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Urbanisation and the Choice of Fuel Wood as a Source of Energy in Nigeria

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ABSTRACT This paper discusses the problem of urbanization and fuel wood consumption in Nigeria and the main objective is to examine the causes and effects of degradation of the environment. Between 1990 and 2000, Nigeria lost an average of 409,700 hectares of forest, equal to an average annual deforestation rate of 2.38%. Additionally, between 2000 and 2005, Nigeria lost 35.7% of its forest cover, or around 6,145,000 hectares. The paper found that the factors causing fuel wood demand in urban areas include, Rural-urban migration, Urbanization, Poverty, Hikes in prices of kerosene and cooking gas amongst others. The paper relied mainly on secondary information from both empirical and non-empirical researches. Furthermore, the consequences of indiscriminate felling of trees such as Deforestation, Desertification, Erosion and Bio-diversity loss were highlighted. The Prospects of harnessing other renewable sources of energy in Nigeria as a measure to reduce the rate of consumption of fuel wood is recommended.

INTRODUCTION

Urbanization is accompanied by shifts of labour force from the rural sector to the urban sector. In most developed nations, the urbanization process is completed while in many developing countries this process is still underway (Xiangchun and Komei 2008). Furthermore, most rural and urban people in Africa, Asia and Latin America still rely on trees and woody vegetation to meet their basic energy needs (Makame 2007). Indeed, the use of fuel wood as a source of energy is a rural habit. However, this has found acceptance in urban areas, and in a manner to which its demand is leading to the harvest of both dry and wet wood, as against the mostly harvested dead woods, dry branches and twigs. In the same vein, Makame (2007) argues that in Africa the pressure on forest resources has increased since the oil shocks of the 1970s. This is mainly because many poor urban dwellers previously using kerosene for cooking have reverted to fuel wood. Currently, Nigeria is using 80 million cubic metres (43.4 x 109 kg) of fuel wood annually for cooking and domestic uses (Sambo 2005). With the continuous growth of the country's population and indeed that of urban areas, this trend is becoming a threat to the environment, particularly the rural areas from where these fuel woods were harvested, with the rate of harvest and utilization higher than its natural regeneration or replenishment. The demand of fuel wood in Nigeria's urban areas has been increasing, due to the fact that other sources of energy are experiencing hike in prices. Also, between 1991 and 1994, kerosene and cooking gas rose by about 900 percent (Momah and Soaga 1999), and today it has risen by more than 1000 percent. This has pushed many households down the energy ladder. Many households could no longer afford to buy kerosene and cooking gas as such, they resorted to the use of fuel wood. At present, fuel wood constitutes the main source of fuel for cooking by over 76% of the Nigerian population. UNDP figures for 1993 in Olusegun (2009) showed Nigeria consuming 262,783 metric tonnes of fuel wood compared with 7,210 tonnes for South Africa and 35,313 tonnes for Thailand. While our dependence on fuel wood is rising in Nigeria, it has virtually ceased in the other two countries. At the present rate of fuel wood consumption, cutting may soon convert our forests to savannahs and grasslands. Furthermore, Yahaya (2002) stated that the poorer a country is, the greater its dependence on fuel wood. This is further buttressed by the United Nations Centre for human settlements that despite the availability of modern energy sources to some city dwellers, the majority of the immigrants cannot afford them, wood still remains their fuel; but instead of collecting it from dead trees, branches and twigs, they now buy it from vendors (Habitat-UNCHS 1990). In Nigeria, fuel wood is being exported from rural areas into urban areas, a scenario Cline-Cole et al. (1988)

described as the urban-rural conflict. However profit oriented the business of cutting down trees for export to the urban areas as fuel wood may be to the rural dwellers, it culminates into a vicious circle of problems to the environment, the rural dweller and eventually the urban areas in general. According to Anderson (2006), urban centres depend on the hinterlands (rural areas) for its resources, if depleted it will spell doom for the nations concerned. It should be noted that, between 1990 and 2000, Nigeria lost an average of 409,700 hectares of forest equal to an average annual deforestation rate of 2.38%. Additionally, between 2000 and 2005, Nigeria lost 35.7% of its forest cover, or around 6,145,000 hectares (Wikipedia 2008). As such, it is of paramount importance if other energy sources available in Nigeria are harnessed and made available and affordable, so as to curb the awaiting disaster of deforestation, desertification and erosion and this will form the focus of this paper.

METHODOLOGY

The method of investigation adopted in the research essentially relied on secondary data. Data were collected from both published and unpublished materials. Non-statistical and statistical methods were employed in analyzing the urbanisation and the choice of fuel wood as a source of energy in Nigeria. The consequence of felling of trees for fuel use and other available energy sources to be harnessed in the country is also analyzed.

OBSERVATIONS AND DISCUSSION

Urbanization and Population Growth in Nigeria

Urbanization is the percentage of persons living in an urban area. The current population of Nigeria is put at 140 million, representing 20% of the entire population of Africa. The population has therefore grown dramatically since the 1952/ 1953 census when it was 31.5 million. Currently, we have a Total Fertility Rate (TFR) of 5.7 children per woman, child birth rate of 42 births per thousand, child death rate of 13 per thousand and a rapid population growth rate of 5.5% per year (Fig. 1). The United Nations project a population of 289 million for the country by 2050.

Apart from population growth, Nigeria has been experiencing increased urbanization over the last five decades (Table 1). The proportion of the population living in the urban centres has risen from 15% in 1960 to 43.3% in 2000 and is projected to rise to 60% by 2015. Total area taken up by urbanization in Nigeria during the same period

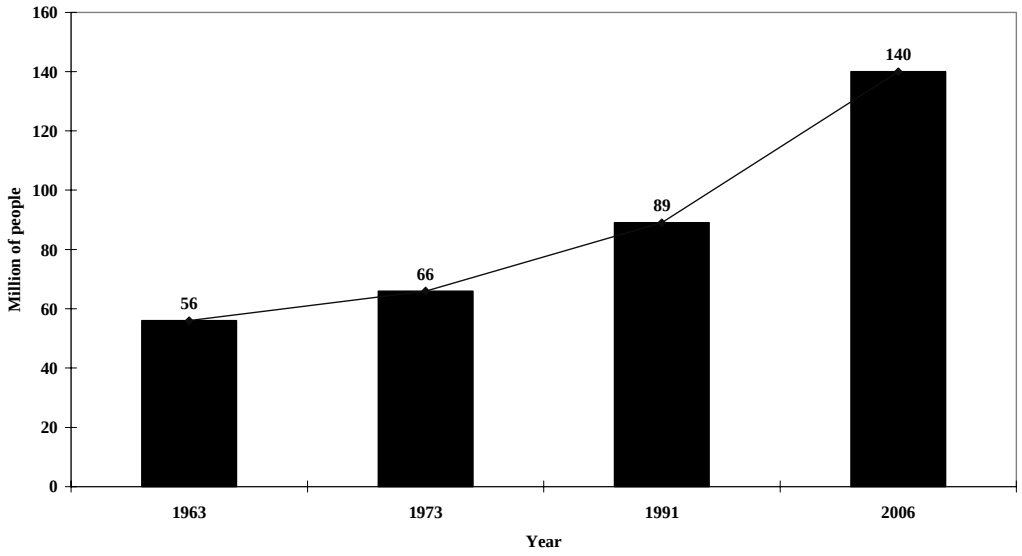

Fig. 1. Nigeria population growth 1963-2006
Source: National Population Commission (2004), *Population and the Quality of Life in Nigeria*

Table 1: Socio-economic statistics of Nigeria

Land area	910768 km^2
Water area	13000 km^2
Population	85.5 million (1991)
	140 million (2006)
Population growth	3.20%
Population below poverty line	45% (2006)
Total area	923768 km^2

Source: Olusegun 2009

increased by 131% from 2,083 sq.km in 1976 to 5,444 with an average rate of urbanization estimated to be 3.7% per year (National Population Commission, 2004). The number of urban centres, i.e. settlements with population of 20,000 or more increased from 56 in 1953 to 359 in 1991 and 450 in 2000. The drivers of urbanization in Nigeria include (a) high population growth rate (b) concentration of development activities in urban centres (c) rapid growth of formal education (d) rural-urban wage differentials.

One of the major negative impacts of high urbanization is massive waste generation (liquid, gaseous, industrial and domestic) and attendant disposal problems resulting in a threat to the quality of air we breathe and water we consume. In general, there is a clear vicious circle linking high population growth, poverty and ecological degradation. Nigerian cities and towns are mostly horrible examples of unplanned population growth, poor town planning methods, squalor and environmental degradation which cry for immediate action. Population growth has also put a lot of pressure on our forests as the rising farming population seeks for more land for survival and fuel wood as a source of energy for cooking and heating. The prospect of harnessing other renewable sources of energy in Nigeria is necessary in order to curb the problem of environmental degradation and its consequence.

Factors Leading to the Demand for Fuel wood in Nigeria

The factors are as follows:

Hikes in Prices of Petroleum Products: Nigeria as a whole suffers from sporadic fuel scarcities, strikes and labour unrest during price hikes of petroleum products. Table 2 shows the increase in prices of petroleum products through the years. From 1990 to 2004, the prices in table 2 have more than tripled. As of today the prices of petroleum products have almost doubled those of 2004.

Affordability: According to the United Nation Conference on Habitat (UNCH 1990), despite the availability of modern energy sources to some city dwellers, the majority of the migrants from rural to urban areas (whom in Nigeria accounted for 65% of the urban population in 1991 to more than 70% in 2006) cannot afford them. Wood remains their fuel; but instead of collecting it, they now have to buy from vendors; signifying that fuel wood is more affordable than other conventional fuel such as kerosene and cooking gas and other sources of energy. Affordability is determined by income. Osinubi (2003) opined that the depth and severity of extreme poverty increase more than seven fold in urban Nigeria compared to a two fold in rural areas. Poverty in Nigerian cities is endemic. The Human Development Report (2004) recorded that nearly 71% of Nigerians survive on less than US$1 daily, while nearly 91% of the population lives on less than US$2 daily. Poverty is a major factor in urban congestion and environmental degradation. Additionally, it is an enormous threat to the political stability, social cohesion and environmental balance of our cities and until it is tackled decisively, sustainable urban development will remain a mirage (Danmole 2002). Furthermore, Mabogunje (2005) added that chronic poverty in urban areas is seen as much more complex and visible than the problems of acute need in rural areas of Nigeria. This vividly express the growing population of the poor in the urban areas and the severity of the situation coupled with the fact that in Nigeria, unemployment and down sizing, rank sizing or retrenchment is the order of the day. With increased population of the poor,

Table 2: Price of petroleum products in Nigeria

Products	*1990*	*1991*	*1993*	*1994*	*1998*	*2000*	*2002*	*2002*	*2003*	*2004*
Gasoline	0.51	0.6	3.25	11	20	22	42.5	32.44	40.23	42.80 - 49.00
Diesel	0.35	0.5	3.00	9	19	8	42	32	38.39	40.50 - 67.00
kerosene	0.15	0.4	2.75	6	17	19	32	32	32.53	41.25 - 59.00
Fuel oil	0.3	0.5	2.75	9	12.4	230	230	230	275	275

Source: Nigerian National Petroleum Corporation 2004 cited in Olubusola 2007

more people are turning to fuel wood because of the increasing economic hardship that exists in Nigeria.

Availability: Energy has a major impact on every aspect of our socio-economic life, reliable and clean energy supply is a pre-requisite for sustainable development and the fight against poverty. Energy, especially electricity, is important in raising the living standard of the people, but the epileptic electricity supply and power outages in Nigeria of not less than 10 hours per day have made this a mirage (Onyegebu 2003). Also, the Daily trust News paper of march 15, 2007 volume 16(4) pp. 1-4, stated that Nigeria's largest power plant with a capacity of 1300 mega watts is generating only 600 mega watts, with a short fall of about 700 mega watts. Similarly, the long queues for kerosene, signify its scarcity. The situation above forced users to turn to the more readily available energy for cooking and that is fuel wood. Also, more wood is consumed when kerosene or gas became scarce. The use of fuel wood in Nigerian urban areas is further made possible due to improved transportation infrastructure which made possible the importation of large quantity of fuel wood from the rural areas into the urban areas. Cline-Cole et al.(1988) reported in Kano state, fire wood are imported into the urban areas from the rural areas from a distance of about 300-4000km.This is further buttressed by Nancy (1994) that supply is harvested from ever more distant wood lands, some as far as 300km or more from the urban centres of Nigeria.

Consequences of Fuel wood Usage as a Source of Energy

There are harmful environmental and health effects associated with the use of some energy sources. The World Health Organization estimates that about 1.5million people per year die prematurely from indoor pollution due to the use of solid fuels. This is equivalent to 4000 deaths per day. In addition, it has been estimated that there are 40,000 new cases of chronic bronchitis yearly due to exposure to soot and smoke (World Bank 2006). In Sub-Saharan Africa, the number of people relaying on biomass as their primary fuel for cooking is 575 million (76%). This number includes 413million (93%) rural dwellers and 163million (53%) urban dwellers. Indoor air quality is therefore a vital issue because deaths that result from biomass smoke rank highly in Annual Worldwide Death by Cause; reinforced further in Figure 2.

Figure 2 shows that deaths from fuel wood smoke rank second after malaria in Annual Worldwide Deaths by Cause. It also ranks higher than Tuberculosis and HIV/AIDS. In the context

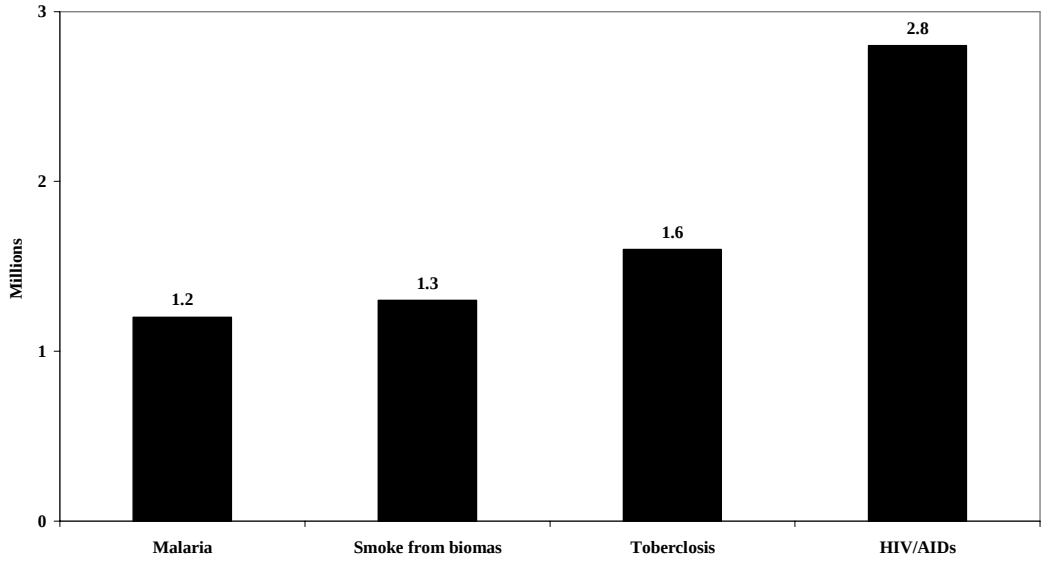

Fig. 2. Annual worldwide death by cause.
Source: World Energy outlook 2006 cited in Olubusola (2007).

of Environmental Health, the practice of deforestation when fuel wood is gathered has a negative impact on the environment (Modi et al. 2006). Deforestation can have a wider implication on humans, plants and animals that depend on the forest/wood land habitat for food and shelter. Increasing deforestation can also make a habitat more predisposed to erosion and desert encroachment (Darkoh 1993). Another effect of deforestation is the release of stored carbon into the atmosphere; this has wider implications to the Global Climate system and the World at large.

The Impact of Felling of Trees on the Environment

Urban demand for fuel wood leads to the indiscriminate cutting down of trees, mainly wet wood which in turn leads to deforestation. The combined effects of felling of trees for timber, urbanization, road construction and industrialization have immensely contributed to deforestation and shortage of fuel wood in Nigeria (Nura 2006). Rural dwellers in their bid to increase their income through wood harvest for urban fuel wood supply increase their poverty indirectly, the reason is that, indiscriminate cutting down of trees, with regeneration slower than consumption, can cause these renewable resource to reduce or deplete, and this is a process of deforestation and with the increase in urban demand for fuel wood. Deforestation is sure to set in and in turn cause desertification. Impact of deforestation in Nigeria includes the following:

Erosion: When trees are cut down, the land becomes vulnerable to erosion and hence land degradation in the form of desertification. Nigeria is currently loosing 351,000km^2 of its land to desert and is increasing south wards, (Wikipedia 2008) a situation if not checkmated will put agricultural production in crises.

Economic Problems: Since agriculture is the major occupation of rural dwellers and urban centres depends on the rural areas for food, a decline in production means a decline in the economy of rural dwellers and hunger for Nigerians.

Loss of Valuable Flora Species: The indiscriminate felling of trees creates loss of valuable tree species which could be used in improving crop variety and increase agricultural yield.

Loss of Valuable Fauna Species: The reduction or disappearance of the flora (loss of habitat) could sometimes lead to the extinction of some fauna species.

Fuel Wood Scarcity: In Nigeria, the total fuel wood consumption in 1985 was 87.587 million cubic metres. Obuah in (2000) stated that 55million tones of fuel wood and charcoal were burnt, and it increased to 80 million cubic metres (43.4 x 109 kg) of fuel wood annually for cooking and domestic uses (Sambo 2005). According to Yahaya (2002), there exists a direct relationship between human population and fuel wood demand, hence the cutting down of wet wood can said to be on the increase. The rate of consumption of fuel wood in Nigeria exceeds the rate of production. It is therefore right to say this renewable source of energy would sooner or later be scarce, should these form of exploitation continue.

Sources of Renewable Energy in Nigeria

Energy is an essential ingredient for socio-economic development and economic growth. The objective of the energy system is to provide energy services. Energy services are the desired and useful products, processes or indeed services that result from the use of energy, such as for lighting, provision of air-conditioned indoor climate, refrigerated storage, transportation, appropriate temperatures for cooking etc. The energy chain to deliver these cited services begins with the collection or extraction of primary energy, which is then converted into energy carriers suitable for various end-uses (Sambo 2003).

From the foregoing, it is clear that energy is an essential input to all aspect of modern life. It is indeed the life wire of industrial production, the fuel for transportation as well as for the generation of electricity in conventional power plants (Sambo 2005).

The renewable energy sources considered are; solar energy, water, biomass and wind energy. These can be described as follows:

Solar Energy: Solar energy is the most promising of the renewable energy sources in view of its apparent limitless potential. The sun radiates its energy at the rate of about 3.8 x 1023 KW per second. Most of this energy is transmitted radially as electromagnetic radiation which comes to about 1.5KW/m^2 at the boundary of the atmosphere. After traversing the atmosphere, a square metre of the earth's surface can receive as much as 1KW of solar power, averaging to about 0.5 over all hours of day light. Studies relevant to the availability of the solar energy resource in Nigeria (Doyle and Sambo 1988) have fully

indicated its viability for practical use. Although solar radiation intensity appears rather dilute when compared with the volumetric concentration of energy in fossils fuels, it has been confirmed that Nigeria receives 5.08 x1012 kWh of energy per day from the sun and if solar energy appliances with just 5% efficiency are used to cover only 1% of the country's surface area then 2.54 x 106 M W h of electrical energy can be obtained from solar energy. This amount of electrical energy is equivalent to 4.66 million barrels of oil per day (Sambo 2005). Solar energy technologies are divided into two broad groups namely solar-thermal and photovoltaic. In solar thermal applications, solar energy, as electromagnetic waves, is first converted into heat energy. The heat energy may then be used either directly as heat or converted into 'cold' or even into electrical or mechanical energy forms. Typical of such applications are in drying, cooking, heating, distillation, cooling and refrigeration as well as electricity generation in thermal power plants.

In solar photovoltaic applications, the solar radiation is converted directly into electricity. The most common method of doing this is through the use of silicon solar cells. In recent times, the commercial viability of photovoltaic systems have been recognized and concerted international efforts in research and development have led to increase in efficiency and reliability as well as reduction in cost.

Wind Energy: Wind is a natural phenomenon related to the movement of air masses caused primarily by the differential solar heating of the earth's surface. Seasonal variation in the energy received from the sun affects the strength and direction of the wind. The case with which aeroturbines transform energy in moving air to rotary mechanical energy suggests the use of electrical devices to convert wind energy to electricity. Wind energy has also been utilised, for decades, for water pumping as well as for the milling of grains.

A study on the wind energy potentials for a number of Nigerian cities shows that the annual wind speed ranges from 2.32m/s for port Harcourt to a figure of 3.89m/s for Sokoto (Sambo 1987).The maximum extractable power per unit area, for the two sites was estimated as 4.51 and 21.97 watts per square metre of blade area, respectively. And when the duration of wind speeds greater than 3m/s is considered, then the energy per unit area works out as 168.63 and 1,556.35 kWh per square metre of blade area, again for Port Harcourt and Sokoto.

Although use of wind energy for water supply has been known and used for hundred of years, in recent times efforts have been directed largely towards the use of wind power for the generation of electricity and in the past twenty years or so rapid changes in technology have occurred and major wind powered generating plants have been installed, especially in the rural areas of developing countries.

Water or Hydro-energy: Essentially, hydro-power systems rely on the potential energy difference between the levels of water in reservoirs, dams or lakes and their discharge tail water levels downstream. The water turbines which convert the potential energy of water to shaft rotation are coupled to suitable generators. The hydro-power potential of Nigeria is very high and hydro-power currently accounts for about 29% of the total power supply. The first hydro-power supply station in Nigeria is at Kainji on the river Niger where the installed capacity is 836MW with provision for expansion to 1156MW. A second hydro-power station on the Niger is at Jebba with an installed capacity of 540MW. An estimate (Sambo 2005) for Kaduna, Benue and Cross-River (at Shiroro, Makurdi and Ikom, respectively) indicates their total capacity to stand at about 4,650 MW. Estimates for the rivers on Mambila Plateau are put at 2,330MW. The overall hydropower resource potentially exploitable in Nigeria is in excess of 11,000MW. It should be noted that hydro-power plants that supply electrical energy between the ranges of 15KW to 15MW are known as mini-hydro-power plants while those supplying below 15Kw are referred to as micro-hydro-power plants. In effect small hydro-power systems can be set up in all parts of the country so that the potential energy in the large networks of rivers can be tapped and converted to electrical energy. In this way the nation's electrification projects can be greatly enhanced.

Biomass Energy: Biomass energy refers to the energy of biological systems such as wood and waste. Biomass energy is an indirect form of solar energy because it arises due to photo-synthesis. The biomass resources of Nigeria can be identified as wood biomass, forage grasses and shrubs, residues and wastes (forestry, agri-

cultural, municipal and industrial) as well as aquatic biomass (Gumau 2007).

Wood, apart from being a major source of energy in the form of fuel wood is also used for commercial purposes in various forms as ply-wood, saw wood, paper products and electrical poles. For energy purposes, Nigeria is using 80 million cubic metres (43.4 x 109 kg) of fuel wood annually for cooking and domestic uses. The energy content of fuel wood that is being used is 6.0 x 109 MJ out of which between 5- 12% is the fraction that is gainfully utilized for cooking and other domestic uses. Although the biomass availability as at 1973 was put at 9.1 x 1012 MJ, it is expected that the overall biomass availability at present is lower than the 1973 figure. This is largely due to the demand of wood also for construction and furniture industries in addition to its use as an energy source. As for forage grasses and shrubs, estimates shows that 200 million tonnes of dry biomass can be obtained from them and this comes up to 2.28 x 106MJ of energy (Sambo 2003).

For crop residues and wastes, estimates of the 6.1 million tonnes of dry are biomass that produced annually leave residues whose energy content approximate to 5.3 x 1011MJ. Estimates made in 1985 give the number of cattle, sheep, goats, horses and pigs as well as poultry birds as 166millon.These produce 227,500 tonnes of animal wastes daily which come to 2.2 x 109MJ taking the calorific value of animal dung to be 9,800 MJ/ tonne. Animal residue can be converted to biogas and estimates show that this is of the order of 5.36 x 109m^3 which has an energy content amounting to 2.93 x 109 kWh (Sambo 2005).

CONCLUSION AND RECOMMENDATION

With the availability of renewable energy resources in all parts of the country, there is the urgent need for all of us to adopt practical measures that will systematically introduce various renewable energy technologies into the economy. Apart from policy measures that will promote the introduction of technologies based on individual renewable energy sources there is also the need to adopt an integrated approach to sustainable energy development. This is in recognition of the fact that conventional energy sources will continue to serve the transport and industrial sector of the economy.

Policy Measures for the Various Renewable Energy Sources

Biomass: The policy should be geared towards the reduction of the consumption rate of fuel wood. Strategies to be adopted include: the adoption of efficient wood- burning stove; systematic cultivation of fast growing trees needed to facilitate the regeneration of forest; active introduction of bio-gas digesters to cater for the cooking needs of especially large households and institutions like boarding schools, hospitals, barracks and prisons. Furthermore, development of alternative technologies to supplement wood both as a domestic energy source and also as a building/furniture material is necessary.

Solar Energy: There should be a policy for the use of solar energy; the thrust of the policy should be the incorporation of solar energy devices into as many spheres of the economy as possible. The strategy for this include: continuous active support for research and development activities to cater for site specifically of design for all parts of the country; support of demonstration and pilot projects to ensure that the general public become aware of the potentials of solar energy systems; provision of financial incentives to encourage the use of solar energy systems particularly in the rural areas where the greatest potentials exist and the introduction of regulatory measures to encourage and protect local capabilities.

Wind Energy: For wind energy, the policy and strategies for solar energy are also applicable here.

Hydro-Power Energy: The policy here is for the nation to manage its water resources for the development of its hydro- electric potentials and other uses: the policy should focus more on the micro-hydro plants. The additional strategy includes the initiating and the updating of data on the potentials of small scale hydro-plants and the preparation of inventories for their locations.

In conclusion, Nigeria is blessed with renewable energy sources if harnessed judiciously will reduce the dependence on fuel wood usage as an energy source. Hence, the problems associated with solid fuel will be greatly minimised.

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