ATPS Working Paper No. 25

Domestic Energy Situation in Nigeria: Technological Implications and Policy Alternatives

Olabisi I. Aina works at the Department of Sociology and Anthropology, Obafemi Owolowo University, Ile Ife, Nigeria

Published by the African Technology Policy Studies Network,
P. O. Box 10081, 00100 General Post Office, Nairobi, Kenya.

Edited, typeset and designed by Magayu K. Magayu,
School of Journalism, University of Nairobi,
P. O. Box 30197 Nairobi, Kenya

Printed by: Ideas & Places,
tel: 742867, email: wcauri@yahoo.com

ISBN 996-916-62-8

African Technology Policy Studies Network (ATPS)

ATPS aims to improve the quality of technology policy decision-making in Sub-Saharan Africa and to strengthen the region's institutional capacity for the management of technological development. This goal is to be achieved through a combination of research, and dissemination efforts, training initiatives and linkages targeted to policy makers and research end-users.

ATPS comprises a network of multidisciplinary researchers in 15 African countries, namely, Botswana, Ethiopia, Ghana, The Gambia, Kenya, Lesotho, Liberia, Malawi, Nigeria, Sierra Leone, Swaziland, Tanzania, Uganda, Zambia and Zimbabwe. It is jointly funded by the International Development Reasearch Centre (IDRC), the Carnegie Corporation of New York and the Rockefeller Foundation.

The vision of ATPS is to become a *centre of excellence* and the brokerage link between science and technology policy researchers and technology policy-makers and implementers, and to become a *centre of reference* on key issues of technology policy in the Sub-Saharan Africa region. The ATPS mission is to improve human and institutional capacity for technology policy formulation, implementation, research, analysis, assessment, monitoring, evaluation and dialogue.

The specific objectives of ATPS are to:

(a) generate a critical mass of the knowledge for strengthening policy making and for identifying and assessing the impact on past and present policy on technological change and its consequences for development;
(b) build a continuous interactive process of knowledge diffusion by fostering linkages among and between researchers researchers and the private sector, policy-makers and other end-users; and
(c) disseminate and encourage utilization of research results through publications, a biennial international conference, dissemination seminars, and policy round tables.

ATPS provides modest research grants to individuals and institutions to carry out research on issues of science and technology policy in Sub-Saharan Africa. The research results are disseminated to policy-makers and other end-users through reports, books, journals, workshops, conferences and the internet.

Dr. Osita Ogbu
Executive Director

Table of Contents

Chapter One

Introduction to the Domestic Energy Situation in Nigeria

Background

Global, regional and national data on the extent to which human health and well being have been affected by changes in the human environment, particularly with reference to air and water pollution in the last two decades, present a gruesome picture. This situation is further compounded by the domestic energy crisis presently affecting most developing nations, including oil-producing countries like Nigeria. The micro impact of the domestic energy crisis and its implications for technology use and innovations has largely been neglected as a research and policy area. This study documents access to technology and technological innovations in the domestic energy sector in Nigeria.

The world's primary energy supply sources are hydro-electricity traditional biomass (fuelwood, crop residues and dung, among others), and renewable energy such as alcohol, bagasse, biogas, geo-thermal, small hydro, solar, wind and ocean thermal (Bernard, 1995). In Nigeria, the main energy sources are oil, gas, coal, wood and hydro-electricity. Nigeria has four oil refineries, two at Port Harcourt, one at Warri and another in Kaduna. The refined products are used in industries and for domestic purposes. Although the country has huge gas reserves, these are not judiciously exploited. Much of the gas found in association with oil is flared.

Before the petroleum era, most of the country's generating plants were fuelled by coal, while wood served as a major source of domestic energy, especially in the rural areas. The construction of the Kainji dam between 1964 and 1968 marked the beginning of a large-scale development of hydro-electricity programme in the country. Later, Jebba, and Shiroro dams were added.

The economic crisis of the mid 1980s rendered useless the gains of the 70s. Many reverted to the use of the fuel wood because of sudden increase in the prices of kerosene, gas, and electricity. A survey carried out by FAO in Nepal (1986), showed that over 94 percent of households surveyed used fuel wood and twigs. In Nigeria, many families have gone back

to the use of the fuelwood owing to high prices or scarcity of kerosene and liquefied gas (*Guardian* newspaper, April 19, 1994, pp. 12; *The Daily Times*, January 25, 1995, pp. 12). The scarcity of kerosene in particular has resulted in hoarding, adulteration and black marketeering. Adebayo (1995) notes that 50 residential and commercial houses at Somolu in Lagos had fire outbreaks in November, 1994. This has been a common occurrence across the country. Also, despite the abundance of sunshine across the country, solar energy is yet to be tapped.

Statement of the research problem

The process of technological development in Nigeria was predicated on the strategy of technology transfer. The economic base for attracting investors, financing technological and industrial development was almost entirely dependent on oil earnings (Dennis, 1984). Apart from this, the supporting environment for Nigeria's projected industrial take-off is also practically reliant on the functioning of the Nigerian petroleum industry. Technology, be it in the areas of health, transportation, communications, education or at the domestic front should be seen as more than a part of a national industrialisation programme. It is also not solely to achieve international competitiveness. The chief end of technologies is to contribute to the growth of individual and national productivity, to improve the standards of living of people, while enabling them to cope with everyday demands.

The current fuel crisis, has its origin in the dependence on both high technology as well as excessive reliance on a depleting resource. Activities ranging from the supply of electrical power to basic survival needs of the populace have been affected, impinging dramatically on the quality of life of almost every citizen.

In discussing technological policy implications in the promotion of small enterprise, Wangwe (1993) argues for the possibilities of blending new technologies with traditional technologies. Biotechnology applications to some African fermented foods like Kaffir beer, Nigerian ogi and gari and cloning of tea in Malawi have been reported as promising cases (Wangwe, 1993, citing Bhalla et al., 1984). Furthermore, he notes that literature suggests that photovoltaic technology is a viable option for providing electricity in the rural areas of developing countries to be used in water pumping, refrigeration, telecommunications, lighting and multipurpose systems (Stevens, 1988 cited in Wangwe, 1993). In the context of the Nigerian oil crises, however, such technological developments are hardly explored. The innovations revolve around the resurrection of semi-discarded traditional technologies and their modification for modern use. The imperatives are not for advancement but for survival. Such survival imperatives are in no way unique to Nigeria. The African continent is currently racked by problems of poor economic growth, balance of payments problems, a decline in overall productivity, and political authoritarianism (Gaidzanwa, 1993). This has resulted in appallingly high levels of human suffering and degradation, and closely tied to this, are problems of insufficient energy supplies, technological retrogression and a sharp decline in the quality of life.

The domestic fuel crisis facing Nigeria, the technological innovations and survival strategies of the people and the impact of all this provide valuable lessons for much of Africa and indeed the developing world.

Rationale for the Study

Although the Nigerian government established an Energy Commission in 1987 with the sole responsibility of co-ordinating the activities of NGOs and government agencies in charge of electricity generation, petroleum production, coal production and gas supply, the agencies continue to operate without the necessary linkages (Oladosu, 1994). As it is, the requisite framework to address household energy issues is lacking, while the issue of the fuelwood (which provides over 80 percent of household energy consumption) is yet to be addressed by government policy decision-makers. To make the necessary policy decisions on the current domestic energy crisis in the country, it is important to know the extent of the problem, the choices of domestic energy sources and technologies available, preferred technology choices, and the factors which determine technology choice in domestic energy use.

This study addresses the following research questions: What technological innovations exist in the domestic energy sector in Nigeria? Are these innovations efficient, accessible and affordable? What are the people's preference - local or imported technologies? What technology policies exist in the domestic energy sector in Nigeria? Are these policies effective and appropriate? What alternative policies can be formulated to develop technological capabilities in the domestic energy sector in the country? Can Nigeria learn any lessons from the strategies of other African countries, for example Kenya?

Research Objectives

The broad objective of the study is to carry out research to document the level and types of technological capability in the domestic energy sector in Nigeria, for the purpose of technology policy planning. The specific objectives are:

i) To document affordability and access to technology in the domestic energy sector, highlighting recent technological innovations and user preferences resulting from the domestic energy crisis;

ii) To highlight the human profile of technology use in the domestic energy sector (i.e. the main actors in terms of innovations, and decisions on use, and the users' socio-economic characteristics);

iii) To examine the socio-economic implications of change in technology use in the domestic energy sector following the energy crisis;

iv) To investigate the policy implications of the domestic energy situation on technology use and innovations; and

v) To document the energy situation in another Africa state with a more efficient domestic energy policy and programme (e.g. Kenya) and the possible lessons Nigeria could learn from it.

Chapter Two

Literature Review

Energy crises, with their attendant social, economic, and political consequences are not new phenomena in the international scene. There has been tremendous academic interest in oil politics and the causes and consequences of energy-related crises. The impact of the 1973 oil war, for instance, motivated the more advanced countries of the West to seek alternative energy sources. Important substitutes for oil, systematically researched and developed in these countries include tar sands, heavy oils, coal and nuclear power, and wind energy conversion, among others (Nead, 1986 cited in Looney, 1991). Hampered by economic limitations, technological and leadership inadequacies and other constraints, the Less Developed Countries (LDCs) have not provided such a systematic response.

Domestic energy in the Third World is largely sourced from biomass (i.e. fuelwood, charcoal and other biofuels such as animal and crop residue). Although electricity production, especially from hydro sources, and liquefied natural gas has increased over the years (World Resources, 1986), it is found that such commercial energy sources and equipment are generally unaffordable or inaccessible to the poor who comprise over 80 percent of the Third World population. Thus, fuelwood continues to be the most popular energy source for many poor countries (Cecelski, 1985).

In many African countries, Nigeria included, fuelwood provides over 80 percent of energy used (Courier, 1986). But the use of fuelwood has been found to be detrimental to socio-economic life in Third World nations. One of the consequences of over-dependence on fuelwood is deforestation. Trees are cut indiscriminately to meet basic needs of the teaming population (Oppong, 1992; and Ardayfio-Schandorf, 1993). Ardayfio-Schandorf (1993) argue that besides demographic factors, others include inequality in access to resources, change from subsistence to large-scale commercial farming and the gradual collapse of the traditional resource management system. All of these have further compounded the growing rate of deforestation in the Third World.

Many other activities contribute to rapid depletion of fuelwood. Some of these are wood-based activities such as fencing and house construction. Also, many income-generating

activities of women in the informal sector use large quantities of wood for energy. According to Courier (1986), 90 percent of Tanzania's industrial fuel comes from wood, while firewood is needed in large quantities to smoke fresh fish in many West African countries.

Urban and rural dwellers continue to compete for wood (Haile, 1989; and Ardayfio-Schandorf, 1993). Oppong (1992) notes that an estimated 112 million Africans lived in a situation of acute fuel wood scarcity in 1980.

This figure was expected to have more than doubled by year 2000. Thus, Oppong opined, "poor families may not pay cash for fuel but they often have to give valuable labour time in return for use of fuel available and may even have to enter into exploitative wage labour relationships."

Chapter Three

Theoretical and Conceptual Framework

Explanations of the issues raised in this study are entrenched in the political economy framework. The political economy model focuses on how political and economic forces help to shape the contexts within which men and women make alternative choices among competing forces of development. This model takes into account macro level factors such as government economic and energy policies and the social implications of these. For example, following the economic policies of the mid-1980s, which culminated in the structural adjustment programmes in Nigeria, was a general downturn in social development programmes. Cuts in government budgetary allocations to social services left the social sector in the doldrums. The dramatic changes culminated in remarkable changes in the rights, incomes, and benefits for the people. This is true because economic policy reforms are always accompanied by accelerated 'open' inflation, without equivalent change in people's earnings or economic potential under SAPs. SAPs thus imposed considerable hardships on people, while they sometimes stifled economic and technical progress. It is in this respect that the Social Dimension of Adjustment (SDA) project was launched as a joint project of the United Nations Development Programme's (UNDP) regional programme for Africa, the African Development Bank, and the World Bank (World Bank, 1990). The major objective of SDA was to integrate poverty reduction policies and programmes into development plans in the era of SAPs.

Some sectors of the economy have however recorded positive developments, especially in improvement of demands for locally produced goods and technical inputs. An example is the domestic energy sector which has witnessed increased demand for locally, fabricated technical inputs. Unfortunately, the fall of the naira not only made local technology expensive but also less competitive.

The political economy also helps to explain the problems of energy pricing in the country. Although there is strong economic basis for raising the price of domestic energy in Nigeria, there is a strong resistance to phasing out subsidies in the sector. One of the major elements of the economic adjustment programmes is that scarce national resources should be allocated more efficiently so as to increase the overall productive efficiency. SAP policies have failed

to meet expected outcomes. The financial sector alone recorded positive performance while the economy stagnated or declined. The value of the naira fell while the earning potential of the people dwindled. Worse, while the ordinary Nigerian is adopting belt-tightening measures and greater prudence, public officers are involved in utter profligacy. No wonder then that there is a public outcry against subsidy phase-out, especially in the energy sector. The contradictions in the political economy continue to lead to contradictions in market mechanisms, and the reign of the 'black' market.

This background helps to explain changes in the domestic energy sector, and trends in technology development. The study however does not assume homogeneity in the ways people experience the impact of the political economy. Rather, factors such as gender, geographical location, and social placement in society interplay in a special way to determine the impact of the structure of the political economy on social realities.

However, to analyse technological capability building in the domestic energy sector, the study borrows from the work of Ernst, Myeltka, and Ganiatsos (1994). Although technological capability in the domestic energy sector is closely tied to the prevailing political economy, it is a process by itself which must be understood. This process will be understood within in the light of:

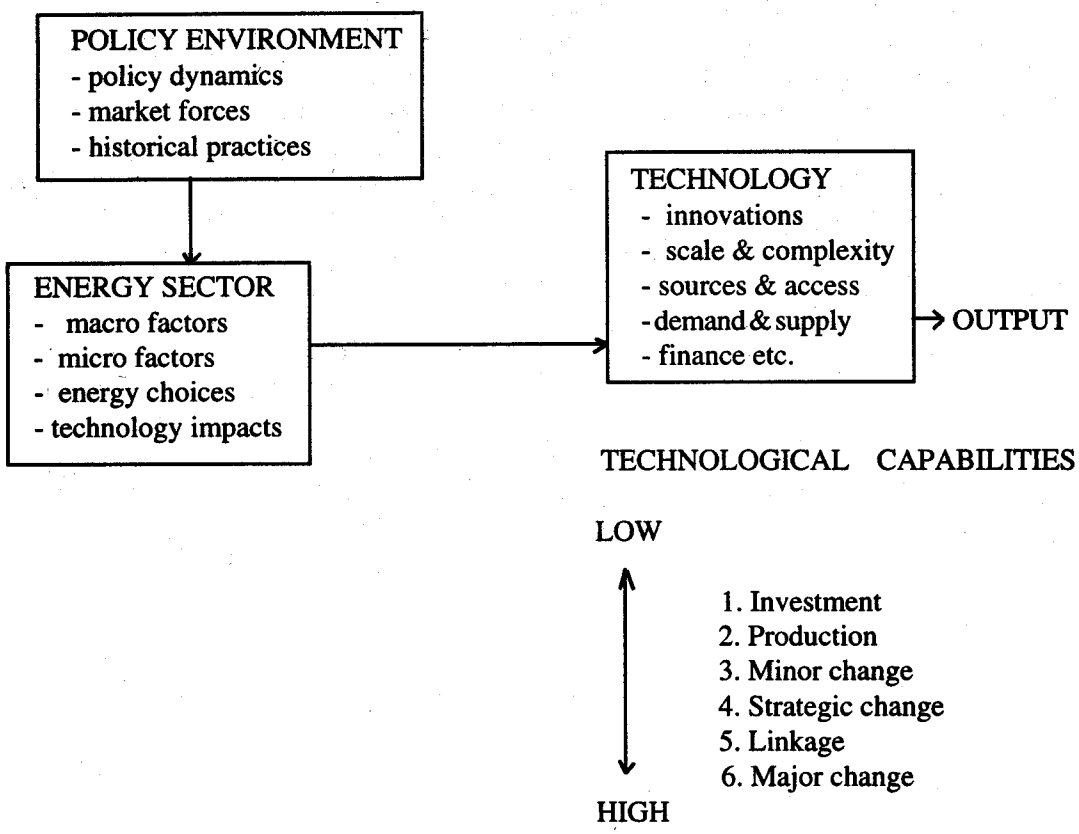
- investment capability;
- production capability;
- linkage capability
- minor change capability;
- strategic market capability; and
- major change capability.

Study Assumptions and Propositions

The problem statement and the subsequent theoretical explanations given for this problem led to the following study assumptions:

1. That a series of technological innovations have been developed in the domestic energy sector in Nigeria to cope with the energy demands in homes;
2. Choice of technologies in the domestic energy sector varies depending on ecological zones, rural or urban locations, and the socio-economic status of the respective families.
3. That the choice of technologies in the domestic energy sector has altered drastically because of poor access to energy choices.
4. That because of the economic hardships, most people will likely prefer domestic energy technology that is cheap and less efficient to technology which is expensive and highly efficient.

Figure 1: Conceptual Framework



Key Concepts

Technology is used here to mean both the method and equipment used in the domestic energy sector.

Domestic energy consumption pattern as a concept includes various ways in which household members use domestic energy sources. The ways include cooking, ironing, generating power for motor machines, and frequency of use.

Choice of technologies refers to choice of fuel and equipment.

Domestic energy situation refers to costs, availability, affordability and suitability of domestic energy sources and equipment.

Technological innovations are new methods and equipment in the domestic energy sector. They are either products of indigenous knowledge or patents by local or foreign engineers and are therefore results of modern science or technical inventions.

Investment capability is used in this study to mean assets and enabling environment for the development of appropriate technology for the domestic energy sector. This is explicable in macro and micro level structures and includes the activities of local fabricators and other sources of technological innovations in the sector.

Production capabilities refers to knowledge and skills used in achieving technical

innovations in the domestic energy sector, and the ability to sustain the innovations.

Linkage capabilities refers to ability to adapt indigenous knowledge to modern usage and the ability to adapt foreign technology to local needs.

Minor change capability is the ability to improve and adapt indigenous technology in the domestic energy sector to suit modern tastes.

Strategic marketing capability is the ability to meet customers needs, and create new markets for technical innovations in the domestic energy sector.

Major change capability is the extent to which research and development capabilities have resulted in new technologies in the domestic energy sector, and the role of tertiary institutions in this.

Chapter Four

Research Methodology

Study Locations

Field studies were carried out both in Nigeria and Kenya. Most of the data on Kenya are secondary data, while more detailed field research was carried out in Nigeria. The Kenyan data are used as supplements and to provide wider policy options for Nigeria.

The Nigerian Case Study

Nigeria has four broad vegetational zones: the low lying mangrove forest on the coastline in the south; the tropical main forest; the Guinea Savannah of the middle belt; and the Sudan zone in the north. Forest and savannah woodland constitute about 12 and 20 million hectares, respectively of a total of 91 million hectares of land area in the country.

The study was carried out in two ecological zones namely the mangrove forest region and the arid zone in the far North. Two locations, one rural and one urban, were selected in each ecological zone making four study locations.

Forest Zone: (Southern Nigeria)

The survey was carried out in the urban area of Oyo State, in the southern zone in Ibadan and its environs. Oyo State was created in 1991. Previously, it was part of a larger political entity also known as Oyo State created in 1976 from the former Western State of Nigeria. Oyo State is made up of 25 local government areas, with Ibadan City alone constituting five out of the 25 LGAs. Oyo State is the ninth largest state in Nigeria and has a population of 3,488,789 (50.04 percent males and 49.9 percent females). The State is the most urbanised after Lagos. Ibadan, the capital, is the largest indigenous city in black Africa. According to the 1991 provisional census figures, Ibadan has a population of 1,829,187, with Ibadan North being the most populated LGA in the State (300,000). Three of the five LGAs in the city of Ibadan were selected for the study. The clusters selected in the respective LGAs represented major social categories in the city - the migrants, the

indigenes, and the different economic classes including the urban rich, the urban middle class and the urban poor. A village was also surveyed in the Akinyele LGA near the city of Ibadan.

Arid Zone in the North

Kano State was selected to represent the arid zone in the North. What makes up Kano State today is the Kano Emirate, following the creation of Jigawa State (excised from the old Kano State) in August 27, 1991. Kano State has 35 LGAs, with Kano as the capital. The vegetation in and around Kano consists of the Sudan and the Guinea savannah, although both have been replaced by cultural vegetation, four-fifths of the state being now composed of farmed parkland dotted with patches of shrub savannah. The population is predominantly Hausa-Fulani, while others are the Nupe and the Kanuri, occupying the old city and the Yorubas and Igbos occupying the Sabon-Gari area of the city. Others are other Nigerian minority groups, the Shua Arabs, and the Lebanese. Hausa is the popularly spoken language, while the indigenes are predominantly Muslims.

Using the 1991 census figures, Kano State has a population of 5,632,040 (50.7 percent males and 49.3 percent females). The City of Kano is carved into three Local Government Areas, the Municipal, Nassarawa, and Dala. All three LGAs in the Kano metropolis were surveyed, plus a rural LGA, Kumbotso, near Kano.

Data Collection

The methods of data collection included:

1. Interview survey
2. In-depth interviews
3. Focus Group Discussions and
4. Available records (secondary data).

The categories of people surveyed include:

- Household heads;
- Wives in selected households;
- Wood traders;
- Commercial users of domestic fuels including canteen owners, grinders, millers and bakers.
- Traders in domestic fuels and equipment for domestic energy such as electric cookers, kerosene stoves and gas cookers
- Local fabricators of domestic energy end-use appliances; and
- Research and development institutions and parastatals dealing in energy matters.

To select households from Ibadan and Kano, a multistage sampling technique was used so as to include different socio-economic classes in the respective towns. A systematic random sampling technique was used to select from each urban cluster. There was house listing of each cluster, while the systematic random sampling technique was used to select each dwelling, and a simple random sampling technique was used to select the target household from a list of households in each dwelling. In each of the households selected, two of its members were interviewed. These were the head of the household and a spouse preferably the one in charge of cooking if the a household was polygamous.

Need for a Comparative Study

A field visit was made to Kenya during a two-week period in September, 1997 to document technological innovations in the Kenyan domestic energy sector and allow for a possible exchange of technology between the two countries. Positive lessons from Kenya's response to domestic energy crisis may be useful in planning technological policy and change in Nigeria.

Chapter Five

Results and Discussions

The study documents the domestic energy situation in Nigeria, noting specific technical innovations in the sector in recent times. The Kenyan domestic energy situation is also documented to allow a comparative analysis that could lead to possible technical transfer and knowledge sharing between the two countries. Thus, the study looks at the energy policy environment in both countries, and the emerging technological capabilities in the domestic energy sector. The subsequent sections provide a summary of field data.

The Household Survey

Household Characteristics

A total of 585 households was surveyed and the households showed the following characteristics:

- Patriarchal relations still predominate in household functioning. There is a strict gender division of labour, each sex having distinct responsibilities for specific activities in the home, including cooking, sourcing for domestic fuel, and end-use technology.
- Household heads are predominantly men. The few households headed by women seem more socially and economically deprived compared to those male-headed households.
- Trade is the most popular occupation followed by salaried jobs. Unemployment is very high in the surveyed households (54 percent of household members were unemployed), making the present economic crisis in the country very pronounced on family members.
- Wives, as a general rule, prepare meals at home, and are therefore in charge of conserving domestic fuel.
- Most of the surveyed households occupy traditional houses built with mud bricks, although many of these are cemented.
- A sharp difference found between traditional house and modern house designs was the location of the kitchenettes. While in a traditional house, the kitchenette is separated from the main building, in a modern building, the kitchenette is located within the main

building. This has implications for domestic fuel use. For example, in traditional kitchens, hearth stoves are built for the use of fuelwood while the fuelwood could not be used in a modern apartment house. Gas and electric cookers and kerosene stoves are more adaptable to modern kitchens, where the safety of cooking gadgets is ensured and where the gadgets could be properly secured and therefore prevent kitchen accidents.

Socio-economic Characteristics of Respondents

Important socio-economic characteristics of the respondents were also identified. These are:

- The mean age of household 547 heads is 40.6 years (42.3 years in Ibadan and 38.8 years in Kano). The mean age of wives in the selected households is 34.3 years (37.07 years in Ibadan and 31.2 years in Kano).
- The majority of the household heads have medium level education (secondary or polytechnic).
- The majority (80 percent) of the non-literate household heads are from the rural communities.
- The educational level of wives is generally very low compared to that of their husbands.
- Household incomes are generally low.
- Income of household heads ranges from about N500 to N15,000 per month although there were very few who earned more than the N5,000.

Domestic Energy Situation in the Surveyed Households

The domestic energy situation in homes is a reflection of the state of the political economy of fuel use, a situation in which the individual appears helpless. Some general trends emerged in the use of domestic fuels in homes:

- Domestic fuels found in homes are kerosene, gas, electricity and fuelwood. Other fuel derivatives serving as supplements are sawdust charcoal and animal dung. However, the extent of use varies from one type of fuel to the other (see *Table 1*).
- Kerosene is the most commonly used of the domestic fuels. It is used by 84 percent of the residents of Ibadan; and 51.8 percent of the residents of Kano). The popularity ranking of domestic fuels presently used in homes gives this ordering - kerosene, fuelwood, and electricity (see *Table 1* and *Table 2*).
- Fuelwood is used more in the Northern arid zone, probably due to lack of alternative choices rather than as a result of preference.

In terms of efficiency, kerosene was described as the most efficient fuel, followed by gas and electricity. Such description was an outflow from the experience based on accessibility, affordability and availability rather than on the scientific measures of fuel efficiency (*Table 3*). Families have built their tastes around the domestic fuels that are available and affordable, rather than fuels that are necessarily efficient.

The hardware technology in the domestic energy sector, which is locally sourced, is still rudimentary. The following trend was observed from field data:

- About 89 percent of the households use the kerosene stove, which is normally imported.
- Hearth stoves and portable fuelwood metal stove (*adogan* or *murhu*) are in common use, especially in the rural areas.

- Urban households use mainly the kerosene stove, charcoal pot, gas or the electric cooker while the rural households mainly use the open hearth stove and sometimes the kerosene stove. In the rural towns, fuelwood is generally used for cooking, while kerosene is used mainly for lighting. In the North, supplements to fuelwood are *kara* or sorghum stalks and cow-dung, while sawdust is a common fuel supplement in the south.
- Only 22.5 percent of the households have gas cookers, while only 10.6 percent have electric cookers. Both gas and electricity cookers are rarely used because of scarcity of LPG and irregular electric power supply. The high cost of gas cylinders also inhibits use of LPG (*Table 4*).

Fuel Switching

Field data showed that there is a high degree of fuel switching. An average household experiments with two to three types of fuels. However, the decision to switch fuel is often determined by a number of factors, which include:

- Cost of fuels and end-use technology. It was found that low income households alternate between the kerosene stove (76.7 percent) and the hearth stove (47.3 percent). The low-income families hardly use gas or electric stoves. Many of those who use LPG are white-collar workers, who described LPG as convenient and clean to use. None of the high-income households use the hearth stove. On the whole, (91 percent) reported using of kerosene stove, because of its affordability.
- Individual preferences and idiosyncrasies. For example, by cooking particular food items with particular fuels it is believed that some particular tastes are preserved.

On the whole, emerging cooking technologies are seen as depicting status symbols. Traditional cooking technologies are seen as belonging to the low income households, while high income families exhibit preference for LPG and electricity as well as for imported end-use technology.

The Dynamics of Domestic Fuel Supply in Homes

The study also sought the dynamics of domestic fuel supply in homes. Both husbands and wives supply fuelwood although there are zonal differences. In the South, women usually supply fuelwood, in the North, men are charged with this responsibility since wives are generally kept in Purdah seclusion that is obligatory among Muslims. Electricity bills are, as a rule, paid by husbands. LPG is also bought by husbands. However, household realities show that many men shirk their responsibility. Notably, the provision of domestic fuels and end-use technology jointly by husband and wife is more of a Southern phenomenon.

Profile of Users

The overall profile of those who use particular domestic fuels was documented. Variables that determine the profile of users include ecological zones, rural/urban location, household size, socio-economic status of household members and the type of building occupied by the respective households (*Table 5*). The study found that the pattern of fuel use in the two ecological zones presented a similar trend, although the intensity of fuel use differed across zones. For example, many of the households in the Northern zone depended on fuelwood, while in the Southern zone, more households depended on kerosene. Household's size was not statistically significant in determining the choice of more efficient cooking technologies.

It was found that the choice of a particular fuel is more of a function of education, and not necessarily a consideration for demographic factors. Domestic fuels are determined often by economic considerations rather than tastes, preferences or demographic needs. However, irrespective of socio-economic status of the households, fuelwood and kerosene are now the most popular fuels in use. This presents the macro political economy structures as strong predictors of fuel use patterns and trends. The present supply factors have made LPG, charcoal, and electricity less popular options. For example, it was found that irrespective of the educational level of the household head and wife, kerosene remains the popular option.

Personal attributes still have some influence on domestic fuel use. For example, homes with literate wives tend to use less fuelwood, but more gas and electricity if affordable and available (*Table 6*). The income of household heads is significantly related to choice of more expensive fuels like gas and electricity. However, irrespective of the household's economic base, kerosene is commonly used. Though the use of kerosene and fuelwood seems common in homes, the salaried workers reported more fuel options gas, electricity and charcoal while farming families had fewer options.

Technical Innovations in the Domestic Energy Sector (DES)

More households are using the emerging technical innovations in the DES, although still remain few. The technical innovations include:

- Local electric cooker and oven (7.3 percent).
- Sawdust stove nicknamed by some as Abacha[1] (3.8 percent);
- Local gas cookers and ovens (5.8 percent)
- Local kerosene stove 4.3 percent)

The local kerosene stove faces a lot of competition from the imported kerosene stove made in China. The China stove is relatively cheap and of better quality. However, locally made kerosene stoves come in different sizes. Thus, canteens and those who mass-produce cooked meals often prefer the locally made kerosene or gas stoves which could be adapted into larger sizes, to hold large cooking pots. To many, the locally made electric, gas cookers and ovens are becoming better alternatives because of the high cost of the imported but high quality end-use technology. However, users, over years, are getting discouraged because of scarcity of gas, and irregular electricity supply.

Trends in Fuel Costs

The cost of fuels and cooking appliances is very high. The official price of a litre of kerosene is Naira 600 while on the black market the price is Naira 250. A lot of time is wasted queuing for kerosene at the petrol stations. Also, such foods as beans are now eaten less frequently in homes to conserve energy. Other activities that have been stopped in order to conserve energy include boiling water for drinking, ironing, boiling of baby feeding utensils and bathing in hot

---

1 This is a name coined by the Nigerian public using the name of then military Head of State General Sani Abacha - and by so doing signifying the degeneration of social services during this regime.

water. The use of gas and electricity has gone down drastically. Respondents show preferences for certain fuels. However, several factors affect such preferences. Fuels that are highly efficient (e.g. electricity and LPG) are preferred, even though they are generally unaffordable. Kerosene becomes less popular when idealistic choices are made. However, consumers are pragmatic about the choice they make, and the type of development options proffered for the domestic energy sector. For example, most households wanted immediate government intervention in the production and the distribution of kerosene so as to meet the immediate needs of households. Respondents wanted the government to intensify the harnessing of LPG resources so that more households can use the more efficient fuel. The overall suggestion is that the government should take a more pragmatic approach in dealing with domestic energy issues.

Table 1: Domestic fuel currently used in the surveyed households

Domestic fuel	Ibadan %	Kano %	Total %
Kerosene	84.0 (215)	51.8 (170)	65.9 (385)
Liquified gas	6.6 (17)	17.1 (56)	12.5 (73)
Electricity	0.8 (2)	6.1 (20)	3.8 (22)
Firewood	5.9 (15)	20.4 (67)	14.0 (82)
Sawdust	0.4 (1)	1.2 (4)	0.9 (4)
Charcoal	0.4 (1)	0.9 (3)	0.7 (4)
No response	2.0 (5)	2.4 (8)	2.2 (13)
Total	100.0 (256)	100.0 (328)	100.0 (584)

Table 2: Distribution of wives by cooking fuels, which were ranked highest first in use in the two ecological zones (Percent of sample)

Cooking fuels which ranked first in use	Ecological zone		Total sample
	Southern Forest	Northern Arid	
Kerosene	84.6 (236)	50.0 (119)	68.7 (355)
Fuelwood	12.5 (35)	39.1 (93)	24.7 (128)
Electricity	2.9 (8)	10.9 (26)	6.6 (34)
Total	100.0 (279)	100.0 (238)	100.0 (517)

Table 3: Women's description of the overall efficiency of cooking fuels in homes (Percent of sample)

Items	Inefficient	Efficient	Very efficient	Total Response
1. Firewood	22.1 (95)	63.7 (274)	14.2 (61)	430
2. Charcoal	60.2 (154)	34.4 (88)	5.5 (14)	256
3. Sawdust	70.3 (137)	27.1 (53)	2.6 (5)	195
4. Kerosene	6.0 (30)	69.6 (352)	24.5 (124)	506
5. Gas	6.1 (17)	24.3 (68)	69.5 (194)	279
6. Electricity	16.8 (62)	45.1 (167)	38.1 (141)	370

Table 4: Cooking equipment available in each household

Equipment	Ibadan (% of sample) N=252	Kano (% of sample) N= 326	Total (% of sample) N= 578
Gas cooker/ oven	18.3 (46)	24.0 (78)	21.5 (124)
Electric cooker oven	8.7 (22)	12.0 (39)	10.6 (61)
Kerosene stove	95.6 (241)	84.7 (276)	89.4 (517)
Hearth stove	33.7 (85)	44.2 (144)	39.6 (229)
Microwave	1.6 (4)	1.8 (6)	1.7 (10)
Pressing iron	48.8 (123)	26.7 (87)	36.3 (210)
Ring boiler	29.4 (74)	27.9 (91)	28.5 (165)
Bathroom water heater	10.7 (27)	27.6 (90)	20.2 (117)
Electric kettle	13.1 (33)	10.7 (35)	11.8 (68)

Table 5: Cooking Technologies Available in Households by Users' Profiles - (Percent of Household Heads)

Users' profiles	Hearth stove	Kerosene stoves	Gas cooker	Electric cooker
Ecological zones:				
- South Forest Zone	37.1 (85)	95.6(241)	19.8(46)	8.7(22)
- North Arid zone	62.9 (144)	84.7(276)	24.0(78)	12.0(39)
Location:				
- Rural	27.9(64)	5.8(30)	-	-
- Urban	72.1(165)	94.2(487)	100.0(124	100.0(61)
Household Size:				
- Small	38.0(87)	89.1(156)	26.3(46)	12.6(22)
- Medium	33.6(77)	91.5(194)	17.9(38)	9.0(19)
- Large	28.4(65)	87.5(168)	20.9(40)	10.4(20)
Education of Household Heads:				
- None	61.1(140)	85.2(138)	9.9(16)	10.5(17)
- Primary	27.9(64)	94.2(98)	6.8(7)	2.9(3)
- Secondary	7.9(18)	92.1(129)	10.7(15)	5.7(8)
- Technical	2.2(5)	85.9(61)	38.0(27)	15.5(11)
- University	0.9(2)	90.2(92)	57.8(59)	21.6(22)
Occupation of Household Heads:				
- Farming	10.0(23)	76.0(19)	12.0(3)	8.0(2)
- Business/Trading	52.4(120)	90.8(157)	16.3(28)	8.1(14)
- Artisan	24.5(56)	98.7(78)	7.6(6)	2.5(2)
- Salaried job	13.1(30)	87.4(249)	29.5(84)	14.7(42)
Income of Household Heads				
- Low	83.0(190)	89.2(389)	16.8(73)	7.8(34)
- Medium	17.0(39)	90.6(58)	31.3(20)	20.3(13)
- High	-	89.9(71)	39.2(31)	17.7(14)

Table 6: Cooking Fuels Which Were Ranked Highest in Use and the Profile of Women in Target Households (Percent of Sample)

Profile of women target households	Kerosene	Fuelwood	Electricity
Family size:			
- Small	58.6(187)	39.8(45)	39.3(11)
- Medium	32.3(103)	31.9(36)	46.4(13)
- Large	9.1(29)	28.3(32)	14.3(4)
Total	319	113	28
Education of wives			
- None	22.8(82)	39.8(51)	5.9(2)
- Primary	23.1(83)	18.0(23)	8.8(3)
- Secondary	36.2(130)	32.0(41)	38.2(13)
- Technical	8.6(31)	7.0(9)	14.7(5)
- University	9.2(33)	3.1(4)	32.4(11)
Total	359	128	34
Occupation of wives			
- Farming	1.1(4)	0.8(1)	-
- Trading	42.7(149)	10.7(3)	15.2(5)
- Salaried job	56.2(196)	88.4(107)	84.8(28)
Total	349	121	33
Income of wives:			
- Low	95.0(341)	98.4(126)	88.2(30)
- Medium	2.5(9)	0.8(1)	8.8(3)
- High	2.5(9)	0.8(1)	2.9(1)
Total	359	128	34
Ecological zones:			
- Southern forest	66.5(236)	27.3(35)	23.5(8)
- Northern Arid	33.5(119)	72.7(93)	76.5(26)
Total	355	128	34
Location:			
- Rural	22.0 (78)	60.9(78)	-
- Urban	78.0(277)	39.1 (50)	100.0(34)

Commercial Users and Retailers of Domestic Fuels and End-user Appliances

The survival of many micro enterprises depends on the availability of appropriate domestic fuels including fuelwood, charcoal, kerosene, gas, and electricity. The micro enterprises surveyed were mostly owned by women, whose earnings are important for the survival of their households. The urban informal sector continues to expand, as the sector attracts many of the unemployed urban dwellers, especially women. Many women now make brisk business selling roasted yam, corn, and plantains along the major streets. Many women are also moving into cassava processing business (*gari* frying) which used to be a rural phenomenon, while others are erecting local *bukas* (food shops) at every street corner. These activities have implications for fuel use in the cities, as many such trades depend on fuelwood. This means that the demand for fuelwood will continue to increase with the expansion of the informal urban labour market. To date, there are few technical innovations that would ease problems in this sector and neither are there technical innovations that to allow use of more friendly domestic fuel sources.

Petrol stations are supposed to be the major centres for distribution and sale of kerosene. However, it was found that the petrol stations hardly sell kerosene directly to the public. Rather, supplies are diverted to local retailers who now sell the fuel to the public at exorbitant prices.

Traditionally, women generally retail kerosene in local communities. Today both men and women are found in the trade. Children are found hawking kerosene along major streets. Gas is sold at petrol stations and in retail shops. The price of LPG varies depending on the type of cylinder used - Eagles/National, Total and Utigas, among others. For a long time, each petroleum marketing company sold gas cylinders with restrictive gas cylinder adaptors. Today, universal cylinder adaptors are used to make the choice of LPG less restrictive. However, LPG is still restrictive, as consumers can only buy from specific retailers using specific gas cylinders.

Unlike kerosene, the price of LPG is less susceptible to 'black marketeering', although it is hardly affordable to low income families.

Woodfuel Survey

Women form the majority of woodfuel traders, although this is more of a southern phenomenon. The domination of the fuelwood trade by men in the North is associated with the institution of *purdah*. Fuelwood is commonly got from surrounding forests, and farmland, while fuelwood trade is a mechanism for economic survival in urban areas many of the fuelwood traders are ignorant of the detrimental effects of fuelwood use, especially deforestation.

Fabricators Survey

The local fabricators surveyed were all men, ranging in age from 25 to 57 years. They generally had attained low level of education. Their income per month ranges from Naira 500 to Naira 5,000. Most of the fabricators moved into this sector following a general crisis in the

domestic energy sector. Thus, many fabricators are new to the business. Some of the materials used in producing the end-user appliances and accessories are steel plate and hollow pipes. These raw materials are often scarce while working tools are often unaffordable.

Although the domestic energy sector appears potentially rich in technical innovations, the present technological capabilities seem low. Innovations are often rudimentary or intermediate. Popular innovations are kerosene stoves, gas and electric cookers and ovens, charcoal pots and fuelwood kilns and metal wood stoves.

Many of the problems that continue to face fabricators are lack of access to critical resources such capital, labour, and entrepreneurial skills. In most cases, fabricators have low education and therefore often lack the sophistication required in modern business management and entrepreneurship.

Technical skills are acquired mainly through apprenticeship (71.3 percent) or technical knowledge passed from one generation to the other (25 percent). A major problem facing the foundry industry is how to organise efficient marketing. Raw materials are often scarce or expensive. Imported second-hand (*tokunboh*[2] cooking appliances) presently compete with locally fabricated ones.

Institutional Capabilities and Capacities

The institutional survey aimed primarily at documenting the capabilities and capacities within institutions, including government parastatals, research and development institutions, and indigenous knowledge-based institutions. Two government parastatals, three tertiary institutions and some local fabricators were surveyed. The parastatals are the Nigerian National Petroleum Company (NNPC), Nigeria Electric Power Authority (NEPA), while the tertiary institutions are the Obafemi Awolowo University, Ife, the Polytechnic, Ibadan and Bayero University, Kano.

The activities of the NNPC are hampered by under-funding, corruption, and bad management practices. The refineries and other pipeline facilities are poorly maintained. Also the regulatory arm of NNPC is weak. For example, the experience has been that over the years, and particularly under the military dictatorship, non-professionals have taken over the administration of NNPC, especially through various military task forces. Also, the parastatal tends to operate a fire brigade mode of planning against emergencies, rather than a stable planning mechanism. Still, NNPC tends to under-estimate research and development initiative, and has therefore not been able to innovate as would have been expected. NNPC gives little priority to issues relating to the domestic energy sector.

Both the Lagos and the Kano offices of NEPA were visited, and their activities appraised. NEPA has not been able to devote much money to research and development activities. In fact, NEPA struggles to pay workers salaries; for many, such salaries are so poor that many NEPA officials indulge in stealing NEPA facilities. Presently, NEPA's revenue generation is low due to defaulters and NEPA's staff who collude with the public to dupe the authority. The result of this has been NEPA's poor performance. Many believed that NEPA would become more effective if fully commercialised. Major problems currently facing NEPA

---

2 *Tokunboh is a Yoruba terminology for items or persons of foreign origin*

include under-funding, non-availability of accurate data and shortage of technical personnel in its research and development unit.

The OAU Ife Experience

Two units in this university are primarily concerned with technical innovations in the energy sector. They are the Centre for Energy Research and Development (CERD) and the Technological Planning and Development Unit (TPDU) established in 1962.

CERD recently carried out a series of studies for the Ministry of National Planning and Energy Commission on 'Long-term energy demand and supply for Nigeria'. CERD also works closely with NNPC and many other industries in the private sector. Some of the perceptions of CERD staff about the present energy situation in the country are as follows:

- There is no comprehensive national energy policy;
- Energy production, transmission, and distribution bodies are not well co-ordinated;
- There is no functional body at the apex to co-ordinate energy matters in the country;
- There is no particular policy direction on domestic energy sector;
- Energy policies from the different energy institutional bodies are haphazard, and they often do not take equity and efficiency into consideration;
- Energy policies are presently poorly monitored while they are often left to the whims and caprices of NNPC and NEPA officials;

TPDU (OAU Ife) was established in 1962 for purposes of technology planning and development. It has a growing interest in energy research, especially in the area of improved wood stoves. Presently, the university is funding a project on improved wood stoves. The primary concern for this project is to find a way for sustainable energy use in the domestic energy sector. Thus, there is interest in conservation, in making the stove pollution free, and in investigating more alternatives in the renewable energy sector. For the project, an appropriate wood stove should be smokeless, comfortable, healthy, and efficient. Rather than aiding deforestation, the improved wood stove is fuelwood-saving. The wood stove is adaptable to wood residue such as saw-mill waste including sawdust, wood shavings and wood-chips as well as agro-waste and charcoal. The improved wood stove aims at controlling the smoke and loss of energy associated with the traditional wood stove. Thus, the wood stove design is cost-saving, time-saving and clean. It is also healthy and saves fuelwood. Materials for the stove are primarily locally sourced. They include mud, clay, metal and concrete. Part of the design is to put a chimney to the improved stove to control smoke and thus reduce its effects on health. Some consideration is also given to the positioning of the stove. A raised platform is preferred for the improved stove so that women do not have to bend down whenever they are cooking. This is to prevent backaches associated with the traditional hearth stove. The project plans disseminate the product widely.

The Polytechnic of Ibadan Experience

The Mechanical Engineering Department at Ibadan has been involved in the design and construction of a charcoal cooker, a kerosene stove, an incubator and an oven. Some are student projects carried out in partial fulfilment of their diploma courses. Some individual staff make stoves for the public, but at a higher cost.

Bayero University, Kano

A major research project on woodfuel in Kano was carried out at Bayero. It was sponsored by the United Nations University (UNU) in 1990. The study documented the perennial problem of woodfuel in the City of Kano and other fuel options in the city. Most of their findings are supported by the present study. Apart from this study, there are no institutional efforts at technical innovations that have been recorded in the domestic energy sector.

Others Institutions

During the field survey, the following other popular projects were mentioned:

- Improved cooking woodstoves at Sokoto;
- Solar dryers developed by the Centre for Energy Research and Training, University of Nigeria, Nsukka.
- PRODA in Enugu has devised a local stove that uses coal briquettes as fuel. It is presently largely used in some of the eastern cities that are close to the eastern coal mines.

Other available technologies mentioned cow dung stove in the North solar concentrators, biogas and the multi-fuel stove. Many of these are associated more with the Northern zone than with the Southern zone.

Problems Facing Technical Innovation in the Surveyed Institutions

Some of the hindrances facing innovation are as follows:

- Problem of under-funding of research projects generally, and the area of the domestic energy particular.
- Lack of adequate personnel;
- Those with technical know-how are discouraged from engaging in active research because the environment is hostile to innovations;
- Raw materials are often scarce and expensive, for example, metal sheets;
- Negative societal values discriminating against indigenous technologies in general and in particular, against local initiatives in the domestic energy sector;
- Government policy does not promote research and development initiatives. There are very limited incentives for technical innovations in the country.

Policy Options Proposed by the Surveyed Institutions

These include:

- Encouraging use of bio-fuel;
- Planting fast growing trees such as the *gliricidia* purposely for generation of domestic energy;
- Encouraging energy mix;
- Conserving renewable energy sources such as bio-fuel;
- Encouraging use of solar energy;

- Energy saving stoves a priority;
- Making stoves that are clean, healthy and cheap;
- Providing incentives for local production of stoves;
- Adopting energy management policies that balance supply and demand;
- Adopting long-term and short-term measures for supply and demand;
- Adopting policies on energy that give adequate consideration to the rural and urban poor.

Assessment of Institutional Performance

Presently, both original and adaptive technical innovations have been found in both research and development institutions and informal local fabricating shops. An original technical innovation has been described as one that originates from a basic idea or the recognition of a social need. It is concretised as a prototype and polished through research and development before it is manufactured. While an adaptive technical innovation starts with an existing product that needs modification or improvement, it is developed to the required standard. The wood stove is and example of a technical innovation while the gas and electric cookers and the oven are examples of adaptive technical innovations.

Table 7 presents a descriptive summary of capabilities and capacities in both formal and informal institutions in cooking technologies. The capabilities and capacities in these institutions are generally low. Generally, many serious technical innovations were recorded, but the investment capability to back these up is low in research and development institutions and among the local fabricators. Minor change is high for both formal and informal institutions while major change capacities are generally low. Technical experts in the tertiary institutions seem better in financial management and in general managerial and leadership skill, mainly because of their training. However, the local fabricators tend to have better access to markets because they live among the people. Formal institutions are yet to build appropriate links with the government and the consumers. However, compared with the local institutions, formal institutions seem to be doing better in linking up with the government. This is done either through collaborative research work or through dissemination of research reports. In all the institutions, innovations have not got to the stage of patenting. Market competition seems to exist between indigenous and foreign innovations, and between local engineers and local blacksmiths.

A sharp difference between local fabricators and research and development institutions is in respect of the appropriateness of technology innovated. The research and development institutions are generally concerned with evolving appropriate technology in the domestic energy sector that is convenient, comfortable, clean, smokeless, and cheap. For the local fabricators, the concern is more on affordability and profitability of products, while the overall utilitarian value of their innovation is treated with levity.

Table 7: Capabilities and Capacities in Selected Formal and Informal Institutions Producing Cooking Technologies

Capabilities & Capacities	RDIs (Formal Systems)			Local Fabricators (Informal)		
	Low	Medium	High	Low	Medium	High
Production Capability	+			+		
Financial-Management and Control Capability			+	+		
Marketing Capability	+				+	
Managerial and Leadership Capability			+	+		
Infrastructures	+			+		
Venture Capital	+			+		
Use of Patents	+			+		
Linkage capabilities		+		+		
Minor Change Capability			+			+
Major Change Capability	+				+	
Strategic Change	+				+	
Innovations		+			+	
Investment Capability	+			+		

Key: +
This symbolises where this variable is present and the form it takes, i.e. low, medium or high.

Chapter Six

The Kenyan Experience

Both Nigeria and Kenya have well laid out energy policies. However, Kenya seems to have done less of lip service to its energy policy. Nigeria seems to be less clear in its energy policy institutional arrangements, while Kenya has created space for country-based NGOs to share some of the responsibilities of improving the domestic energy situation.

The energy situation in Kenya is more precarious compared to the situation in Nigeria. Thus, Kenya has been more forceful in its domestic energy policy implementation. Two programmes - KREDP and KWAP, sponsored by USAID and Netherlands, respectively, laid down a solid foundation for Kenya's non-conventional energy programmes. The intensity of the problems in the domestic energy sector in Kenya has led to a series of technical innovations - improved fuelwood and charcoal stoves, including the *Kuni mbili* stove, *Maendeleo* stove, *Nyungu, Chepkube* stove, sawdust stoves and fireless cookers, among others. Some of these stoves were found to be efficient both in use and energy conservation.

Chapter Seven

Technological Implications of Changes in the Domestic Energy Sector, and Policy Alternatives

The problem of the domestic energy sector in Nigeria is not that of resource but largely that of management of the available resources. The energy policy itself looks beautiful on paper but defaced in implementation. The political environment itself has been quite unstable for some time now to allow for adequate and consistent planning. A major flaw in the domestic energy policy is the lack of appreciation for the role of end-users of domestic energy appliances such as stoves, gas or electric cookers and ovens and cylinders. This sector is left largely in the hands of individuals, usually local fabricators, who lack the sophistication required for competitive technical innovations. Tertiary institutions that could come up with scientific and technical innovations often lack the financial and administrative support needed for the challenges and for patenting of innovations. According to Gilbert Mudenda (1995), technology policy cannot be given piece-meal treatment. To develop local technological capacity, policies must necessarily incorporate human resource development, providing science and technology, infrastructure, and a dynamic industrial infrastructure. The development of local technological capacity has been under-played in the domestic energy sector. Although improved technical systems lead to innovations and technical change, efforts in this direction are yet to be co-ordinated. The case of the local fabricators is an example.

Energy resources in Nigeria must be made more efficient. This could be done in the following ways:

- The government should make liquefied petroleum gas more affordable and accessible so that as many households as possible can embrace it. The present end-use devices, such as gas cookers and cylinders should be subsidized by the government to make them more affordable to low income families. The public may be counselled on LPG use and on precautions against accidents.
- The government should promote the use of improved cooking stoves. Presently, very little emphasis is placed on this even in the Northern arid region.

- Presently, the public lacks knowledge on different modes of energy conservation. There is generally low awareness of energy saving devices. There is an urgent need for a nation-wide energy conservation campaign.

To embark on renewable energy sources, consideration must be given to the following:

- Cultural and social patterns in food consumption, cooking and basic needs of the target population;
- The matching of technology to local needs;
- A needs assessment must be made;
- Substantial resources to back-up needs assessment, prototype development, laboratory, and field testing, developing dissemination strategies and building up a production and market network;
- Government support in the area of financing, removing legal barriers and providing an enabling environment, for example, through tax subsidies;
- Involvement of a network of committed NGOs and private entrepreneurs;
- Provision of an effective dissemination network;
- Affordable, adaptable, accessible and durable technology;
- New technology which must appeal to consumers in terms of appearance, cost, method of use, and impact on the living standards;
- Provision of policy support for new projects by the government;
- New technologies that are gender sensitive. Users (men and women) must be involved in the design and the development process.

To say that the present domestic energy situation in Nigeria is chaotic is an understatement. Families are facing a lot of hardships sourcing for domestic fuel. The government needs to put better planning mechanisms in place to meet its projections. The activities of local fabricators need a co-ordinator to target them for improved performance. The government needs to create a more efficient pricing scheme so as to discourage black marketeering of domestic fuel products. For example, the government needs to regulate the price of kerosene so as to make it more accessible and affordable to the public. The government may need to provide better funding schemes for tertiary institutions that are directly involved in technical innovations in the domestic energy sector. The present state of domestic energy financing needs to be improved. For example, local fabricators need to be encouraged through special incentives. Local manufacturing firms may need to develop interest in producing domestic energy end-user appliances to ease the current hardships in the sector.

As it is, there is a general lack of co-ordination of activities across interest groups in the domestic energy sector. To make policy instruments effective, the government may need to address the threat posed through importation of *tokunboh* cooking appliances in the country. More often than not, the importation inhibits local innovations. The policy should revisit the use of end-user appliances and accessories in the domestic energy sector.

Since petroleum as an energy source has a life span, it is high time Nigeria thought of renewable energy sources, for example, solar and wind energy. If other fuel alternatives are developed, there will be a drastic reduction in the use of fuelwood, which will help reduce or stop deforestation. If the present flaring of gas is stopped and production of LPG is intensified, gas will become accessible to more households. More efforts may need to be intensified to secure more international co-operation and collaboration to improve the present state of the Nigerian domestic energy sector. The present distribution system, especially that of kerosene,

needs overhauling, and a system that will ensure an end to black market profiteering.

Uptill now, Nigeria has not succeeded in promoting its own indigenous based technologies because in many cases, government policies are either antagonistic or the political will is absent. For example, to achieve energy efficiency, the political economy must be supportive of the energy sector. This must be done pragmatically by carrying out conservation activities and investing in improved technologies. A consideration for energy financing is directly related to the macro-economic policy reforms and the likely effects of energy pricing. It may be necessary to give incentives to investors in energy saving technologies.

References

Adebayo, Rotimi (1995), "Kerosene Scarcity and our Forests" in *Daily Times* January 25 pp. 12.

African Guardian, Lagos, May 24, 1993.

Ardayfio-Schandorf, E. (1993), "Women, Population Growth and Commercialization of Fuelwood in Northern Ghana". A paper presented at the Conference on Women and Demographic Change in Sub-Saharan Africa, Dakar, Senegal, 3-6 March.

Bernard, Gilland (1995), "World Population, Economic Growth and Energy Demand, 1990-2100". in *Population and Development Review*, Vol. 21(3) (September) pp.520.

Courier (1986), "The Woodfuel Crisis," in *The Courier*, No. 95, (January - February).

Dennis, C., (1984) "Capitalist Development and Women's Work: A Nigerian Case Study", in *Review of African Political Economy*, No. 27/28, 1984.

Ernst, D.; L. Mytelka; and T. Ganiatsos (1994), "Technological Capabilities: A Conceptual Framework," Chapter 1 of the Draft Report - *UNCTAD Six Country Research Projects on Technological Development in South and East Asia* (August).

FAO (1986), "Forestry Extension Organization". *Forestry Paper*, 66. pp. 4.

The Guardian, Lagos. May 27, 1993.

Haile, Ferkerte (1989), "Women Fuelwood Carriers and the Supply of Household Energy in Addis Ababa," in *Women's Role in Natural Resource Management in Africa*. IDRC Manuscript Report 238 e, pp. 41-51.

Looney, R.E., (1991), "Book Review Essay: Recent Attempts at Assessing Developments in World Oil Markets", in *Scandinavian Journal of Development Alternatives*, Vol. X (4), December.

Mudenda, Gilbert (1995), "Formulating Technology Policy in Africa: New Directions", in Osita M. Ogbu, Banji O. Oyeyinka, and Hasa M. Mlawa (eds.) *Technology Policy and Practice in Africa*, Ottawa, Canada: IDRC. pp. 82-90.

Oladosu, G.A. (1994), *Nigeria's Household Energy Sector: Issues and Supply/Demand Frontiers* (unpublished).

Oppong, C. (1992), "Population, Environment and Women: Some Issues in Africa" Conference Proceedings - *Population and Environment in Africa*, Gaborone, Botswana, 14 - 19 September.

Wangwe, S., (1993), "Small and Micro-enterprise Promotion and Technological Policy" in *Small Enterprises and Changing Policies*. A. H. J. Helmsing and T. Kolstee (eds.), (London: IT Publications.

World Bank (1990), *World Development Report*.

ATPS Working Paper Series

No.	Title of Publication	Authors
1	The Effects of Economic Reform on Technological Capability.	T.Adeboye M. S. D. Bafachwa O .A. Bamiro
2	Methodological Issues in Science and Technology Policy Research	T. Adeboye N. Clark
4	Rehabilitation in the Manufacturing Sector in Tanzania	S. M. Wangwe
5	Agricultural Policy and Technology in Sierra Leone	C. Squire
6	Effectiveness of Agricultural Research Extension in Sierra Leone	A. K. Lakoh
8	Generation and Utilization of Industrial Innovation in Nigeria	O. Oyeyinka G. O. A. Laditan A. O. Esubiyi
9	Irrigation in the Tuli Block, Botswana Water Conservation Techniques or Optimal Strategies	I. N. Masonde
10	Endogenous Technology Capacity and Capability Under Conditions of Economic Policies of Stabilization and Structural Adjustment	S. E. Chambua
11	Technology and Female-Owned Business in the Urban Informal Sector of South-West Nigeria	Dr R. O. Soetan
12	Technological Innovations Used to Overcome the Problem of Resource Scarcity in Small Scale Enterprises	C. W. Ngahu
13	Financing of Science and Technology Institutions in Kenya During Periods of Structural Adjustment	M. Mwamadzingo
14	Impact of Economic Liberalization on Technologies in Enterprises Processing Agricultural Produce.	P. Madaya
15	Technology and Institutions for Private Small and Medium Firms	B. Oyeyinka
16	Institutional Reform, Price Deregulation and Technological Change in Smallholder Agriculture	E. C. Eboh
17	Adoption of Agricultural Technologies by Rural Women under the Women-in-Agriculture Program in Nigeria	D. S. Ugwu
18	Electrical Power Utilities and Technological Capacity Building in Sub-Saharan Africa	Brew-Hammond
19	Investigation into Factors that Influence the Diffusion and Adoption of Intentions and Innovations from Research Institutes and Universities in Kenya	Bwisa, H. M. and Gachui
20	The Effects of Economic Reforms on the Quality of Technological Manpower Development in Nigeria	H. E. Nnebe
21	Issues in Yam Minisett Technology Transfer to Farmers in Southern Nigeria	Michael C. Madukwe Damian Ayichi Ernest C. Okoli
22	Technological Response to Telecommunications Development: A Study of Firms and Institutions in Nigeria	Adeyinka F. Modupe
23	Gender Differences in Small Scale Rice Farmers' Access to Technological Inputs in Enugu State of Nigeria	David Nwoye Ezeh
24	Adoption of Sustainable Palm Oil Mini-Processing Technology in Nigeria	Nkechi Mbanefoh
25	Domestic Energy Situation in Nigeria: Technological Implications and Policy Alternatives	Olabisi I. Aina
26	Technological Capability in the Nigerian Leather Industry: A Firm-Level Case Study	Uka Ezenwe Enwere Dike Anthony Ihuoma Mike Duru