

Energy – Environment Interaction: Case Study of Northern Nigeria

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Abstract

Energy – Environment interaction is one of the major challenges in both developed and developing countries. In the developing countries extraction of energy sources from the environment without degrading it has become a daunting task. Yet energy is a key ingredient for the development of all sectors of the economy. Data for this research were generated through field surveys and observations as a life time resident of the region and the tools for analysis used include descriptive analysis and the use of pictures, and diagrams The results have shown that the geographical region of Northern Nigeria is a vast region covering over 60 per cent of Nigeria's land area with a population of over 80 million people today. The region is well endowed with energy resources which include hydropower, biomass energy, solar energy, wind energy and crude oil deposits which were recently discovered and exploration is to commence soon. However, over the years the utilization and extraction of these energy sources (especially fuel wood from biomass and dam building for hydro-electric power) has brought about several negative consequences on the environment of the region. These consequences include dam flooding, spread of water borne diseases, deforestation of savannah vegetation and air pollution. It is therefore recommended that conscious efforts should be made to minimise the negative consequences and their impact on the local people of the region. Furthermore as crude oil exploration is about to start the region must learn from the experiences of southern Nigeria where oil extraction has lead to massive negative impact on their environment. Besides this the region should give more emphasis on exploiting its potential in renewable energy such as solar, wind and biogas for sustainable development.

Keywords: Energy, Environment, Interaction, Northern Nigeria.

1. Introduction

Energy and the environment posed major scientific and technological challenges for 21st century. Now technologies for increasing the efficiency of harvesting and utilizing energy resources are essential to a nation's economic competitiveness. At the same time the quality of life depend inherently on the environmental impact of energy production and utilization. The interdependence makes it imperative to develop a better understanding of the environment and new strategies for minimizing the impact of energy – related activities [1].

Energy is required by human beings for cooking, heating, lightening, cooling etc in our homes. It is required to move locomotive engines and transport goods. It is required to run machines and all forms of mechanical equipment to speed up the execution of work and to run industries [2]. Energy is thus fundamental to the quality of life on earth and a key ingredient in all sectors of modern economics. Man is totally dependent on an uninterrupted supply of energy for living and working. Meeting the growing demands of energy sustainable is one of the major challenges of the 21st century [3]. The environment is where energy sources are obtained by man to satisfy his energy needs which clearly shows the interaction between energy and the environment. This paper aimed at examining energy-environment interaction using northern Nigeria as a case study.

Northern Nigeria was a British protectorate in the northern areas of modern day Nigeria formed in 1905 form the union of the Niger Coast with territories chartered by the Royal Niger Company above Lokoja on the River Niger [4]. Today, northern Nigeria is a geographical region of Nigeria that is made up of nineteen (19) out of the thirty six (36) states that comprise the Federal Republic of Nigeria. The region covers about 60 per cent of Nigeria's land area of 923,800 square kilometres [5]. It is more populated than the southern region and based on the 2006 population census; the States have a population of 73,599,965 representing 52.57 per cent of the total population [5].

2. Energy Sources Utilized In Northern Nigeria

Nigeria has variety of energy sources that are utilised for various purposes. Some of these sources are found in the northern part include hydropower, biomass energy, solar energy, wind energy and crude oil.

2.1. Hydro power

Falling water is used to generate hydro electric power (HEP). In Nigeria, the main HEP stations are located in the northern part. They include Kainji HEP station (the largest) on the river Niger in Niger State, Jebba HEP station on River Niger in Niger State, Shiroro Gorge HEP station on River Kaduna in Niger State and Kurra Falls HEP station on River Kurra in Plateau State. The Kainji HEP station built for hydro-

electricity generation in 1969 is the largest and foremost dam in Nigeria. Kainji had in 1982 generated 533.8 million dollars at a generating capacity of 520MW [6]. The dam was designed to have a generating capacity of 960 MW, however only 8 of its 12 turbines have been installed reducing the capacity to 760 MW. The dam and others listed above generates electricity for all the major cities in Nigeria particularly those in the north [7]. Some of the electricity generated from these dams is sold to the neighbouring country of Niger. Besides these dams federal government of Nigeria has completed the design for the construction of both Mambilla and Zungeru Hydro power plants all in the north which will add about 3,000 MW to the national grid to boost electricity generation [8].

2.2. Biomass energy

Nigeria as a whole has abundant biomass energy resources. The availability of biomass resources follows the pattern of the nation's vegetation. The savannah vegetation in the north generates some quantity of woody biomass. In the north, the vegetation consists of three types of savannahs namely Guinea Savannah, Sudan savannah and Sahel savannah. Guinea and Sudan savannahs consist of trees such as Mahogany, silk cotton tree, locust bean tree, dum palm, baobab etc. There are also shrubs that are found within these savannahs. The trees and shrubs are used for fuel wood in households for cooking and for small scale industries in the region. There is high demand for fuel wood for cooking and heating in the northern region and the region's vegetation zones cater for the demand. Other sources of biomass energy come from agricultural residue and municipal solid wastes. Crop residues are abundant as a large percentage of the population are food and cash crop farmers. Municipal solid wastes are generated from the large cities of the north such as Kano, Kaduna, Sokoto, Zaria, Maiduguri, Abuja etc. There are saw dust and wood wastes that are also important biomass resources associated with timber brought from southern part of Nigeria [9].

2.3. Solar Energy

Nigeria lies within a high sunshine belt and thus has enormous energy potentials. The mean annual average of total solar radiation varies from about 35 KWhm⁻²day⁻¹ along the coastal latitudes to about 7KWhm⁻²day⁻¹ along the semi arid areas in the far north [10]. The north due to its arid/semi-arid continental climate has long hours of sunshine that are utilised to generate energy for various purposes. According to Sambo (2007) solar thermal applications for which technologies are already developed in Nigeria include solar cooking, solar water heating for industries, hospitals and households, solar evaporative cooling, solar crop drying, solar incubators and solar chick brooding [10].

In the north, solar electricity is used for water pumping in the rural areas. Solar boreholes are drilled in states such as Borno, Yobe, Jigawa, Kano and Katsina States. Many streets in these states are now lightened by solar electric streets lights and also traffic lights as recently introduced on the streets of Katsina, the capital of Katsina State. In terms of village electrification Tungar Buzu in Kebbi State is the first model

solar village in Nigeria [11]. Recently in 2012 Kano and Katsina State governments entered into a partnership with companies from Germany for the establishment of solar energy plants in different sites in these States.

2.4. Wind Energy

Northern Nigeria has over the years tried to harness its wind energy potentials for various purposes. The technologies for harnessing this energy have over the years been tried mainly for water pumping from open wells in secondary schools in Sokoto, Zamfara, Kano, Jigawa as well as in Katsina, Bauchi and Plateau States [10]. There are the wind energy conversion systems for the production of electricity for the rural community. Example is the 5 KW wind energy conversion system for village electrification of Sayyan Gidan Gada in Sokoto state. There are also the wind energy conversion systems for integration into the national grid system. Example is the Katsina State 10 MW wind farm designed to generate electricity for integration into the national grid to boost electricity production in the country as a whole.

A study by Ibrahim (2009) examines the wind energy potential for electricity generation in some northern states and concluded that out of the five States considered Sokoto and Kano are the most suitable sites for using wind energy systems using the three blade propeller type horizontal axis turbine based on the mean wind speed of 5.14 and 6.24 m/s respectively [12]. The north has potentials for wind energy at a time the world is moving towards 'green energy' and the several studies carried out by scholars in the north will in the near future attract the harnessing of the wind energy potentials of the region.

2.5 Crude Oil

Nigeria is the 12th largest producer of petroleum in the world and the 8th largest exporter and has the 10th largest proven reserves [13]. Nigeria's crude oil production in million barrels from the year 2000 to 2007 can be seen on the bar graph on figure 2. Crude oil production in Nigeria is entirely based in the southern part with the north having only one refinery at Kaduna. Pipelines buried underground from Warri in the south transport the crude oil to the Kaduna refinery where the crude oil is refined into petroleum, kerosene, diesel oil etc. These products are distributed and used as sources of energy to power motor vehicles and for cooking in households.

However, crude oil deposits were recently discovered in the Chad Basin in Borno State and on the Sokoto River Basin in Sokoto State. The prospects of crude oil exploration and exploitation in the north has gladdens the hearts of many people in the region. This is in view of the many years of agitation for resource control and increase in share of the national allocation due to presence of crude oil in the southern parts. However, as exploration is set to commence soon efforts must be made to avoid the undesirable social consequences of the exploration and production on the local people.

3. Consequences of Extraction of the Energy Sources on the Environment

The various energy sources that are extracted from the environment have consequences on the environment of northern Nigeria.

3.1 Hydro-electric Power Generation

The generation of hydro-electric power involved the building of dams on rivers which have negative consequences on the environment. These are:

- Flooding of communities, both human and plants/animals. In October 1998 spillways of the Kainji Dam simultaneously release water and all communities along the River Niger from Jebba to Pategi, a distance of about 300km were flooded. 100,000 people were affected as thousands were displaced [6]. Again in 1999, uncoordinated opening of the dam flood gates led to the flooding of about 60 villages [6]. The Kainji dam nearing to its full capacity can be seen on fig.1
- These dams have released water and contributed to the damaging floods that have affected many states in the federation in the year 2012. In particular the states of Niger, Kaduna and Plateau where these dams are sited are among the worst hit states.
- The building of dams involves making large quantity of water to remain stagnant which is the idle breeding ground of vectors of diseases such as *schistosomiasis*, *onchocerciasis*, malaria fever etc. These are common diseases affecting people who live around the dam sites.
- The ecosystem is disrupted due to the creation of dams; the local wild life displaced as the ecosystem becomes fragmented.



Fig. 1: Kainji dam located on River Niger, Northern Nigeria.

3.2 Fuel wood Extraction

The high demand and usage of fuel wood for cooking, heating and small scale industrial use has resulted in the cutting of many trees and even shrubs in the savannah region of northern Nigeria. According to Food and Agricultural Organization (FAO) Nigeria has the world's highest deforestation rates with the collection of wood as fuel cited as a leading cause of deforestation [14]. Deforestation arising from fuel wood extraction have created a lot of negative consequences on the environment of the north. These are

- The felling of trees has contributed to the deforestation of large areas in States such as Sokoto, Kebbi, Kano, Katsina among others. Plate number 2 shows deforestation in the Guinea Savannah vegetation zone of Northern Nigeria. A study of Ladan (2013) have shown that even gazetted forest reserves in Katsina State were not spared by the deforestation which already has brought about negative consequences on the environment [15].
- The felling of trees and shrubs has contributed to the desertification of the Sudan and Sahel savannah vegetation zones in the northern states. Most of these areas today resembles desert environment as desert continue to encroach upon the once productive vegetation zones of the north.
- The burning of fuel wood for domestic energy produce air pollution and the smoke affects the user's eyes and lungs when inhaled, this has serious negative impact on the personal health and well being of many women in the rural and urban areas of northern Nigeria.
- The deforestation of the vegetation is expected to continue if no special programme is put in place to discourage the use of fuel wood, promote the use of alternatives and replenish through deliberate afforestation and fuel wood lots. This has grave implications for sustainable environment of the low income households who depend on fuel woods [10].

3.3 Solar and Wind Energy Extraction

These are renewable energy sources that produce energy referred to as 'Green Energy' due to the little or no negative impact on the environment. Solar energy plant has impacts that are negligible with minimal impacts on the environment, even though the plant does produce waste which are easily disposed off [16]. Wind energy generation has some minimal environmental damage which is listed below.

- Wind farms are sources of noise pollutions as the propellers when in motion generates noise which can disturb the local people that reside around such sites.
- Wind farms interrupts the view in remote isolated places and destroy the sense of isolation and the natural beauty [17]. This can be serious in the region as some of the wind farms (e.g Katsina 10 MW wind farm) are not too far from residential areas and as such can be seen and heard.
- The propellers of wind farms when set in motion disturbs the movement of wildlife that fly in the air especially birds. Hence bird's kills were a common problem as witnessed in wind farms in the United States of America [17].

3.4. Crude Oil Extraction

Crude oil extraction in Nigeria has over the years been associated with massive negative consequences on the environment especially that of the Niger Delta region and the surrounding oil producing areas. The north with its one refinery has some share of the consequences.

Crude oil refining in Kaduna is a major industrial activity that has led to environmental degradation specifically land and water pollution arising from oil pillages from the refinery [18].

The general impacts of energy extraction from the environment in Northern Nigeria can be seen on figure 3 below.

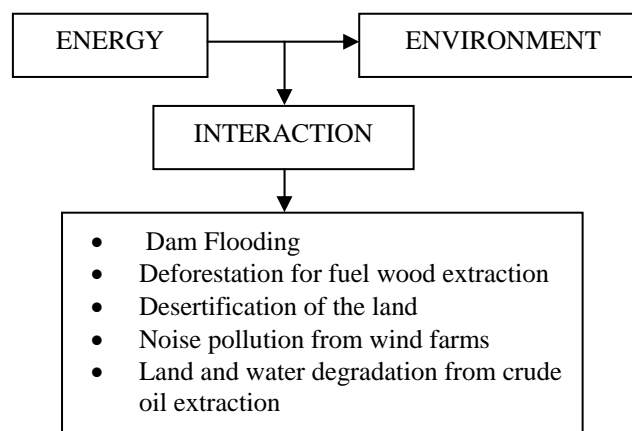


Fig. 2: Impacts of energy extraction on the environment in Northern Nigeria.

4. Conclusions

Today the extraction of sources of energy from the environment is an inevitable part of economic growth, development and human welfare. In northern Nigeria, the environment has suffered various forms of degradation due to extraction and utilization of energy sources. This has therefore necessitates the need to minimize the problems associated with energy sourcing from the environment and its negative consequences. In particular people should be able to afford and access alternative sources of energy rather than fuel wood to reduce deforestation, promote afforestation and improve the environment. Furthermore as crude oil exploration is about to start, the region must learn from the experiences of southern Nigeria where oil extraction has led to massive negative impact on the environment. Beside the region should give more emphasis in exploiting its potentials in renewable energy such as solar, wind and biogas for sustainable development.

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