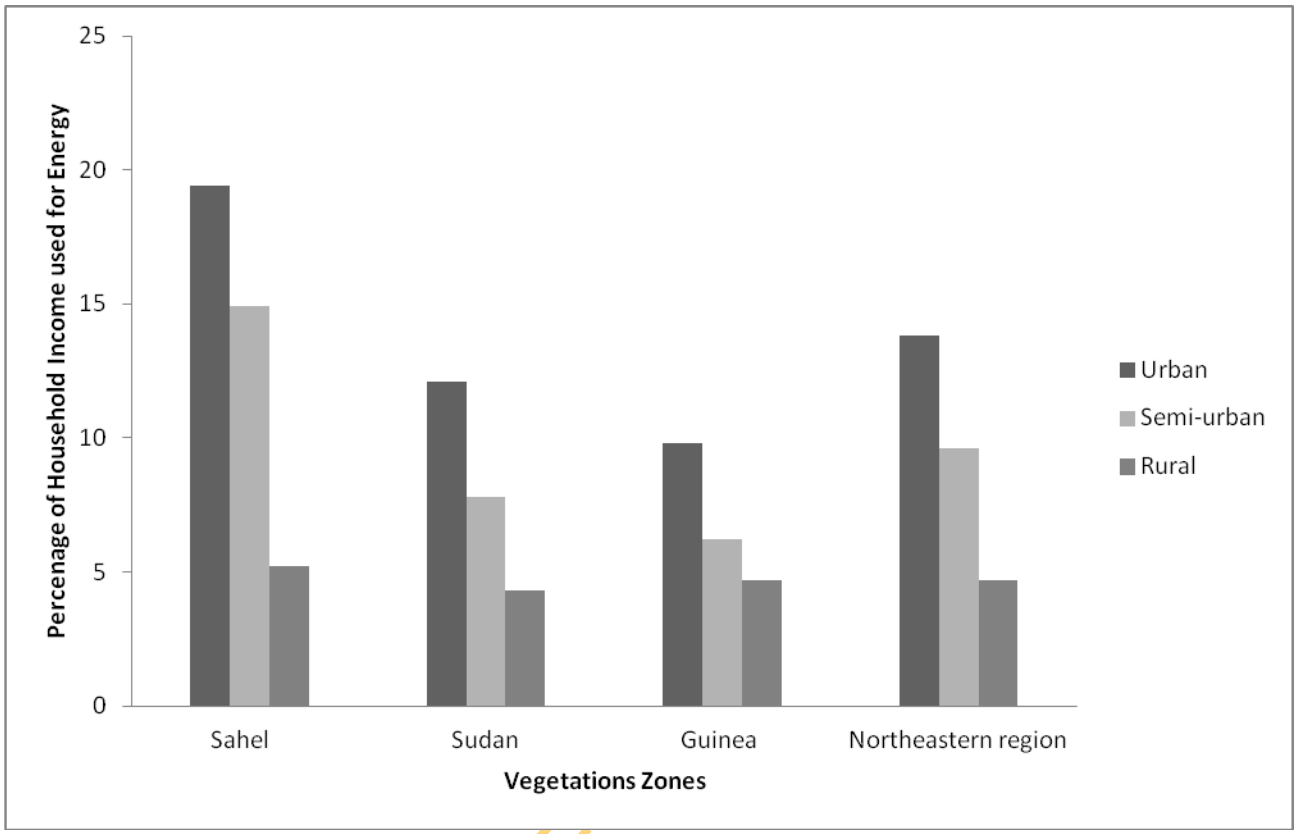

Fig.4.5 Percentage Household Income Expended on Domestic Energy in Northeastern Nigeria

4.7.2 Effect on consumption pattern

Indicative responses of 76 percent (Sahel), 79.2 percent (Sudan) and 87.1 percent (Guinea savannah) reflect declining domestic energy consumption as energy price increases (Table 4.19). Nwofor, Ogujiuba and Asogwa (2006) reported that an increase in price of a commodity no matter how essential commodity it is, always results in reduction in the consumption of the product, thus, concluded that the notable change will not only be on the petroleum products but also on other goods the household consumes. This is exactly what the respondents indicated. This is a common occurrence in the case of rural and urban poor households, where the poor had to do without things they cannot afford or find substitutes to them; most times these things are not satisfying. Similarly, Cecelski, (1987) and Misana (1988) emphasized that increasing scarcity and hike in prices of `domestic energy compels two broad reactions by the households, some switch to other cheaper alternatives or may adjust their cooking patterns to the prevailing level of shortages while facing the consequences of adopting such coping strategies.

The change in the consumption pattern of domestic energy in turn has its impact on the households. These impacts range from irregular feeding habits, poor health conditions of the whole family and sometimes malnutrition particularly in the case of infants.

Irregular feeding habits could mean altering feeding frequency of meal times; this could lead to poor health condition of the family. For instance, if a household changes its feeding from three times to two times a day or resort to eating unconventional foods, this will definitely affect the health status of the family, thereby bringing about the metabolic and physiological malfunctioning of the body systems.

In the Sahel zone 84.2 percent admitted the effect of reduction in the rate of use of the conventional domestic energy on the health status of their households, 74.0 percent in the Sudan

savannah and 72.8 percent in the Guinea savannah; while 12.4 percent, 10.4 percent and 11.0 percent of the respondents indicated that shortage in domestic energy results in malnutrition in the Sahel, Sudan and Guinea savannah zones respectively. On the other hand, only 3.3 percent, 2.5 percent and 16.2 percent in the Sahel, Sudan and Guinea respectively indicated that reduction in domestic energy consumption does not have significant effect on them (Table 4.19).

The implication of change in feeding habit in households could be poor health status of the household members which could also affect family labour force, which will in turn lead to lesser productive activities in the households thereby retarding the economic status of the household, hence remain in the vicious cycle of poverty.

Table 4.19. Consequences of Energy Price Increases on Households

Variables	Effects	Sahel zone		Sudan zone		Guinea zone	
		Frequency	%	Frequency	%	Frequency	%
Consumption	Reduced consumption.	92	76.0	61	79.2	118	87.1
	Irregular feeding habits.	18	14.9	11	13.3	16	11.7
	No effect	11	9.1	5	6.5	2	1.2
	Total	**121**	**100**	**77**	**100**	**136**	**100**
Consequences of reduced energy consumption	Poor health	102	84.2	57	74.0	99	72.8
	Malnutrition	15	12.4	8	10.4	15	11.0
	No effect	4	3.3	2	2.5	22	16.2
	Total	**121**	**100**	**77**	**100**	**136**	**100**
Income	Reduced income size	104	86.0	67	87.0	109	80.1
	No effect	17	14.0	10	13.0	27	19.9
	Total	**121**	**100**	**77**	**100**	**136**	**100**

Source: Field survey, 2006

4.8 Household Energy Consumption Pattern

It is evident (Table 4.20) that fuelwood is consumed by the majority (97.6%) of households in northeastern Nigeria. This is far beyond Ayodele's (2003) report, that 80.0 percent of Nigerians in general, use wood as domestic energy. Popoola, (1992) also maintained that 82 percent of Nigerians entirely depend on wood for their cooking energy and reiterated that it is even more in the northern part of the country. This indicates that dependence on fuelwood for household energy is on the increase in this region. Koirala (2007) also reported a similar case of high dependence on wood for domestic energy by residents of Nepal in the 2004/2005 fiscal year, asserting that 89.0 percent of the total energy consumption is wood.

The acceptability of wood as household energy in this region is not unconnected to its relative abundance; accessibility and its relative cheapness. Even in the urban centres, people with better income level, patronize wood more than other household energy types. Fuelwood is closely followed by kerosene (94.3%), charcoal (66.7%), electricity (31.8%), Agricultural residue (29.6%), cooking gas (14.9%) and coal (3.0%). Kerosene became the second most patronised domestic energy among the households in this region because of its use to fuel hurricane lamps, since electricity is epileptically supplied to only a few locations. As it is, if efforts are not made to reverse the incessant increase in domestic energy prices, it will definitely continue to have negative consequences on the sustainability of forest resources in the region.

Table 4.20. Energy Use in Northeastern Region

Class	Energy types	Yes	%	No	%
More efficient	Kerosene	315	94.3	19	5.7
Energy types	Electricity	107	31.8	229	68.2
	Cooking gas	50	14.9	286	85.1
Alternative	Fuelwood	328	97.6	8	2.4
Energy types	Charcoal	224	66.7	112	33.3
	Coal	10	3.0	326	97.0
	Solar radiation	92	27.5	242	72.5
	Agricultural residue	99	29.6	235	70.4
	Animal waste	53	15.9	280	84.1
	Saw dust	38	11.4	296	88.6

Source: Field work, 2006

4.9. The effect of Domestic Energy Price Increases on Forest Resources.

The increase in household energy prices has a negative impact on forest resources. The increase at most times tends to push households to shift to cheaper alternative energy types in order to sustain their households. Despite the existence of several other domestic energy types, most households in the study area tend to prefer fuelwood for its relatively cheaper cost and regular availability, making it the most popular alternative domestic energy (Table 4.22).

The result also showed that 86.0 percent of the households in Northeastern Nigeria indicated fuelwood as best alternative domestic energy in times of domestic energy crisis. The implication of this finding is that 86 percent (16,364,176) of the population in the region depend on wood from the forest for their source of domestic energy (Table 3.2). This is in addition to other forms of pressure that are being exerted on the forest like urbanization and agricultural expansion. The study is indicative that the mass recourse to the use of fuelwood by households is as a result of their inability to acquire other energy types.

Respondents as a result of incidences of increased domestic energy prices find the forest as a means of supplementing their income through exploitation of non-timber forest products for sale. Activities such as hunting, honey, mushroom, gum and medicinal plants collections are examples of other activities exerting pressure on the forests in this region (Energy and Society, 2004).

Majority (88.2%) of the heads Government Forestry Agencies (Table 4.21) attributed the upsurge in the fuelwood use by households to high cost of fossil-based domestic energy types and viewed it as a threat to forest resources conservation. They also confirmed that the rate of increase in fuelwood consumption is alarming considering the zero percent annual plantation establishment in the region. They regretted that the present administrative dispensation do not consider curbing environmental degradation a priority.

The outcome of this study is similar to the Poverty Environmental Hypothesis (PEH) formulated for Bruntland by the Asian Development Bank (ADB, Jalal, 1993) which states that "the poor rely more than others on common property resources, such as open access forests for reasons of lower shadow cost of labour, lower preference to cleaner but more expensive fuel substitutes and credit constraints thereby resorting to subsistent productive activities". The situation in question is the issue of unequal income distribution and high cost of domestic energy. According to PEH therefore, halting environmental degradation requires the reduction of poverty, via growth or redistribution of public resources. Table 4.22 shows that when fossil-based fuels are scarce or price hike occurs, households revert to the use of fuelwood. It therefore implies that fuelwood is the most popular alternative energy in the region. The heads of forestry agencies in the study area attributed the influx in the population switching to the use of fuelwood for domestic purposes to unavailability and the increasing prices of the other domestic energy types. This confirms the report of the Forest Monitors (2007) in which price increases of domestic energy in the Congo, led to massive deforestation of the Virungal National Park.

Table 4.21 Impact of Domestic Price Increases on Forests

Characteristic impact	Agreed		Disagreed	
	Frequency	percentage	Frequency	percentage
Fuelwood collection	14	93	1	7.0
Agric./Farming	13	87.0	2	13.0
Urban Development	7	47.0	8	53.0
Timber Exploitation	9	60.0	6	40.0
Over grazing by livestock	13	87.0	2	13.0
NWFP collection	9	60.0	6	40.0
Hunting activities	10	67.0	5	33.0

Source: field survey, 2006

Table 4.22. Households' Choice of Alternative Domestic Energy

Zones	Sahel		Sudan		Guinea		Northeastern Nig.	
Domestic Energy Type	Frequency	%	Frequency	%	Frequency	%	Freq	%
Fuelwood	104	86.0	68	88.4	115	84.5	278	86.3
Charcoal	41	33.9	10	13.0	40	29.4	91	25.4
Coal	0	0.0	0	0.0	0	0.0	0	0.0
Kerosene	14	11.6	2	2.6	5	3.6	20	6.0
Cooking gas	2	1.7	1	1.3	3	2.2	6	1.7
Electricity	24	19.8	17	22.0	15	11	59	17.6

Source: Field survey, 2006

4.10 Analyses of the Coping Strategies

Economic crisis is among the most important situations that heighten sharp incidence of poverty around the world (Lustig, 1999). Poverty, outcome of crisis for a particular household depends crucially on the extent to which a household is exposed to economic difficulties and its ability to respond or cope with such perils (Holzmann and Jorgensen, 1999). The case of domestic energy price hike in Nigeria is an instance of such economic incidences exerting an untold hardship on households.

Each of these households has its own way of adjusting to survive these hardships. From the list of options provided as coping strategies, the respondents rated differently in terms of status of application and how successful they were in helping to cope with the hardships. (Table 4.23) gave an idea whether or not individual strategies were used and how successful they were, according to the respondents' own account. "Reduction in rate of energy use (**RRE**)" 79.9%, was the most adopted coping strategy among the respondents in the study area. Households that adopt this strategy resorted to cooking once or twice a day in order to reduce expenses on household energy. This behaviour of households in the study area is similar to the situation in the United Kingdom; where households were reported to reduce the rate of household energy use by living on readymade foods from the shops (Energy & Society, 2004). In a similar study, Metcalf's (2002) reported that electricity consumers in Russia resorted to hanging their laundry out to dry, turning off their extra storage freezers, turning off security lights, heaters and air conditioners in order to reduce the bills as coping strategies. The next popular coping strategy adopted in the study area was "expenditure cutting on other household needs to cover cost of domestic energy (**EC)" (**77.8%), 'suspension of capital projects like buildings to have enough money to buy domestic energy at its new price (**SCP**)' (75.4%) and 'suspension of the use of kerosene, electricity and gas to

use cheaper domestic energy like wood until there is enough money to acquire it (**FW**)' (75.4%) were both ranked the third most popular coping strategies among households in the study area (75.4%). This confirms Meikle and Bannister's (2003) report on a similar study in Ghana, Indonesia and China; and Kulindwa and Shechambo (1995), where poor households tend to shift from the use of commercial domestic energy to cheaper alternatives. Participation in many ad-hoc jobs (DMJ) was the next most popular coping strategy among the respondents (67.7%); while the least of all was craft making (Blacksmithing, carving, weaving,(**MC)** (17.4%).

From the responses in this region, it implies that during periods of domestic energy crisis (scarcity, hike in price) the fall-back is the fuelwood, whose source is the forests thereby, exerting more pressure on the forest resources.

Table 4.23. Percentage Ranking of Adoption of Coping Strategies in the Study Area

Coping strategies (CS)	YES	NO
1_ Reduced quantity of food cooked in the house **(RDF)**	68.3	31.7
2_ Cutting expenditure on other household needs to cover cost of domestic energy (**EC)**	77.8**	22.2
3_ Reduce rate of domestic energy use **(RRE)**	79.6***	20.4
4_ Stop warming water for any use (**SBW**	71.3	28.7
5_ Avoid foods that take long time to cook (**ALTF)**	73.1	26.9
6_ Use solar to preserve/dry food in place of oven (**USE**)	71.0	29.0
7_ I operate small scale business to get more money to buy required domestic energy at its new price (OSCB)	65.6	34.4
8_ I participate in many ad-hog jobs as possible to increase my income to enable me buy enough of my desired energy type (**DMJ**)	67.7	32.3
9_ I reduce my family size (**RFS**)	36.2	63.8
10_I suspend some of my family obligations like sending money to distant relations (**SSFO)**	70.7	29.3
11_I suspend my capital projects like buildings to have enough money to buy domestic energy at its new price (**SCP**)	75.4*	24.6
12_I suspend the use of kerosene and gas to use cheaper domestic energy like wood until I have enough money to acquire it (**FW**)	75.4*	24.6
13_I suspend the use of kerosene and gas to use electricity for domestic energy (**ELEC**	50.6	49.4
14_I supplement the use of kerosene and gas with fire wood (**SKGW**) -	59.0	41.0
15_We stop cooking, and eat in restaurants (**EIR**)	25.4	74.6
16_I hire out my labour (**WHL)**	40.1	59.9
17_I go about borrowing money from relatives to supplement my income (**BMFR**)	53.0	47.0
18_I join thrift group (**JTG)**	63.5	36.5
19_I keep domestic animals (**KDA**)	66.5	33.5
20_I collect forest products for sale (**CNTP**)	54.5	45.5
21_I join co-operative society (**JCS)**	43.1	56.9
22_I engage in occasional transport business (**EOTB)**	40.4	59.6
23_I trade in primary products (fruits, grains, vegetables etc.) (**TPP**)	57.5	42.5
24_I do multiple cropping on my farms (**DMC**)	45.8	54.2
25_I brew local beer (**BLB**)	26.9	73.1
26_Craft making (Blacksmithing, carving, weaving, etc.) (**MC**)	17.4	82.6
27_Hair dressing (**HDB**)	18.9	81.1
28_I use ox-drawn plough (**UAP**)	23.7	76.3
29_Food processing (Gari, rice, etc.) (**FP**)	20.4	79.6
30_Catering services (**CS**)	25.4	74.6
31_Skipping meals (**SM**)	29.0	71.0
32_Eat unconventional foods (**EUF**) 33_	28.7	71.3
33_Prolonged breast feeding (**PBF)**	18.6	81.4

***_ 1st most adopted coping strategy, **_ 2nd most adopted coping strategy, *_3rd most adopted

In the guinea savannah, "the suspension of the use of commercial domestic energy for cheaper alternatives like wood (**FW**)" and "supplementing use of kerosene, cooking gas and electricity with wood (**SKGW**)" was equally ranked as the most popularly adopted coping strategies (70.5%) (Appendix IIIC). Though this zone among others is endowed with more forest resources, the outcome of this study indicates threat signals to these resources. Therefore, if this trend is not reversed, the resources will be depleted within a short period. Similar to the findings of Meikle and Bannister, (2003). "Expenditure cutting on other household needs to cover the increased cost of domestic energy" (**EC**) was the third popular coping strategy adopted in the Guinea savannah zone (68.3%). The implication of this is that some other needs of the household will not be met; hence the normal productive activities will be obstructed leading to tendencies of perpetual poverty.

In order to reduce expenditure on domestic energy, households in the Sudan savannah "reduce the frequency of cooking" (**RRE**) (72.1%) in order to cope with hike in prices or shortage in supply of domestic energy (Appendix IIIB). This coping strategy was the most popular among households in this zone. The second popular coping strategy in this zone was "the suspension of capital projects like building" (**SCP**) in order to buy the much needed energy to sustain the households (70.1%), followed by the "suspension of the use of fossil-based domestic energy for cooking" (**FW**) (67.5%). This was also adopted by poor households in Ghana and Indonesia (Meikle and Bannister, 2003). Some of the strategies adopted in this zone are environment friendly since "reduction in cooking frequency" and "suspension of capital project in order to acquire enough commercial domestic energy" implies sustained use of fossil-based domestic energy types.

In the same trend, households in the Sahel zone ranked "suspension of the use of fossil-based domestic energy for cheaper alternatives like wood (**FW**)" as the most favoured (61.6%), while "supplementing the use of kerosene, cooking gas and electricity with wood (**SKGW)**"

(54.2%) was the second most adopted coping strategy. The least adopted coping strategy in this zone is "brewing of local beer (**BLB**)" (1.6%).

Responses to coping strategies varies amongst genders, educational levels, household sizes, and vegetation zones, income levels/means of livelihoods and settlement types (urban, semi-urban and rural areas). Chi-square (χ^2) analysis of responses on the coping strategies in the entire study area (Tables 4.24) revealed the existence of significant differences ($p \leq 0.05$) in the level of adoption of the coping strategies among the respondents. This is an indication that the level of adoption of the coping strategies is not the same amongst households, thus, every household has its own way of responding to critical situations based on the circumstances surrounding them. Details of these hypotheses are discussed in section 4.11.

4.11 Test of Hypotheses

4.11.1 Hypothesis I Chi-Square analysis

H_o: *There exist no significant differences in the adoption of coping strategies among households in the study area.*

In order to test the existence of variation in the responses from households on the adoption of coping strategies based on the socio-economic characteristics (vegetation zones, educational status, occupation, gender, marital status and settlement type), the data were subjected to Chi-Square (χ^2) analysis. (Table 4.24).

4.11.1.1 vegetation zones

Based on the vegetation zones, Chi-Square (χ^2) analysis indicated significant ($p \leq 0.01$) differences in the adoption of coping strategies in 75.8 percent of all the coping strategies. These include: "expenditure cutting on other household needs to cover cost of domestic energy (**EC)"**, "stop boiling water (**SBW**)"**, "** avoiding foods that take long time to cook (**ALTF**)" , "use solar radiation to preserve/dry food in place of oven (**USE**)", " operation of small scale business to get more money to buy required domestic energy at its new price

(**OSCB**)**",** " participation in as many ad-hoc jobs as possible to earn more income to buy enough of my desired energy type (**DMJ**)", "reduction of family size (**RFS**)", "suspension of the use of kerosene and gas to use electricity for domestic energy (**ELEC**)**", "** supplement the use of kerosene and gas with fire wood (**SKGW**)", "stop cooking, and eat in restaurants (**EIR**)", " hire out labour (**WHL**)", "go about borrowing money from relatives to supplement my income (**BMFR**)", "join thrift group (**JTG**)", "keep domestic animals (**KDA**)", "collection of forest products for sale (**NTP**)", "engage in occasional transport business (**EOTB**)**", "**trade in primary products (fruits, grains , vegetables etc.) (**TPP**)", "do multiple cropping on farms (**DMC**)", "brew local beer (**BLB**)", and "craft making (Blacksmithing, carving, weaving, etc.) (**MC**)|". Others are "food processing (Gari, rice, etc.) (**FP**)", "catering services (**CS**)", "skipping meals (**SM**)", "eat unconventional foods (**EUF**)" and "prolonged breast feeding (**PBF**)". While it is significant ($P<0.05$) in three of the coping strategies which include "reduction of quantity of food cooked in the house **(RDF)", "**suspension of capital projects like buildings in order to have enough money to buy domestic energy at its new price (**SCP**)" and "engagement in hair dressing business (**HDB**)". By this result the null hypothesis is rejected and the alternative upheld, therefore, it is concluded that there exist significant difference in the adoption of coping strategies among households in the vegetation zones.

Only four of the coping strategies were proved to have no significant difference in their adoption amongst the eco-vegetation zones. These include "reduction in the rate of domestic energy use **(RRE)", "**suspension of some of family obligations like sending money to distant relations (**SSFO**)", "suspension of the use of kerosene and gas to use cheaper domestic energy like wood until I have enough money to acquire it (**FW**)" and "Use of ox-drawn plough (**UAP**).

The results of this analysis revealed that adoption of majority of the coping strategies by households is not the same in the Sahel, Sudan and Guinea savannah zones as well as in the

rural, semi-urban and urban areas. This result therefore, implies that vegetation type brought about the differences in the adoption of these coping strategies by households. Also the variation might not be unconnected with the variation in income, educational status, and occupation of the respondents as indicated by CBN (2007) that Northeastern region of Nigeria has variations in poverty incidence (Table 2.8).

4.11.1.2. gender

It is assumed that adoption of any of the coping strategies will depend on the gender of the household head, but the result of the Chi-square (χ^2) analysis defies this assumption. Table 4.24 shows that there exist no significant differences in the adoption of majority (84.8%) coping strategies among gender of households' heads. This implies that whether heads of households are female or male; their reaction as it relates to coping with hardship caused by scarcity or hike in price of domestic energy does not significantly vary.

Among all the listed coping strategies, only five (15.2%) vary with gender. These include the use solar to preserve/dry food in place of oven (**USE**), operate small scale business **(OSCB),** suspension of the use of kerosene and gas to use electricity for domestic energy (**ELEC**), join thrift group (**JTG**) and food processing (Gari, rice, etc.) (**FP**). The existence of significant differences among gender on these coping strategies might not be unconnected to the fact that most of the actions described are feminine related activities.

Table4.24 Chi-Square (χ^2) of Socio-economic Characteristics and Adoption of Coping Strategies

Coping strategies (CS)		Eco-veg.	Gender	Education	Occupation	Marital status	Settlement types
CS1_ Reduced quantity of food cooked in the house **(RDF)**	χ^2	10.97*	2.52^{ns}	10.84^{ns}	2.63^{ns}	8.11^{ns}	8.10*
	Df	2	1	5	3	5	2
	P	0.0119	0.1117	0.0547	0.4519	0.1499	0.0173
CS2_ Cutting expenditure on other household needs to cover cost of domestic energy (**EC)**	χ^2	25.54**	0.69^{ns}	3.49^{ns}	3.87^{ns}	9.71^{ns}	7.49*
	Df	2	1	5	3	5	2
	P	0.0000	0.4062	0.6250	0.2763	0.0838	0.0236
CS3_ Reduce rate of domestic energy use **(RRE)**	χ^2	3.96	0.26^{ns}	11.86*	3.13*	4.63^{ns}	11.49**
	Df	2	1	5	3	5	2
	P	0.2657	0.6143	0.0368	0.03714	0.4622	0.0032
CS4_ Stop warming water for any use (**SBW**)	χ^2	25.23**	0.7493^{ns}	9.52^{ns}	12.21**	12.96**	6.18*
	Df	2	1	5	3	5	2
	P	0.0000	0.3866	0.0897	0.0067	0.0237	0.0455
CS5_ Avoid foods that take long time to cook (**ALTF**)	χ^2	19.22**	0.02^{ns}	34.85**	2.46^{ns}	7.66^{ns}	8.33*
	Df	2	1	5	3	5	2
	P	0.0003	0.9019	0.0000	0.4826	0.1761	0.0155
CS6_ Use solar to preserve/dry food in place of oven (**USE**)	χ^2	17.61**	11.43**	19.60**	3.70^{ns}	7.13^{ns}	32.48**
	Df	2	1	5	3	5	2
	P	0.0005	0.0007	0.0015	0.2951	0.2111	0.0000
CS7_ Operate small scale business to get more money to buy required domestic energy at its new price **(OSCB)**	χ^2	39.10**	6.97*	16.49**	2.88^{ns}	12.22*	2.79^{ns}
	Df	2	1	5	3	5	2
	P	0.0000	0.0082	0.0056	0.4105	0.0318	0.2477
CS8_ Participate in many ad-hog jobs as possible to more income to enable me buy enough of my desired energy type (**DMJ**)	χ^2	17.87**	1.23^{ns}	11.95*	5.74^{ns}	7.85^{ns}	8.50*
	Df	2	1	5	3	5	2
	P	0.0005	0.2671	0.0354	0.1249	0.1648	0.0142
CS9_Reduce family size (**RFS**)	χ^2	22.51**	1.03	10.82	2.45	6.68	0.77
	Df	2	1	5	3	5	2
	P	0.0001	0.3107	0.0549	0.4840	0.2453	0.6807

CS10_ I suspend some of my family obligations like sending money to distant relations (**SSFO**)	χ^2	1.93ns	1.42	6.53	1.58	4.25	10.59**
	Df	2	1	5	3	5	2
	P	0.5862	0.2341	0.2576	0.6647	0.5147	0.0050
CS11_ Suspend capital projects like buildings to have enough money to buy domestic energy at its new price (**SCP**)	χ^2	9.57*	0.94	3.57	5.17	4.56	5.31
	Df	2	1	5	3	5	2
	P	0.0226	0.3313	0.6130	0.1600	0.4714	0.0703
CS12_ Suspend the use of kerosene and gas to use cheaper domestic energy like wood until I have enough money to acquire it (**FW**)	χ^2	4.27ns	0.01	5.81	3.68	6.56	8.19*
	Df	2	1	5	3	5	2
	P	0.2338	0.9634	0.3250	0.2978	0.2550	0.0167
CS13_ Suspend the use of kerosene and gas to use electricity for domestic energy (**ELEC**)	χ^2	35.60**	4.24*	8.36	0.14	8.84	0.95
	Df	2	1	5	3	5	2
	P	0.0000	0.0396	0.1373	0.9861	0.1154	0.6216
CS14_ Supplement the use of kerosene and gas with fire wood (**SKGW**)	χ^2	13.54**	0.26	9.74	6.46	12.87*	10.76**
	Df	2	1	5	3	5	2
	P	0.0036	0.6105	0.0831	0.0911	0.0246	0.0046
CS15_ Stop cooking and eat in restaurants (**EIR**)	χ^2	25.52**	1.33	9.20	2.10	1.11	3.03
	Df	2	1	5	3	5	2
	P	0.0000	0.2496	0.1013	0.5522	0.9528	0.2199
CS16_ Hire out my labour (**WHL**)	χ^2	18.19**	0.11^{ns}	19.60**	4.21^{ns}	15.22**	5.57^{ns}
	Df	2	1	5	3	5	2
	P	0.0004	0.7370	0.0015	0.2394	0.0095	0.0616
CS_17 Go about borrowing money from relatives to supplement my income (**BMFR**)	χ^2	17.38**	0.12^{ns}	5.65^{ns}	4.69^{ns}	4.29^{ns}	23.03**
	Df	2	1	5	3	5	2
	P	0.0006	0.7251	0.3421	0.1963	0.5087	0.0000
CS18_ Join thrift group (**JTG**)	χ^2	17.45**	7.10**	17.24**	3.01^{ns}	5.33^{ns}	8.80*
	Df	2	1	5	3	5	2
	P	0.0006	0.0077	0.0040	0.3904	0.3766	0.0123

CS19_ Keep domestic animals (**KDA**)	χ^2	23.22**	1.61^{ns}	17.70**	14.40^{ns}	10.95ns	22.12**
	Df	2	1	5	3	5	2
	P	0.0000	0.2050	0.0034	0.0024	0.0524	0.0000
CS20_ Collect forest products for sale (**NTP**)	χ^2	42.25**	2.08^{ns}	15.54**	6.68^{ns}	4.74^{ns}	2.38^{ns}
	Df	2	2	5	3	5	2
	P	0.0000	0.1491	0.0083	0.0829	0.4489	0.3035
CS21_ Join co-operative society (**JCS**)	χ^2	42.48**	0.18^{ns}	29.06**	2.47^{ns}	6.58^{ns}	8.99*
	Df	2	1	5	3	5	2
	P	0.0000	0.6756	0.0000	0.4801	0.2541	0.0111
CS22_ Engage in occasional transport business (**EOTB)**	χ^2	27.37**	0.33^{ns}	19.40**	3.72^{ns}	2.35^{ns}	4.77^{ns}
	Df	2	1	5	3	5	2
	P	0.0000	0.5610	0.0016	0.2929	0.7994	0.0918
CS23_Trade in primary products (fruits, grains, vegetables etc.) (**TPP**)	χ^2	15.03**	1.55^{ns}	28.39**	0.6392^{ns}	3.58^{ns}	12.12**
	Df	2	1	5	3	5	2
	P	0.0018	0.2129	0.0000	0.8874	0.6108	0.0023
CS24_ Do multiple cropping on my farms (**DMC**)	χ^2	40.36**	1.29^{ns}	6.56^{ns}	6.34^{ns}	13.84*	34.66**
	Df	2	1	5	3	5	2
	P	0.0000	0.2562	0.2558	0.0961	0.0167	0.0000
CS25_ Brew local beer (**BLB**)	χ^2	36.77**	0.75^{ns}	14.15*	5.87^{ns}	0.93^{ns}	1.40^{ns}
	Df	2	1	5	3	5	2
	P	0.0000	0.3867	0.0147	0.1184	0.9683	0.4954
CS26_ Craft making (Blacksmithing, carving, weaving, etc.) (**MC**)	χ^2	29.50**	0.18^{ns}	10.51^{ns}	3.81^{ns}	2.55^{ns}	0.95^{ns}
	Df	2	1	5	3	5	2
	P	0.0000	0.6722	0.0621	0.2820	0.7694	0.6218
CS27_ Hair dressing (**HDB**)	χ^2	8.44*	0.70^{ns}	17.90**	3.74^{ns}	4.51^{ns}	2.68^{ns}
	Df	2	1	5	3	5	2
	P	0.0377	0.4031	0.0030	0.2908	0.4783	0.2623
CS28_ Use of ox-drawn plough (**UAP**)	χ^2	5.56^{ns}	2.35^{ns}	9.47^{ns}	1.78^{ns}	1.49^{ns}	7.90*
	Df	2	1	5	3	5	2
	P	0.1336	0.1250	0.0918	0.6193	0.9147	0.0193

CS29_ Food processing (Gari, rice, etc.) (**FP**)	χ^2	27.32**	9.20**	16.08**	9.15*	10.23^{ns}	2.49^{ns}
	Df	2	1	5	3	5	2
	P	0.0000	0.0024	0.0066	0.0273	0.0689	0.2877
CS30_ Catering services (**CS**)	χ^2	23.78**	0.25^{ns}	22.03**	7.07^{ns}	7.33^{ns}	0.07^{ns}
	Df	2	1	5	3	5	2
	P	0.0000	0.6179	0.0005	0.0698	0.1973	0.9666
CS31_ Skipping meals (**SM**)	χ^2	19.87**	2.03^{ns}	10.82^{ns}	1.74^{ns}	13.58*	1.89^{ns}
	Df	2	1	5	3	5	2
	P	0.0001	0.1543	0.0552	0.6290	0.0185	0.3878
CS32_ Eat unconventional foods (**EUF**)	χ^2	25.06**	1.35^{ns}	10.37^{ns}	3.61^{ns}	5.64^{ns}	1.05^{ns}
	Df	2	1	5	3	5	2
	P	0.0000	0.2451	0.0655	0.3072	0.3428	-.5917
CS33_ Prolonged breast feeding (**PBF**)	χ^2	31.00**	0.02^{ns}	21.19**	0.61^{ns}	3.15^{ns}	4.53^{ns}
	Df	2	1	5	3	5	2
	P	0.0000	0.8848	0.0008	0.8933	0.6775	0.1039

Source: computed from field data, 2006. ** Highly significant (p=0.01), *- Significant (p=0.05), ns- Not significant

4.11.1.3 educational attainment

The results of the chi-square (χ^2) analysis shown on Table 4.24 shows the existence of significant differences in the adoption of coping strategies by households amongst the educational levels of the households' heads, 45.5 percent of the coping strategies provided for the study. These variations might not be unconnected to the fact that most of the actions that tested significant were those that could be related to the low literacy level of the households' heads. For instance, venturing into local food processing (**FP**), brewing local beer (**BLB**), operation of small scale business **(OSCB),** hiring out labour (**WHL),** joining of thrift groups (**JTG**) and trade in primary products (fruits, grains, vegetables etc.) (**TPP**), which tested highly significant, are such menial activities that literate heads of households in a rural setting are not likely to adopt.

It is a well known fact that educational status is an indicator of one's income level. This therefore, indicates that adoption of coping strategies vary along educational levels of the heads of households. Thus, in the advent of domestic energy crisis, methods dealing with the situation depend very much on the educational status of the heads of households.

4.11.1.4 occupation

Chi-square (χ^2) analysis of the coping strategies indicated the non existence of significant differences in their adoption among the occupational groups. Only three out of 33 tested significant. Stoppage of boiling water (SBW) for instance is the only option that tested highly significant. This is an action that might not be considered as a strategy by most households for the reason of the location of the study area -the tropical region, having major part of its seasons hot and dry, such that the need for warm water for bathing might not arise for most part of the season.

4.11.1.5 marital status

The Chi-square (χ^2) analysis of the adoption of coping strategies along marital status tested significant on only a few of the options provided. These include, stoppage of boiling of water for any use (SBW), operation of small scale business (OSCB), supplementing the use of kerosene and gas with fire wood (SKGW), hire out labour (WHL), multiple cropping on farms (DMC) and skipping of meals (SM). The trend of this result might not be unconnected to the fact that marital status is used to assess the magnitude of liability of individuals, thus, a married person is expected to have more responsibilities than the unmarried. The content of these options also showcase the fact that they are actions that can give a difference between the married and the unmarried individuals. An unmarried person might not at all consider hiring out labour or doing multiple cropping on farms as remedies in times of domestic energy scarcity.

Apart from the listed coping strategies above, all the others were not significant; therefore, for the majority of the coping strategies there exists no significant differences in their adoption amongst marital statuses of household heads. This could be associated to the low number of the single headed households.

4.11.1.6. settlement types (urban, semi-urban and rural areas)

The results of Chi-square (χ^2) analysis reveal the existence of significant differences in the adoption of 50 percent of the options provided. These include 'reduction in the rate of domestic energy use' (RRE), 'use of sun-drying to preserve/dry food in place of oven' (USE), 'doing many ad-hoc jobs' (DMJ), 'suspension of some family obligations like

sending money to distant relations' (SSFO), 'suspension of the use of kerosene and gas to use cheaper domestic energy like wood' (FW), 'supplementing the use of kerosene and gas with fire wood' (SKGW), 'going about borrowing money from relatives to supplement my income' (BMFR), 'keep domestic animals' (KDA), 'trading in primary products' (fruits, grains, vegetables etc.) (TPP) and 'do multiple cropping on my farms' (DMC). This implies that adoption of these strategies vary significantly with the settlement type of the households, whether the household is located in the urban, semi-urban or in the rural areas.

Glancing through the list of coping strategies that tested significant revealed that they are settlement bound. For instance, the use of fuelwood in wood stoves or keeping domestic animals may be difficult strategies to adopt in some locations in the urban areas.

4.11.2 Test of hypothesis II

H_o: socio-economic characteristics of respondents do not significantly influence adoption of coping strategies among households.

Logistic regression analysis

Five of the coping strategies that tested significant in the Chi-square analysis by at least four of the socio-economic characteristics of the respondents were subjected to logistic regression analysis in order to determine the influence of these characteristics on the adoption of the coping strategies. These five coping strategies are: hiring out labour (WHL), joining thrift groups (JTG), operation of small scale business (OSCB), use of solar radiation to preserve food stuff (USE) and stoppage of boiling water (SBW), while the socio-economic characteristics are: gender (GN), education (ED), age (AG), household size (HS), income level (IL), marital status (MS), and settlement types (ST).

Logistic regression analysis was employed to describe the relationship between the various independent variables on the socio-economic characteristics of the respondents and the binary dependent variables of the adoption of coping strategies.

4.11.2.1 influence of household characteristics on hiring out labour as a coping strategy

The logistic regression analysis revealed (Table 4.25) a significant ($P \leq 0.05$) negative relationship between socio-economic characteristics of respondents and the adoption of hiring out labour (WHL) in situations of domestic energy crisis, is very much dependent on the settlement type, whether the respondent is resident in the rural, semi-urban or urban areas. Adoption of this strategy does not depend on all other variables. The logistic estimation of the likelihood of respondents to adopt hiring out their labour as a sort of coping strategy in the advent of domestic energy crisis is p = -0.291. The result of the prediction equation revealed that if all the socio-economic variables are put together, 29 percent of the respondents are not willing to heir out their labour as a coping strategy. This implies that settlement type influence the adoption of hiring out labour they will rather continue in their energy poverty, thereby continue to patronise the cheapest low quality energy.

Table 4.25 Logistic Regression for Hire out Labour as a Coping Strategy (WHL)

Variables	B	S.E.	Wald	Df	P.Value	Exp(B)
GD	.183	.330	.307	1	.579	1.201
ED	.105	.083	1.618	1	.203	1.111
AG	-.016	.011	2.029	1	.154	.984
HS	-.004	.027	.028	1	.867	.996
IL	.000	.000	2.102	1	.147	1.000
MS	-.658	.346	3.607	1	.058	.518
ST	-.625	.256	5.951	1	.015	.535
Constant	.724	.650	1.242	1	.265	2.063

Source: Logistic regression analysis, $P(WHL) \leq - 0.291$

$P(WHL) = 0.724 + 0.183(GD) + 0.105(ED) + 0.016(AG) + 0.000(IL) - 0.658(MS) - 0.625(ST) = -0.291$……(6)

4.11.2.2 influence of household characteristics on joining thrift groups as a coping strategy

Table 4.26 shows significant relationship between joining thrift groups as coping strategy and gender ($P \leq 0.05$) and settlement type ($P \leq 0.01$) though both of them have negative coefficients -0.933 and -0.924 respectively. This also is an indication that gender and the location of respondents' place of residence invariably influence the adoption of joining of thrift groups as a way of coping with household energy problems. The prediction equation revealed that only 10 percent of the respondents are adopting this coping strategy ($P(JTC) \leq 0.101$).

This implies that joining of thrift groups is not a popular activity among respondents in Northeastern Nigeria.

Table 4.26 Logistic Regression for Joining Thrift Groups as a Coping Strategy (JTG)

Variables	B	S.E.	Wald	Df	P.Value	Exp(B)
GD	-.933	.378	6.101	1	.014	.393
ED	.143	.084	2.876	1	.090	1.153
AG	-.018	.012	2.466	1	.116	.982
HS	.020	.027	.560	1	.454	1.021
IL	.000	.000	.292	1	.589	1.000
MS	-.005	.379	.000	1	.989	.995
ST	-.924	.258	12.807	1	.000	.397
Constant	1.818	.694	6.860	1	.009	6.161

Source: Logistic regression analysis, P(JTC) ≤ 0.101

P(JTG) = 1.818 – 0.933 + 0.143 – 0.018 + 0.020 + 0.000 – 0.005 – 0.924 = 0.101.....(7)

4.11.2.3 influence of household characteristics on operation of small scale business as a coping strategy

Table 4.27 shows the existence of negatively significant relationship between operation of small scale business (OSCB) and gender ($p \leq 0.05$) and settlement type ($p \leq 0.05$); while significantly positive relationship with education ($p \leq 0.01$). This implies that educated respondents in the study area are more likely to operate small scale business as a coping strategy. However, adoption of this strategy by the respondents very much depends on their gender and settlement type. The result of the prediction equation (Equation 8) indicates that about 46 percent of the households do not adopt this action during domestic energy crisis P(OSCB) = - 0.457.

The repulsive attitude of respondents to this strategy may not be unconnected to avoidance of the risk of loosing the little resources available to a business that may not yield any interest or end loosing even the capital invested particularly the low income class. Policy makers should consider making funds available and accessible to the public, particularly the peasants for them to be engage in profitable ventures, this is likely to reduce the fears and eventually lead to income improvement.

Table 4.27 Logistic Regression for Operation of Small Scale Business as a Coping Strategy (OSCB)

Variables	B	S.E.	Wald	Df	P.Value	Exp(B)
GD	-.818	.385	4.519	1	.034	.442
ED	.216	.084	6.583	1	.010	1.241
AG	-.007	.012	.357	1	.550	.993
HS	.019	.028	.452	1	.501	1.019
IL	.000	.000	.006	1	.940	1.000
MS	-.789	.417	3.587	1	.058	.454
ST	-.534	.259	4.239	1	.040	.586
Constant	1.457	.710	4.205	1	.040	4.292

Source: Logistic regression analysis, P(OSCB) ≤ - 0.457

P(OSCB) = 1.457 – 0.818 + 0.216 – 0.007 + 0.019 – 0.789 – 0.534 = -0.457.....(8)

4.11.2.4 influence of household characteristics on use of solar radiation in food preservation as a coping strategy

Table 4.28 is the results of logistic regression analysis for determining the influence of demographic and socio-economic characteristics on the use of solar radiation in food preservation in the study area as a coping srategy, it revealed that gender and settlement type tested highly significant ($P \leq 0.01$). The negative coefficient indicates the negative attitudes of the heads of households towards these coping strategies as it relates to their sex and their settlement type. The prediction equation shows that that if all the independent variables are considered together, 80 percent of the respondents will adopt these strategies if such crisis occures at any time (P(USE) = 0.800.)

The tropical nature of the study area made the solar energy readily available in abundance and if harnessed can provide the most efficient household energy. Preservation of excess food materials is mostly done by drying under the sun rays mostly done by women.

Concerted efforts should be made to utilized abundant solar energy in the region so as to curb the energy poverty in the Northeastern Nigeria.

Table 4.28 Logistic Regression for use of Solar Radiation in Place of Electric Ovens as a Coping Strategy (USE)

Variables	B	S.E.	Wald	Df	P.Value	Exp(B)
GD	-1.409	.476	8.745	1	.003	.244
ED	-.048	.092	.266	1	.606	.954
AG	-.013	.013	1.079	1	.299	.987
HS	.018	.030	.354	1	.552	1.018
IL	.000	.000	.642	1	.423	1.000
MS	.174	.422	.170	1	.680	1.190
ST	-1.180	.275	18.431	1	.000	.307
Constant	3.258	.821	15.739	1	.000	26.010

Source: Logistic regression analysis, P(USE) ≤ 0.800

P(USE) = 3.258 – 1.409 – 0.048 – 0.013 + 0.000 + 0.174 – 1.180 = 0.800...(9)

4.11.2.5 influence of household characteristics on stoppage of boiling of water as a coping strategy

An analysis to determine the influence of socio-economic status of respondents (Table 4.29) on stopping boiling water (SBW) in order to conserve domestic energy as a coping strategy in northeastern Nigeria revealed that adoption of this attitude is significantly influenced by the gender ($p \leq 0.05$), the age ($p \leq 0.01$), marital status ($P \leq 0.05$) and settlement type ($p \leq 0.05$) of the heads of households. This implies that sex, age, marital staus and where the respondents live can influence the decision of whether or not to adopt this coping strategy. Despite the fact that the coefficient values of these variables are negative, the prediction equation indicates that more than double (233%) of the repondents are willing to adopt this strategy (P(SBW) = 2.331).

The overwhelming adoption of this strategy by respodents may not be unconnected to the fact that most period of the season is hot, therefore the issue of warming water for bathing or washing are not necessary. This indicate s that many more people are willing to stop warming water if that will bring about domestic energy conservation.

Table 4.29 Logistic Regression for Stoppage of Boiling of Water as a Coping Strategy (SBW)

Variables	B	S.E.	Wald	Df	P.Value	Exp(B)
GD	.731	.357	4.185	1	.041	2.077
ED	-.124	.096	1.669	1	.196	.884
AG	-.040	.014	8.722	1	.003	.961
HS	.058	.032	3.325	1	.068	1.060
IL	.000	.000	.360	1	.548	1.000
MS	-1.023	.446	5.267	1	.022	.360
ST	-.661	.277	5.697	1	.017	.516
Constant	3.390	.809	17.584	1	.000	29.679

Source: Logistic regression analysis, $P(SBW) \leq 2.331$

$$P(SBW) = 3.390 + 0.731 - 0.124 - 0.040 + 0.058 - 1.023 - 0.661 = 2.331 \quad \text{.....(10)}$$

In Table 4.25 to Table 4.29 various socio-economic variables were subjected to analysis with regards to adoption of the coping strategies that tested significant in the Chi-square analysis in section 4.11. Among the respondents settlement type has proved to influence the adoption of all the coping strategies tested; gender is said to influence the adoption of joining of thrift groups (JTG), operation of small scale business (OSCB), use of solar radiation to preserve food stuff in place of electric ovens (USE) and stopping of boiling water (SBW). Education is indicated to have influence on the adoption of operation of small scale business (OSCB) only; age and marital status influence stopping of boiling water (SBW) alone.

The significant relationship between settlement type and all the coping strategies may not be unconnected to the variation in the social and economic characteristics of the residents of all settlement types considered. For instance joining thrift groups, boiling of water and operation of small scale business are uncommon activities in the rural areas, therefore, their adoption varied with settlement types. The use of solar radiation to preserve food stuff is a common activity in the rural and semi-urban areas, so the urban dwellers will need more energy to power their storage freezers compared to the rural dwellers.

4.11.3 Test of hypothesis III

H_o: *Price changes of kerosene do not significantly affect that of fuelwood in the study area.*

Correlation Analysis

Table 4.30 shows the correlation coefficient for price increase of kerosene and that of fuelwood within the period of study. It indicates positive correlation in all the analyses.

This implies that increase in the price of kerosene leads to rise in the demand for fuelwood which translate in to rise in price of the fuelwood during the study period in the study area. The null hypothesis is therefore rejected and the alternative hypothesis is accepted. It could therefore, be concluded that price increases of kerosene led to increase in demand for fuelwood, hence increased exploitation of wood for fuel and other uses from the forests.

The price sensitive to adjust to price of fuelwood from that of kerosene are noticed in the semi-urban (r = 0.9729) and urban (r= 0.9623) areas of guinea savannah, urban areas of Sudan (r = 0.9616) followed by rural areas of guinea savannah (r = 0.9166), while the least price sensitive to adjust to prices of fuelwood from that of Kerosene are in the semi-urban (r = 0.7893) and urban (r = 0.7873) of Sahel zone areas and rural (r = 0.6670) areas of Sudan.

Table 4.30 Correlation of Price Changes of Fuelwood and that of Kerosene between 1999 and 2005

Zone\Location	Urban	semi-Urban	Rural
Sahel savannah	0.7873	0.7893	0.9035
Sudan savannah	0.9616	0.9250	0.6670
Guinea savannah	0.9623	0.9729	0.9166

Source: Computed from field survey, 2006.

4.11.4 Test of hypothesis IV

H_o: *There exists no significant difference in the domestic energy price changes amongst vegetation zones between 1999 and 2005.*

Student t-test

The prices of all domestic energy types from the different vegetation zones were paired and subjected to the student t-test (Table 4.31). This is to see if there exist any significant differences in the energy price changes of domestic energy types among the various zones. The result showed no significant differences, thus, the trend in price increases in kerosene, fuelwood, and charcoal or cooking gas in Sahel zone is not significantly different from the trend of price increases in the other zones. By this the null hypothesis is upheld. This implies that the price increases in domestic energy in one location does not significantly differ from the same settlement type in another vegetation zone. This may not be unconnected to the uniformity of this region to the source of these fossil-based domestic energy types.

Table 4.31 Student's t-Test for Domestic Energy Price Increases between 1999 and 2005

Vegetation zone	Domestic energy	$T_{calculated}$	$T_{tabulated}$
Sahel & Sudan	Fuelwood	0.0056^{ns}	1.796
Sahel & Guinea	Fuelwood	0.0056ns	1.796
Sudan & Guinea savannah	Fuelwood	0.0001ns	1.796
Sahel & Sudan	Kerosene	0.3208ns	1.796
Sahel & Guinea	Kerosene	0.3208ns	1.796
Sudan & Guinea savannah	Kerosene	0.3940ns	1.796
Sahel & Sudan	Charcoal	0.2327ns	1.796
Sahel & Guinea	Charcoal	0.0300ns	1.796
Sudan & Guinea savannah	Charcoal	0.0116ns	1.796
Sahel & Sudan	Cooking gas	0.8201ns	1.796
Sahel & Guinea	Cooking gas	0.1292ns	1.796
Sudan & Guinea savannah	Cooking gas	0.0000ns	1.796

Source: Computed from field survey, 2006 ns = Not significant P≤0.05

Comparative price increases of domestic energy among the 3 eco- vegetation zones in the Northeastern Nigeria.

CHAPTER FIVE

5.0 SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.1 Summary of Major Findings

1. Household energy is indispensible to livelihood sustenance in the Northeastern region of Nigeria.
2. The availability of domestic energy types vary from one place to the other, but fuelwood is more widely available compared to charcoal, kerosene, cooking gas, electricity and even agricultural residues.
3. The price changes of domestic energy between 1999 and 2005 are significant.
4. Changes in government policy most especially the removal of subsidies on energy, is the major cause of domestic energy price increases. This has exerted untold hardship on households and this in turn exerted pressure on forest resources in Northeastern Nigeria directly and indirectly.
5. Households in the study area expend an average of 9.4 percent of their hard earned monthly income on domestic energy.
6. Cost, availability and ease of use of energy type were the major determinants of the choice of domestic energy choice by households.
7. In the advent of incessant domestic energy price increases, households evolve and adopt coping strategies.
8. Adoption of coping strategies vary amongst households depending on the socio-economic characteristics of the households and settlement types.

9. The most popular coping strategy in the region was reduction in the rate of energy consumption followed by shifting from the more expensive household energy type to relatively lee efficient and cheaper one
10. The most popular alternative household energy in the Northeastern Nigeria is fuelwood.
11. The only fossil-based energy patronised by over 90 percent of households is kerosene, mainly used to fuel for hurricane lamps.
12. Due to the high poverty indices in this region shift from reliance on wood as major source of domestic energy is not feasible, thus, wood exploitation despite its inefficient method of utilisation will continue.

5.2 Conclusion

Access to clean and affordable energy to the poor is a major concern for sustainable development. Northeastern Nigeria houses a large section of the poor without access to clean energy. The social welfare of the people is directly linked to the energy sector through domestic energy supply and utilisation. However, the energy input to other sectors of the economy affect the people indirectly through the provision of industrial products, transport and other social services. Also, energy use has implications on the natural environment in terms of extraction of wood fuel, and reduction of carbon dioxide emission/absorption capacity of the vegetation.

Despite the years of strategies, planning and legislation, the Nigerian government could not fashion out an ecologically sustainable energy policy, a policy that both secures a steady supply of energy resources and ensures that energy production, distribution and

use, takes place in ways that protect the health of the ecosystem and ecological services on which all life depends.

The study shows that energy is significant for the livelihood of households among other needs in the region. It is evident that price increases of domestic energy were significant within the period of study (1999-2005). This ugly situation has exerted an untold hardship on households particularly the poor ones, this in turn negatively affected the forest resources in the region through the uncontrolled extraction of wood fuel resulting into massive deforestation (resource depletion), erosion and desertification in the region. Long term aspirations and investments of households in the region were curtailed by the shock of energy price rises. Households adopted some coping strategies to accommodate these price changes: switching to cheaper energy options, reduction in the overall consumption of the energy, reducing expenditure on non-energy needs and suspension of capital projects, and this resulted in increased vulnerability for all poor households.

One important implication of the findings is that as many households continue to use fuelwood, the increase in fuelwood harvesting would negatively impact on the economies of these communities. Biomass scarcity will worsen living conditions in poor neighbourhoods, by forcing residents to use lower-quality waste as cooking fuel. Rising demand for commercially traded fuelwood in towns and cities will put pressure on supplies in nearby rural areas. As rural supplies become monetised, traditional "free" sources will diminished. A solution to these environmental consequences requires that clean cooking fuels be made more accessible and affordable, and fuelwood and charcoal use be made sustainable.

The continuous use of biomass energy implies that more of the productive time will be used for the harvesting of wood and utilisation of wood thereby making the households remain in perpetual poverty

Finally, the public should be educated on environmental quality to improve people's understanding of safer and sustainable environmental exploitation as a way of ensuring that use of fuelwood and charcoal remains environmentally sustainable.

5.3 Recommendations

It is evident that biomass use for household energy is likely to continue in this region for some times to come, therefore, energy policies must be made to support ways of using wood more efficiently and sustainably; while creating necessary conditions for supplying of modern fuels to those who lack. In line with this, the following recommendations are therefore made;

1. There is urgent need for greater cooperation among Non-Governmental Organisations, private sector and government agencies to bring about the energy needs (modern energy services) and sustainable livelihoods for the urban poor and rural dwellers of northeastern Nigeria.
2. In the course of this study, it was observed that traditional energy conversion technologies in use were rudimentary, limited in capability and generally inefficient. This raises the need for the training and capacity building for the sustenance of energy conversion technologies of modern services, so as to enhance energy conservation, poverty alleviation, employment opportunities and expansion of rural markets.

3. Value-addition on biomass in form of bricked making is very much recommended.
4. Woodlot establishment should be encouraged by providing incentives to farmers intending to invest in woodlot.
5. Improve the efficient use of biomass through provision of improved fuelwood and charcoal stoves.
6. Attractive operational conditions should be given to would-be investors in rural energy supplies.
7. Reactivate the coal mines and improve distribution channels.
8. Effort should be made towards completing the hydroelectric power projects of Gembu and Plateau to boost power supply to the region.

5.4. Suggestion for Further Studies

This study aimed at identifying how price increases of domestic energy affects the day-to-day activities of households; how the changed behaviour of these households by means of coping strategy adoption affected domestic energy consumption pattern and the impact of this scenario on the general welfare of households in this region. Investigations could be carried out on the consumption and the production rate of these resources so as to strike a balance between consumption and production.

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APPENDIX I

QUESTIONNARES

SECTION A

1. Interviewer
2. State AD BA BO GO TA YO
   1 2 3 4 5 6
3. Town/Village……..
4. Sampling Point:…….
5. LGA:……
6. Gender of respondent (i) Male……. (ii) Female ……..
7. Ethnic Group:……
8. (i) Age…….

(ii) Marital Status M…….. S…… (iii)widowed……. (iv) Divorced……..

9. (i) No. of Children Male…….... Female……. No. of wife……
   (ii) Other members of the household (No)…….
10. Educational background : (i) None…….
    (ii) Primary…… (iii) Secondary…….. (iv) Tertiary…….
11. Income per year (N)
12. Eco-vegetation……
    Sahel…….. Sudan……..Guinea …….

SECTION B

13. Which of these domestic energy types do you patronise for cooking and other household uses?
    (i) Fire wood (ii) Charcoal (iii) Kerosene
    (iv) Cooking gas (v) Electricity (vi) Others (specify)
14. Considering the regularity of usage, rank the energy types you indicated in (14) in order of importance to your household
    1st 2nd 3rd 4th 5th
15. How many units of these domestic energy sources (14) do you use weekly?
    Fire wood ……bundles Kerosene…… gallons
    Gas …….cylinder Charcoal…….bags/sacks
    Electricity…… units Others(specify)
16. How much does the weekly consumption of this domestic energy cost you?
    (i) Fire wood……..(ii)Charcoal……(iii)Kerosene……
    (iv) Gas……..(v) Electricity……...
    (vi) Others……..

Rank the list of household needs provided in order of importance 5 being the most important and 1 least.

Food, ……Water,……Cooking Energy, ……..Shelter, …….Mobility……

17. What do you use these domestic energy types?
    (i) Firewood……Charcoal…….

(ii) Kerosene……Gas……

(iii) Electricity……..

18. Do you notice any seasonal differences in your household consumption of these domestic energy you mentioned in (13) above?

Yes…… No…….

19. If Yes, Why?…….. If No, Why?……...

20. What determines your choice of domestic energy? Rank them in order of relevance from 5 very relevant to 1 not relevant at all

(i) Prices (ii)Availability (iii)Convenience

(iv) Cultural believes (v)My Position in Society

21. What constraints your choice? Rank them 1 – 4 as in (21)

Costs…….Supply……..Income……..Convenience……

22. Given the choice, which of these energy types would you prefer to use and why?

……..

……..

……..

23. Assuming your income increases, would you change to another form of domestic energy? Yes……. No…….. Why?

……

24. How would you describe the price increases of domestic energy between 1999-2005?

(i) Very High (ii)High (iii)Moderate

(i) Low (v)Very Low

		1999	2000	2001	2002	2003	2004	2005
i.	Fire wood							
ii.	Charcoal							
iii.	Kerosene							
iv.	Gas							
v.	Electricity							
vi.	Others							

25. Rank the domestic energy in order of availability between 1999-2005 with 5 being most regularly available and 1 least available.

		1999	2000	2001	2002	2003	2004	2005
i.	Fire wood							
ii.	Charcoal							
iii.	Kerosene							
iv.	Gas							
v.	Electricity							
vi.	Others							

26. Indicate the prices of the given domestic energy types in the provided

		1999	2000	2001	2002	2003	2004	2005
i.	Fire wood							
ii.	Charcoal							
iii.	Kerosene							
iv.	Gas							
v.	Electricity							
vi.	Others							

27. In your opinion, are you satisfied with the supply situation of domestic energy in (26)? Yes…….. No……
Why?…….

28. What the source of supply of your domestic energy?
(i) Filling Station (ii) Black Market (iii) Dealers
(iv) From the Forest (v) Others

29. What has been the effect of price increases on your household consumption of the domestic energy?
(i) ……
(ii) ……
(iii) ……
(vi) ……

30. What are the consequences of the changes in quantities consumed on the general living standard of your household?
(i) ……
(ii) ……
(iii) ……
(vi) ……

31. What action do you take when the price of your favourite domestic energy skyrockets such that the usual money allocated for it will not get you enough of it?
(i) I go for cheaper alternatives.
(ii) I buy as much as the money can buy.
(iii)

32. If you were to go for cheaper alternatives, which of these domestic energy types would you go for?
(i) Fire wood (ii) Charcoal (iii) Kerosene (iv) Gas
(v) Electricity (vi) Others

SECTION C: Coping strategies: Tick in the appropriate column.

In a situation of high cost and scarcity of domestic energy, in order to stabilize my budget, the coping strategies I adopt include:

	Coping Strategies		
		No	Yes
1	I reduce the quantity of food cooked in my household.		
2	I cut expenditure on other household needs to cover up the increased cost of domestic energy. e.g. purchase of dresses		
3	I reduce the rate of use of domestic energy e.g. cooking once or twice a day instead of three times.		
4	I stop warming water for any use.		
5	I avoid foods that take long time to cook.		
6	I use solar energy to preserve/dry foodstuff in place of oven.		
7	I operate small scale business to get more money to acquire the domestic energy at its new price.		
8	I participate in as many ad-hoc jobs as possible to increase my income to enable me buy enough of my desired energy type		
9	I reduce the size of my family by sending away the dependents.		
10	I suspend some of my family obligations e.g. sending money to distant relations.		
11	I suspend my capital projects (e.g. building) to have enough money to buy domestic energy at its new price.		
12	I suspend the use of kerosene and gas to use a cheaper domestic energy like firewood until I have enough money to acquire it.		
13	I suspend the use of kerosene and gas to use electricity for domestic cooking.		
14	I supplement the use of kerosene and gas with fire wood.		
15	We stop cooking and eat in a restaurant.		
16	I hire out my labour		
17	I go about borrowing money from relatives to supplement my income.		
18	I join thrift group		
19	I keep domestic animals		
20	I collect forest products to sale		
21	I join cooperative society		
22	I engage in occasional transport business		

23	I trade in primary products (fruits, grains, vegetables)		
24	I do multiple cropping on my farm		
25	Brew local beer		
26	Craft making (Blacksmithing, carving, weaving)		
27	Hair dressing		
28	Use ox-drawn plough		
29	Food processing (Gari, rice etc)		
30	Catering services		
31	Skipping of meals		
32	Eating unconventional foods		
33	Prolonged breast feeding		

35. What are your recommendations/comments? ……

QUESTIONNAIRE FOR DOMESTIC ENERGY MARKETERS

1. Interviewer…….
2. State AD BA BO GO TA YO
   1 2 3 4 5 6
3. Town/Village……..
4. Sampling Point:…….
5. LGA:……
6. Gender of respondent (i) Male……. (ii) Female ……
7. Ethnic Group:……
8. (i) Age…….
(ii) Marital Status M…….. S…… (iii) widowed……. (iv) Divorced……..
9. (i) No. of Children Male…….. Female…….. No. of wife……
   (ii) Other members of the household (No)…….
10. Educational background : (i) None…… (ii) Primary…(iii) Secondary……..
    (iv) Tertiary…….
11. Income per year (N)
12. Eco-vegetation……
    Sahel…….. Sudan……..Guinea ……

13. What product do you sell?
    (i) Kerosene (ii) Cooking gas (iii) Fire wood
14. How long have you been in this business?
    (1) (2) (3) (4) (5) (6 or more years)
15. What is the sales unit of your product?
    (i) Kerosene …… /gallon
    (ii) Cooking gas……. /cylinder
    (iii) Fire wood……bundles
16. How do you get your supply?
    (i) From NNPC depot
    (ii) From independent marketers
    (iii) From sub dealers
    (iv) Fire wood depots
    (v) From the forest
17. How often do you get your supply?
    (i) Daily (ii) Weekly (iii) Monthly (iv) No specific regularity of supply
18. What is the regular quantity of your supply?
    (i) Kerosene……Litres
    (ii) Cooking gas……cylinders
    (iii) Fire wood…….. Bundles
19. What class of people patronizes you more?
    (i) Low income (ii) Middle income (iii) High income (iv) Peasants

20. What is the highest quantity of sale per individual that you have recorded during the following years?

1999	2000	2001	2002	2003	2004	2005

21 What is the lowest quantity of sales per individual can you remember in the following years?

1999	2000	2001	2002	2003	2004	2005

22. Have you noticed any changes in the rate of consumption of your product?
(i) Yes (ii) No

23. Record the changes against the years

	1999	2000	2001	2002	2003	2004	2005
Reduction							
Increase							

24. What do you think could have caused these changes in the consumption of the product you sell?

		99	00	01	02	03	04	05
i.	Increase in price of the product							
ii.	Availability of cheaper substitutes							
iii.	Low income level							
iv.	Reduction in purchasing power of the naira							

25. Before the recent price increase, what were your average sales per week?……...
26. What is your weekly sales after the price increases?……..
27. Do you know the substitutes of your products?
(i) Yes (ii) No

28. If yes, list these substitutes
(i) ……..
(ii) ……..
(iii) ……..
(iv) ……...
(v) ……...

QUESTIONNAIRES FOR COMMUNITY LEADERS

SECTIONS A

1. Interviewer ……..
2. State Borno Gombe Taraba
   1 2 3
3. LGA ……..
4. Town/Village ……..
5. Sampling Point (ward) ……..
6. Gender of respondent(i) Male…….. (ii) ……..
7. Ethnic Group:……..
8. (i) Age…….
9. (ii) Marital Status M…… S…… (iii) Widowed …… (iv) ……..
10. (i) No. of Children Male……. Female …… No. of wife ……..
    (ii) Other members of the household (No) ……
11. Educational background:
    (i) None….. (ii) Adult Education……(iii) Religious Education
    (iv) Primary …… (v) Secondary …… (vi) Tertiary ……..
12. Occupation……
13. Eco-vegetation……
    Sahel…… Sudan…… Guinea ……
14. What are the major sources of domestic energy in your area?
15. What will you attribute the choice of these domestic energy types by your subjects to?
    i. Cost/affordability of other sources
    ii. Availability
    iii. Ease of operation
    iv. Reliability
    v. Culture
16. Did the price changes of commercial domestic energy in the past six years affect the consumption pattern?
    Yes …… No……
17. If yes how?
    i. Increased consumption
    ii. Reduced consumption
18. What are the major means of livelihood of your subjects

QUESTIONNAIRE FOR FORESTRY OFFICIALS

SECTIONS A

1. Interviewer ……..
2. State Borno Gombe` Taraba
   1 2 3
3. LGA ……..
4. Town/Village ……..
5. Sampling Point (ward) ……
6. Gender of respondent(i) Male…….. (ii) ……..
7. Ethnic Group:……
8. (i) Age…….
9. (ii) Marital Status M…… S…… (iii) Widowed …… (iv) ……..
10. (i) No. of Children Male……. Female …… No. of wife ……..
    (ii) Other members of the household (No) ……..
11. Educational background:
    (i) None….. (ii) Adult Education……(iii) Religious Education
    (iv) Primary …… (v) Secondary …… (vi) Tertiary ……..
12. Occupation…….
13. Eco-vegetation…….
    Sahel…… Sudan……. Guinea……
14. What are the available sources domestic energy in your area of jurisdiction?
15. What are the estimate distribution of the above listed domestic energy sources by percentage in your area?
    i. Fuel wood
    ii. Charcoal
    iii. Coal
    iv. Gas
    v. Electricity
    vi. Agric residue
    vii. Others
16. Others to what can you attribute the selection of the preferred domestic energy source in your area?
    i. Cost/Affordability
    ii. Availability
    iii. Ease of operation
    iv. Reliability
17. Does this pattern of domestic energy use have any effect the fuel wood resources in your area?
    Yes …….. No ……
18. If yes how?
    i. Increased wood extraction
    ii. Increase in the price of fuel wood
    iii. Increase in the number of fuel wood marketers
19. How would you describe the relationship between domestic energy price changes in the past six years to wood extraction?

i. Directly proportional
ii. Inversely proportional

20. What is the percentage of forest cover in your area?
21. What consist of the forest cover by percentage
    i. Plantation
    ii. Forest Reserves
    iii. Game Reserves
    iv. Open forest
22. Were there deforestation intervention attempts in your area?
    Yes ……. No……
23. If yes, what was the nature of the intervention?
    i. Provision of improved fuel wood stoves at subsidized rates.
    ii. Establishment of fuel wood to woodlots
    iii. Distribution of kerosene/gas stoves
    iv. Sale of gas/kerosene stoves at subsidized prices.
24. Who sponsored the intervention programme?
    i. Government (Federal, state and Local Government)
    ii. Multilateral bodies
    iii. Individuals
    iv. Community
25. What is the percentage acceptance of intervention programme?
    (i) 1-25% (ii) 26-50% (iii) 51-75% (iv) 76 – 100%.
26. How was the programme sustained
    i. Community participation
    ii. Provision of incentives
27. To what would you ascribe deforestation in your area
    i. Fuel wood extraction
    ii. Expansion in agriculture
    iii. Urbanization
    iv. NWFP extraction
    v. All of the above
    vi. None of the above

APPENDIX II

Method of Domestic Energy Utilization

zone	Domestic Energy Type	Method of Utilization	Frequency	%
Sahel Urban	Fuelwood	Don't use	1	2.9
		Cooking/heating Light	32	94.1
			1	2.9
		Don't use		
	Charcoal	Cooking/heating	15	44.1
			19	55.9
		Don't use		
	Coal	Cooking/heating	34	100
			0	0.0
		Don't use		
	Kerosene	Cooking/heating	0	0.0
		Light	7	20.6
		Cooking & Light	27	79.4
			0	0.0
		Don't use		
	Electricity	Cooking/heating	0	0.0
		Light	0	0.0
		Light & Appl.	5	14.7
		Pressing	29	85.3
		Don't use		
	Cooking Gas	Cooking/heating	31	91.2
			3	8.8
		Don't use		
Per-Urban	Fuelwood	Cooking/heating	12	21.1
		Light	44	77.2
			1	1.7
		Don't use		
	Charcoal	Cooking/heating	54	94.7
			2	5.3
		Don't use		
	Coal	Cooking/heating	57	100
			0	0.0
		Don't use		
	Kerosene	Cooking/heating	3	5.3
		Light	7	12.3
		Cooking & Light	45	78.9
			2	3.5
		Don't use		
	Electricity	Cooking/heating	22	38.6
		Light	0	0.0
		Light & Appl.	19	33.3
			16	28.1
		Don't use		
	Cooking Gas	Cooking	57	`100
			0	0.0
		Don't use		
Rural	Fuelwood	Cooking/heating	0	0.0
		Light	30	100
			0	0.0

		Don't use		
	Charcoal	Cooking/heating	11	36.7
			19	63.3
		Don't use		
	Coal	Cooking/heating	30	100
			0	0.0
		Don't use		
	Kerosene	Cooking/heating	1	3.3
		Light	0	0.0
		Cooking & Light	28	93.3
			1	3.3
		Don't use		
	Electricity	Cooking/heating	13	43.3
		Light	1	3.3
		Light & Appl.	2	6.7
			14	46.7
		Don't use		
	Cooking Gas	Cooking/heating	29	96.7
			1	3.3
		Don't use		
Sudan Savannah Urban	Fuelwood	Cooking/heating	5	13.5
		Light	32	86.5
			0	0.0
		Don't use		
	Charcoal	Cooking/heating	25	67.6
		Pressing	8	21.6
			4	11.8
		Don't use		
	Coal	Cooking/heating	34	91.9
			3	8.1
		Don't use		
	Kerosene	Cooking/heating	5	13.6
		Light	18	48.6
			14	37.8
		Don't use		
	Electricity	Light	4	10.8
		Light/Elect.appl	3	8.1
			21	56.8
		Don't use		
		Cooking/heating	33	8.1
	Cooking Gas	Light	4	91.9
			0	0.0
Per-Urban		Don't use		
	Fuelwood	Cooking/heating	0	0.0
		Light	19	95.0
		Cooking/Light	1	5.0
			0	
		Don't use		
	Charcoal	Cooking/heating	2	10.0
		Pressing	18	90.0
			0	0.0
		Don't use		
	Coal	Cooking/heating	19	95.0
			1	5.0

		Don't use		
	Kerosene	Cooking/heating	1	5.0
		Light	15	75.0
			4	20.0
		Don't use		
	Electricity	Cooking/heating	5	25.0
		Light	1	5.0
		Cooking & Light	14	70.0
			0	
		Don't use		
	Cooking Gas	Cooking/heating	15	75.0
		Light	5	25.0
			0	0.0
Rural		Don't use		
	Fuelwood	Cooking/heating	0	0.0
		Light	20	100
			0	0.0
		Don't use		
	Charcoal	Cooking/heating	1	5.0
		Light	19	95.0
			0	0.0
		Don't use		
	Coal	Cooking/heating	19	95.0
		Don't use	1	5.0
	Kerosene	Cooking/heating	0	0.0
		Light	0	0.0
			20	100
		Don't use		
	Electricity	Cooking/heating	20	100
		Light	0	0.0
		Cooking & Light	0	0.0
			0	0.0
		Don't use		
	Cooking Gas	Cooking/heating	20	100
		Light	0	0.0
			0	0.0
Guinea Savannah		Don't use		
Urban	Fuelwood	Cooking/heating	2	3.3
		Light	58	96.7
			0	0.0
		Don't use		
	Charcoal	Cooking/heating	23	38.3
			37	51.7
		Don't use		
	Coal	Cooking/heating	60	100
			0	0.0
		Don't use		
	Kerosene	Cooking/heating	3	5.0
		Light	19	31.7
			38	63.3
		Don't use		
	Electricity	Cooking/heating	7	11.7
		Light	3	5.0
			50	83.3
		Don't use		

	Cooking Gas	Cooking/heating	52	86.7
		Light	8	13.3
			0	0.0
Per-Urban		Don't use		
	Fuelwood	Cooking/heating	0	0.0
		Light	37	100
			0	0.0
		Don't use		
	Charcoal	Cooking/heating	6	16.2
			31	83.8
		Don't use		
	Coal	Cooking/heating	37	100
			0	0.0
		Don't use		
	Kerosene	Cooking/heating	4	10.8
		Light	15	40.6
			18	46.6
		Don't use		
	Electricity	Cooking/heating	21	56.8
		Light	1	2.7
			15	40.5
		Don't use		
	Cooking Gas	Cooking/heating	36	97.3
		Light	1	2.7
			0	0.0
		Don't use		
	Fuelwood	Cooking/heating	0	0.0
		Light	39	100
			0	0.0
Rural		Don't use		
	Charcoal	Cooking/heating	0	0.0
			39	100
		Don't use		
	Coal	Cooking/heating	39	100
			0	0.0
		Don't use		
	Kerosene	Cooking/heating	1	2.6
		Light	2	5.1
			36	92.3
		Don't use		
	Electricity	Cooking/heating	21	53.8
		Light	0	0.0
		Cooking & Light	18	46.2
			0	0.0
		Don't use		
	Cooking Gas	Cooking/heating	38	97.4
		Light	0	0.0
			1	2.6

APPENDIX IIIA

Ranking of Coping Strategies in Sahel Savannah Zone

	Coping Strategies	Responses		
		Fr	%	Rk
1	I reduce the quantity of food cooked in my household.	20	16.6	20
2	I cut expenditure on other household needs to cover up the increased cost of domestic energy. e.g. purchase of dresses	49	40.8	5
3	I reduce the rate of use of domestic energy e.g. cooking once or twice a day instead of three times.	34	28.3	14
4	I stop warming water for any use.	48	40.0	7
5	I avoid foods that take long time to cook.	36	30.0	13
6	I use solar energy to preserve/dry foodstuff in place of oven.	74	50.8	1
7	I operate small scale business to get more money to acquire the domestic energy at its new price.	11	9.1	25
8	I participate in as many ad-hoc jobs as possible to increase my income to enable me buy enough of my desired energy type	44	36.6	9
9	I reduce the size of my family by sending away the dependents.	12	10.0	25
10	I suspend some of my family obligations e.g. sending money to distant relations.	44	36.6	9
11	I suspend my capital projects (e.g. building) to have enough money to buy domestic energy at its new price.	57	47.5	4
12	I suspend the use of kerosene and gas to use a cheaper domestic energy like firewood until I have enough money to acquire it.	65	61.6	2
13	I suspend the use of kerosene and gas to use electricity for domestic cooking.	30	25.0	16
14	I supplement the use of kerosene and gas with fire wood.	61	54.2	3
15	We stop cooking and eat in a restaurant.	13	10.8	23
16	I hire out my labour	19	15.8	21
17	I go about borrowing money from relatives to supplement my income.	27	22.5	17
18	I join thrift group	33	27.5	15
19	I keep domestic animals	49	40.0	5
20	I collect forest products to sale	21	17.5	19
21	I join cooperative society	4	3.3	30
22	I engage in occasional transport business	12	10.0	26

23	I trade in primary products (fruits, grains, vegetables)	48	40.0	7
24	I do multiple cropping on my farm	44	36.6	9
25	Brew local beer	2	1.6	33
26	Craft making (Blacksmithing, carving, weaving)	5	4.1	29
27	Hair dressing	22	18.3	18
28	Use ox-drawn plough	17	14.2	22
29	Food processing (Gari, rice etc)	4	3.3	30
30	Catering services	3	2.5	32
31	Skipping of meals	9	7.5	27
32	Eating unconventional foods	13	10.8	23
33	Prolonged breast feeding	8	6.8	28

APPENDIX IIIB

Ranking of Coping Strategies in Sudan Savannah Zone

	Coping Strategies	Responses		
		Freq.	%	Rk
1	I reduce the quantity of food cooked in my household.	44	57.1	5
2	I cut expenditure on other household needs to cover up the increased cost of domestic energy. e.g. purchase of dresses	39	50.6	8
3	I reduce the rate of use of domestic energy e.g. cooking once or twice a day instead of three times.	56	72.7	1
4	I stop warming water for any use.	31	40.2	14
5	I avoid foods that take long time to cook.	41	53.2	7
6	I use solar energy to preserve/dry foodstuff in place of oven.	32	42.9	12
7	I operate small scale business to get more money to acquire the domestic energy at its new price.	38	43.3	9
8	I participate in as many ad-hoc jobs as possible to increase my income to enable me buy enough of my desired energy type	19	24.6	21
9	I reduce the size of my family by sending away the dependents.	21	27.2	19
10	I suspend some of my family obligations e.g. sending money to distant relations.	42	54.5	6
11	I suspend my capital projects (e.g. building) to have enough money to buy domestic energy at its new price.	54	70.1	2
12	I suspend the use of kerosene and gas to use a cheaper domestic energy like firewood until I have enough money to acquire it.	34	44.1	10
13	I suspend the use of kerosene and gas to use electricity for domestic cooking.	52	67.5	3
14	I supplement the use of kerosene and gas with fire wood.	27	35.1	16
15	We stop cooking and eat in a restaurant.	16	20.7	24
16	I hire out my labour	21	27.2	19
17	I go about borrowing money from relatives to supplement my income.	28	36.3	15
18	I join thrift group	45	58.4	3
19	I keep domestic animals	27	35.8	16
20	I collect forest products to sale	33	42.8	12
21	I join cooperative society	15	19.4	25
22	I engage in occasional transport business	22	28.5	18

23	I trade in primary products (fruits, grains, vegetables)	37	48.0	10
24	I do multiple cropping on my farm	12	15.5	27
25	Brew local beer	19	24.6	21
26	Craft making (Blacksmithing, carving, weaving)	12	15.5	27
27	Hair dressing	13	16.6	26
28	Use ox-drawn plough	12	15.5	27
29	Food processing (Gari, rice etc)	6	7.8	33
30	Catering services	19	24.6	21
31	Skipping of meals	7	9.0	30
32	Eating unconventional foods	7	9.0	30
33	Prolonged breast feeding	7	9.0	30

APPENDIX IIIC

Ranking of Coping Strategies in Guinea Savannah zone

	Coping Strategies	Responses		
		Freq.	%	Rk
1	I reduce the quantity of food cooked in my household.	65	47.7	14
2	I cut expenditure on other household needs to cover up the increased cost of domestic energy. e.g. purchase of dresses	93	68.3	3
3	I reduce the rate of use of domestic energy e.g. cooking once or twice a day instead of three times.	80	58.8	7
4	I stop warming water for any use.	69	50.7	13
5	I avoid foods that take long time to cook.	75	55.1	10
6	I use solar energy to preserve/dry foodstuff in place of oven.	73	53.7	11
7	I operate small scale business to get more money to acquire the domestic energy at its new price.	77	56.6	8
8	I participate in as many ad-hoc jobs as possible to increase my income to enable me buy enough of my desired energy type	91	66.9	5
9	I reduce the size of my family by sending away the dependents.	28	20.5	32
10	I suspend some of my family obligations e.g. sending money to distant relations.	63	46.3	16
11	I suspend my capital projects (e.g. building) to have enough money to buy domestic energy at its new price.	84	61.7	6
12	I suspend the use of kerosene and gas to use a cheaper domestic energy like firewood until I have enough money to acquire it.	96	70.5	1
13	I suspend the use of kerosene and gas to use electricity for domestic cooking.	36	26.4	28
14	I supplement the use of kerosene and gas with fire wood.	96	70.5	1
15	We stop cooking and eat in a restaurant.	32	23.5	29
16	I hire out my labour	46	33.8	22
17	I go about borrowing money from relatives to supplement my income.	38	27.9	25
18	I join thrift group	64	47.0	15
19	I keep domestic animals	92	67.7	4
20	I collect forest products to sale	59	43.3	17
21	I join cooperative society	57	41.9	18
22	I engage in occasional transport business	57	41.9	18

23	I trade in primary products (fruits, grains, vegetables)	73	53.6	11
24	I do multiple cropping on my farm	77	56.6	8
25	Brew local beer	27	19.8	32
26	Craft making (Blacksmithing, carving, weaving)	55	40.4	20
27	Hair dressing	27	19.8	33
28	Use ox-drawn plough	32	23.5	29
29	Food processing (Gari, rice etc)	44	32.3	23
30	Catering services	30	22.0	31
31	Skipping of meals	38	27.9	25
32	Eating unconventional foods	48	35.2	21
33	Prolonged breast feeding	40	29.4	24

APPENDIX IIID

PERCENTAGE ADOPTION OF COPING STRATEGIES IN NORTHEASTERN REGION

Coping strategies	YES	NO
CS1_ Reduced quantity of food cooked in the house **(RDF)**	68.3	31.7
CS2_ Cutting expenditure on other household needs to cover cost of domestic energy (**EC)**	77.8**	22.2
CS3_ Reduce rate of domestic energy use **(RRE**	79.6***	20.4
CS4_ Stop warming water for any use (**SBW**	71.3	28.7
CS5_ Avoid foods that take long time to cook (**ALTF**	73.1	26.9
CS6_ Use solar to preserve/dry food in place of oven (**USE**)	71.0	29.0
CS7_ I operate small scale business to get more money to buy required domestic energy at its new price (OSCB)	65.6	34.4
CS8_ I participate in many ad-hog jobs as possible to increase my income to enable me buy enough of my desired energy type (**DMJ**)	67.7	32.3
CS9_ I reduce the size of my family (**RFS**)	36.2	63.8
CS10_ I suspend some of my family obligations like sending money to distant relations (**SSFO**	70.7	29.3
CS11_ I suspend my capital projects like buildings to have enough money to buy domestic energy at its new price (**SCP**)	75.4*	24.6
CS12_ I suspend the use of kerosene and gas to use cheaper domestic energy like wood until I have enough money to acquire it (**FW**)	75.4*	24.6
CS13_ I suspend the use of kerosene and gas to use electricity for domestic energy (**ELEC**	50.6	49.4
CS14_ I supplement the use of kerosene and gas with fire wood (**SKGW**)	59.0	41.0
CS15_ We stop cooking and eat in restaurants (**EIR**)	25.4	74.6
CS16_ I hire out my labour (**WHL**	40.1	59.9
CS_17 I go about borrowing money from relatives to supplement my income (**BMFR**)	53.0	47.0
CS18_ I join thrift group (**JTG**	63.5	36.5
CS19_ I keep domestic animals (**KDA**	66.5	33.5
CS20_ I collect forest products to sale (**CNTP**	54.5	45.5
CS21_ I join co-operative society (**JCS**	43.1	56.9
CS22_ I engage in occasional transport business (**EOTB)**	40.4	59.6
CS23_ I trade in primary products (fruits, grains , vegetables etc.) (**TPP**)	57.5	42.5
CS24_ I do multiple cropping on my farms (**DMC**)	45.8	54.2
CS25_ I brew local beer (**BLB**)	26.9	73.1
CS26_ Craft making (Blacksmithing, carving, weaving, etc.) (**MC**	17.4	82.6
CS27_ Hair dressing (**HDB**)	18.9	81.1
CS28_ Use ox-drawn plough (**UAP**)	23.7	76.3
CS29_ Food processing (Gari, rice, etc.) (**FP**)	20.4	79.6
CS30_ Catering services (**CS**)	25.4	74.6
CS31_ Skipping meals (**SM**	29.0	71.0
CS32_ Eat unconventional foods (**EUF**)	28.7	71.3
CS33_ Prolonged breast feeding (**PBF**	18.6	81.4

***_ 1st most adopted coping strategy, **_ 2nd most adopted coping strategy, 2rd most adopted

APPENDIX IVA

Determinants of Domestic Energy choice by Households in Sahel Savannah zone

Variables	Location	Never true	%	Rarely True	%	Often True	%	Regrly true	%	Always True	%
Cost/affordability	Urban	0	0.0	0	0.0	0	0.0	8	6.6	26	21.5
	semi-urban	1	0.8	0	0.0	5	4.1	10	8.3	40	33.1
	Rural	0	0.0	1	0.8	6	5.0	11	9.1	12	9.9
Availability	Urban	0	0.0	1	0.8	4	3.3	13	10.7	16	13.2
	semi-urban	0	0.0	1	0.8	5	4.1	20	16.5	31	25.6
	Rural	0	0.0	0	0.0	2	1.7	16	13.2	12	9.9
Ease of operation	Urban	9	7.4	3	2.5	8	6.7	6	4.9	8	6.6
	semi-urban	14	11.5	6	4.9	14	11.5	20	16.5	3	2.5
	Rural	9	7.4	3	2.5	14	11.5	4	3.3	0	0.0
Cultural belief	Urban	15	12.3	7	5.7	6	4.9	2	1.7	4	3.3
	semi-urban	18	4.8	19	15.6	13	10.7	3	2.5	4	3.3
	Rural	14	11.5	10	8.2	6	4.9	0	0.0	0	0.0
Societal Influence	Urban	18	14.8	3	2.5	8	6.6	3	2.5	2	1.7
	semi-urban	22	18.2	11	9.1	15	12.3	2	1.7	7	5.7
	Rural	14	11.5	11	9.1	4	3.3	1	0.8	0	0.0
Reliability of energy type	Urban	18	14.8	4	3.3	6	4.9	5	4.1	1	0.8
	semi-urban	17	14.0	8	6.6	14	11.5	16	13.2	2	1.7
	Rural	12	9.9	2	1.7	12	9.9	4	3.3	0	0.0
Type of residence	Urban	21	17.4	4	3.3	5	4.1	2	1.7	2	1.7
	semi-urban	21	17.4	21	17.4	8	6.5	5	4.1	2	1.7
	Rural	15	12.3	12	9.9	2	1.7	1	0.8	0	0.0

Source: Field survey, 2006

APPENDIX IVB

Determinants of Domestic Energy choice by Households in Sudan savannah zone

Variables	Location	Never true	%	Rarely True	%	Often True	%	Regularly true	%	Always True	%
Cost/affordability	Urban	1	1.3	2	2.6	0	0.0	1	1.3	33	42.9
	semi-urban	7	9.1	1	1.3	6	7.8	3	3.9	3	3.9
	Rural	0	0.0	0	0.0	1	1.3	7	9.1	12	15.6
Availability	Urban	5	6.5	2	2.6	6	7.8	15	19.5	9	11.7
	semi-urban	6	7.8	1	1.3	10	13.0	2	2.6	1	1.3
	Rural	0	0.0	0	0.0	1	1.3	6	7.8	13	16.9
Ease of operation	Urban	13	16.9	2	2.6	9	11.7	6	7.8	7	9.1
	semi-urban	0	0.0	14	18.2	2	2.6	2	2.6	2	2.6
	Rural	3	3.9	7	9.1	5	6.6	3	3.9	2	2.6
Cultural belief	Urban	31	40.3	3	3.9	3	3.9	0	0.0	0	0.0
	semi-urban	5	6.5	13	16.9	1	1.3	0	0.0	1	1.3
	Rural	7	9.1	6	7.8	4	5.2	3	3.1	0	0.0
Societal Influence	Urban	21	27.3	8	10.4	4	5.2	1	1.3	3	3.9
	semi-urban	3	3.9	17	22.1	0	0.0	0	0.0	0	0.0
	Rural	12	15.6	3	3.9	3	3.9	1	1.3	1	1.3
Reliability of energy type	Urban	16	20.8	5	6.5	12	15.6	3	3.9	1	1.3
	semi-urban	1	1.3	4	5.2	0	0.0	15	19.5	0	0.0
	Rural	15	19.5	3	3.9	2	2.6	0	0.0	0	0.0
Type of residence	Urban	28	2.6	3	3.9	3	3.9	1	1.3	2	36.4
	semi-urban	2	2.6	2	2.6	0	0.0	3	3.9	13	16.9
	Rural	14	18.2	2	2.6	2	2.6	0	0.0	2	2.6

Source: Field survey, 2006

APPENDIX IVC

Determinants of Domestic Energy choice by Households in Guinea Savannah zone

Variables	Location	Never true	%	Rarely True	%	Often True	%	Regularly true	%	Always True	%
Cost/affordability	Urban	1	0.7	4	2.9	5	3.7	9	6.6	41	30.2
	semi-urban	1	0.7	2	1.5	4	2.9	10	7.4	20	14.7
	Rural	0	0.0	4	2.9	12	8.8	12	8.8	11	8.1
Availability	Urban	0	0.0	2	1.5	5	3.7	27	19.9	26	19.1
	semi-urban	1	0.7	3	2.2	8	5.9	10	7.4	15	11.0
	Rural	0	0.0	2	1.5	20	14.7	12	8.8	5	3.7
Ease of operation	Urban	8	5.9	5	3.7	20	14.7	12	8.8	16	11.0
	semi-urban	4	2.9	12	8.8	6	4.4	4	2.9	11	8.1
	Rural	4	2.9	19	14.0	7	5.1	3	2.2	6	4.4
Cultural belief	Urban	44	32.4	11	8.1	2	1.5	3	2.2	9	0.0
	semi-urban	16	13.2	8	5.8	3	2.2	3	2.2	5	3.7
	Rural	29	21.3	1	0.7	4	2.9	2	1.5	3	2.2
Societal Influence	Urban	33	24.3	16	11.8	6	4.4	3	2.2	2	1.5
	semi-urban	26	19.1	3	2.2	3	2.2	3	2.2	2	1.5
	Rural	24	17.6	2	1.5	4	2.9	6	4.4	3	2.2
Reliability of the energy type	Urban	30	22.1	11	8.1	7	5.1	9	6.6	3	2.2
	semi-urban	25	18.4	3	2.0	6	4.4	1	0.7	2	1.5
	Rural	26	19.1	2	1.5	10	7.4	1	0.7	0	0.0
Type residence	Urban	35	25.7	12	8.8	7	5.1	3	2.2	2	25.7
	semi-urban	27	19.9	6	4.4	3	2.2	0	0.0	1	0.7
	Rural	25	18.4	4	2.9	4	2.9	1	0.7	5	3.7

Source: Field survey, 2006