Northern Nigeria's Dependence on Fuelwood: Insights from Nationwide Cooking Fuel Distribution Data

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Abstract

Maconachie et al. (2009) in their work "Descending the energy ladder? Oil price shocks and domestic fuel choices in Kano, Nigeria" show that cooking fuel consumption in Kano city (Northern Nigeria) is biased in favour of the traditional fuelwood (i.e. the northern population are descending the energy ladder, not ascending it, as might be expected). This finding prompted the present wider exploration of cooking fuel supply and consumption at the national scale, in order to understand the spatial patterns of fossil fuel distribution and consumption in the country, with a view to examining whether there are any spatial patterns of such inequalities amongst households across the 36 states of Nigeria (and Abuja the capital city). Spatial analysis of the distribution and consumption of cooking fuel was conducted using Geographical Information Systems (GIS). The results show that fossil fuel supply is precarious in the country. The majority of the northern states are deprived of sufficient fossil fuel, and this is closely correlated with their dependence on traditional fuels (fuelwood), leading to considerable pressure on the region's scarce vegetation resources.

Key words: Nigeria, Fossil fuel, Fuelwood and GIS

1.0 Introduction

Fossil fuel resources are major economic assets worldwide. Petroleum resources, for example, have been the largest contributor to the Nigerian Federation accounts through export earnings and second largest contributor to the Gross Domestic Product (GDP) (Sambo, 2008a). Nigeria's oil reserves are estimated at about 36.22 billion barrels, while natural gas reserves are 187 trillion standard cubic feet. The gas reserve is at least twice that of crude oil in energy terms (Nigerian National Petroleum Corporation (NNPC), 2010) (see table 1).

Although Nigeria is a wealthy country in terms of human and natural resources, its social and economic development is quite slow. This fact can be illustrated by the country's high level of poverty, lack of basic social infrastructure and above all, the indisputably high level of corruption (Kar & Freitas, 2012). For example, about 65 percent of the country's approximately 160 million people are living below the poverty line (on less than US\$1.25 a day) (United Nations Development Programme (UNDP), 2009: p.63 & UNDP, 2010: p. 162). A UNDP report further confirmed that the poverty figure in Nigeria (over 90 million people), is higher than the combined population of 10 other West African nations excluding Ghana and Cote D'Ivoire. The country is ranked 139 on the list of 176 countries in terms of corruption (Transparency International, 2012).

The level of corruption in Nigeria has also manifested itself among all the energy sectors. For example, the country is experiencing a persistent high cost and irregular supply of fossil fuels, despite several governments' promise(s) of making petroleum products freely available (especially whenever they want to justify price increases- see for example Adelekan & Jerome, 2006). Also, the electricity supply is erratic and of poor quality (Odularu & Okonkwo, 2009 & Olise & Nria-Dappa, 2009).

Indeed the electricity supply in the country is so unreliable that people now depend on their own power generators in order to meet their demands. Opara (2013), in a Punch newspaper edition of January 31st, 2013, reported how the country struggled in 2012 to generate even 5,000 megawatts (MW) of electricity for its 160 million population, as compared to at least 40,000 MW, which is required to sustain the basic needs of such a population (UNDP, 2010). The electricity generating figures suggest that Nigeria produces less than half of the Ghanaian average, nine times less than the African average, and 22 times less than the world average (Sambo, 2008b; Sambo, 2009 & Research & Markets, 2011). As Sambo (2008b: p. 33) has indicated, the electricity sector in the country would require an annual investment of more than US\$ 6.46 billion to meet the UNDP's (2010) requirements. However, this is unlikely to happen in the near future, given the level of corruption in the country (Kar & Freitas, 2012). Thus, the population has to depend on the traditional fuel (fuelwood) for their cooking (Maconachie et al., 2009). Table 2 highlights some of the socio-economic characteristics of Nigeria, while figure 1 shows a map of Nigeria and its international boundaries.

From table 2, the human poverty index (HPI) data reveal that poverty is more common in the northern part of the country (with the exception of the FCT, which is the seat of power). Comparatively, all the southern states have a better human development index (HDI) than the northern states. Out of the top 10 states with the highest HDI, eight are in the south; and of the bottom 10 states with the lowest HDI, nine are in the north. Since poverty is a major factor in development, it is therefore not surprising to see that the North East zone (which has the lowest human development profile) has the highest HPI with an average score of about 49 per cent (UNDP, 2009: p. 71 - 95).

This paper uses quantitative methods (Geographical Information Systems (GIS) techniques) to explore spatial inequalities in the national distribution and use of cooking fuel and contribute to an improved understanding of energy poverty in Nigeria. It is also hoped that the policy makers will find the results useful in addressing the complex situation of the Nigerian energy crisis.

2.0 Overview of Fuelwood usage in Nigeria

In Nigeria, the demand for fuelwood is very high because more than 80% of households use fuelwood for their cooking, making it the most used form of cooking energy (Sambo, 2008a). The over-dependence on fuelwood in the country has been attributed to its availability and affordability compared to the other sources of energy (Maconachie et al., 2009). Earlier research found that fuelwood consumption in the north and south western parts (the Ibadan area in Oyo state) of Nigeria far exceeds sustainable production (Cline-Cole et al., 1987; Hyman, 1993; Hyman, 1994 & Ogunkunle & Oladele, 2004), and the deficit is only made up from areas of surplus (pockets of localised vegetation in the other parts of the country), which adds to the cost of the wood (Adeoti et al., 2001).

Nigeria has already shown a tendency towards excessive total fuelwood consumption (see tables 1 & 2), which, according to Sambo (2008a), is due to population growth, low technical efficiency of the traditional cooking style and the lack of adoption of other sustainable cooking methodologies. While Sambo's (2008a) claims cannot be denied as part of the overall problem of fuelwood in Nigeria, one key factor he does not consider is the unreliability in the supply of alternatives to fuelwood in the country.

The 2005 UNDP report on Millennium Development Goals (MDGs) indicates that the majority of the countries participating in the MDGs project (including Nigeria) take little notice of the energy requirements of poor people, by only treating energy development within the context of large-scale infrastructure projects, without taking on board the traditional sources of energy in their policy decisions. The continued lack of commitment shown by most of the countries participating in the MDGs' programme, to address the problem of energy deprivation, is reflected in the energy poverty seen today in many developing countries (Florini & Sovacool, 2009; Cherp et al., 2011 & Scott, 2012).

Overall, Olise and Nria-Dappa (2009) emphasised that the energy situation in Nigeria is actually worse than has been revealed to the outside world. They presented their arguments on the basis of the household income ratio to their spending on energy and revealed that the poorest households earn about 1-2 US dollars per day and spend about 0.4 dollars per day on energy. This represents about 20-40 percent of the household's income spending on energy alone.

Even though this figure seems to be high, the fact remains that the availability and acquisition of fossil fuel products in Nigeria is highly erratic due to the corruption that has become endemic in the Nigerian National Petroleum Corporation (NNPC) (Ogbonnikan, 2012 & Tsan & Odemwingie, 2013).

From the foregoing it is obvious that there are complex issues surrounding energy provision in Nigeria that are yet to be fully understood. To unpack these issues requires a relatively thorough study, and the deployment of methodological approaches to examine both the national situation and regional variations, whose results can be interpreted in conjunction with the existing literature, in order to provide a fully contextualised understanding of the problems involved and suggest possible policy solutions. Past studies have used various methodologies to illustrate this. Examples include Ojo et al. (2010) who used national census data to illustrate the pattern of cooking fuel usage in Nigeria using geodemographic classification system techniques, and Ehinomen and Adeleke (2012) who used data obtained from the NNPC to describe the zonal distribution of fossil fuels in Nigeria using simple statistics. However, no previous study has utilised quantitative analysis techniques based on choropleth mapping (using both national census and fossil fuel supply data) to examine the variation of cooking fuel supply and consumption problems across all scales from the national to the regional level.

3.0 Methodology

3.1 Data Sources

The data for this study were obtained from secondary sources (National Population Commission of Nigeria (NPC), the Pipelines and Products Marketing Company (PPMC) and the Nigerian National Petroleum Corporation (NNPC)). Data on different cooking fuel types used by households are official census figures from the 2006 Nigerian census obtained from NPC (NPC, 2009 & NPC, 2010). The procedure for the Nigerian 2006 census is described on the NPC's website (www.Population.gov.ng).

The data on the distribution of fossil fuel, i.e. petroleum, kerosene and gas products were obtained from NNPC's Corporate Planning and Strategy Division (CP&S) in its 2010 Annual Statistical Bulletin. The data show the annual distribution of fossil fuels to the various states of Nigeria for 2010 in thousands of metric tons.

It should be noted that all the data used in this study are official figures, which cannot be verified from other sources and therefore have to be used as they stand. The unreliability of official data in Nigeria is one of the limitations of this study. Problems arising from this can be illustrated using the 2006 national population census results published by the FG (News Agency of Nigeria (NAN), 2012), where for example, Lagos state regarded the figures from the FG as being biased and politically motivated and therefore not representative of the real distribution of the country's population (Amokeodo & Isah, 2011).

3.2 Data Organization and Analysis

Cooking fuel types in Nigeria can be categorised into fossil fuels, which comprise kerosene and gas, and nonfossil fuels, made up of firewood (fuelwood), charcoal, animal dung, sawdust and solar power. Electricity in the country is generated through both gas turbines and hydro (electricity). This makes it difficult to place it either in the fossil fuel or non-fossil fuel categories. Therefore, for the purpose of this study, fossil fuels, solar and electricity are referred to as modern cooking fuel types, while the non-fossil fuels excluding solar are referred to as traditional cooking fuel types. The data obtained on these two types of cooking fuels were organised into a simple database using a Microsoft Office Excel worksheet and analysed using the ArcMap 10 GIS software.

The energy situation in Nigeria is analysed cartographically to show the extent of spatial variations of each energy type. A map plays a vital role in depicting the spatial organisation of events. However, with the continuous advancement of computer graphic packages to generate maps, especially in the field of Geographical Information Systems (GIS), maps can now be used and presented in more sophisticated ways, for analysis, policy and decision making (Parker & Asencio, 2008). Dent (1985) derives three main uses of choropleth maps as follows: 1) To ascertain an actual value associated with a geographical area; 2) To understand the geographical pattern of the mapped variable with attention to individual values, and finally; 3) To be able to query one choropleth map pattern with another concurrently. For these reasons, choropleth mapping is used in this study. The analysis conducted is illustrated in figure 2, which demonstrates how the various data were incorporated into the GIS for mapping.

All the data were transformed into percentages because they are easier to interpret than the raw data using the formula below.

Equation 1

The fossil fuel distribution data are in thousands of metric litres and were changed to percentage of distribution per state in thousands of metric litres using the formula below.

Equation 2

The location points of refineries, pump stations and depots were digitised from an existing paper map obtained from the PPMC. The map was georeferenced in ArcMap 10 with an existing referenced shapefile of Nigeria. The three data sets (cooking fuel variables, fossil fuel distribution and the location points) were organised in an excel spreadsheet, which was then imported into ArcMap and joined together with the Nigerian boundary shapefile for further analysis.

4.0 Results

4.1. The Consumption Pattern of Cooking Fuel in Nigeria

Results from the analysis of usage of different cooking fuel types among households (figure 3a), revealed that more fuelwood is being used for cooking than any other fuel type. Out of the 28,197,085 households in Nigeria (see table 2), only Lagos state uses less fuelwood than other fuel types, while about 30% of households in each of the remaining 36 states including Abuja the Federal Capital Territory (FCT) primarily use fuelwood for their cooking. Similarly, solar energy is the least popular form of energy. It is only used for cooking by 41,786 households in the country.

Although, fuelwood use varies across the different states, figure 3a shows the northern states to be the largest users of fuelwood. Conversely, kerosene (modern fuel) which is the second most important fuel after fuelwood (in terms of usage among households) dominates the southern part of the country, particularly in the southern states of Lagos, Oyo, Rivers and Ogun where the use of kerosene surpasses any other cooking fuel type. For example, out of the 2,195,842 households in Lagos state, about 1,771,100 households (more than 80%) solely use kerosene for their cooking. In contrast, more than 70% of households in most northern states use more fuelwood than any other cooking fuel type (figure 3b).

4.2 Fossil Fuel Distribution in Nigeria

The zonal distribution of fossil fuel in Nigeria is lopsided (see figures 3c), because some areas receive more supply than others. As observed in figure 3c, the North-East and South-East zones receive the lowest supply.

In terms of the percentage share of the total fossil fuel supply in Nigeria, the South-West receives the highest at 41.54%, followed by the South-South region with 23.87%. The North-Central receives 16.64%, while the North-West, which has the highest population in the country (among all the zones- see table 2), only receives 5.92% of the total supply. The FCT, with the smallest population, receives 4.91%, which is only 1% less than the supply of North-West and slightly higher than the supply of North-East and South-East, which receive 4.35% and 2.77% of the total supply respectively. These variations in the supply patterns of fossil fuels can now be further disaggregated by modern cooking fuel type.

The spatial distribution of Household Kerosene (HHK) between the various states (figure 3d), shows that only Kaduna state in the north; Lagos, Edo, Delta and Rivers states all in the south and the FCT receive a large supply of HHK. It is again evident from figure 3c that the supply of HHK in the country is insufficient, given that the great majority of the states receive a very limited supply of the commodity (figure 3d).

The disparity in the supply pattern of HHK matches the differences in the consumption pattern of fuelwood in the various states (areas with a lower supply of modern fuel are using a greater amount of fuelwood and vice versa). However, a few states were observed to be consuming large amounts of fuelwood, despite also receiving a high or moderate supply of HHK. For example, Kaduna state in the north receives a good deal of HHK (about 3 litres per person), but more than 70% of its households use fuelwood.

In contrast, states such as Anambra in the south, receive a more limited amount of HHK (about 0.8 litres per person) and yet less than 40% of Anambra households use fuelwood. Despite these apparent inconsistencies in a few states, others such as Rivers and Lagos in the south and the FCT, which all receive a large supply of HHK (3.3, 3.0 and 10.1 litres per person respectively), appear to be using correspondingly less fuelwood. Likewise, the majority of the northern states, which receive a limited supply of HHK (less than 1 litre per person), depend largely on the traditional fuelwood.

As shown in figure 3e, the supply of Liquefied Petroleum Gas (LPG) in the northern part of Nigeria is high in Kano state and moderate in Kaduna state. Despite the high and moderate supply of LPG in these states, more than 65% of their households depend on fuelwood for their cooking. In contrast, Anambra, Delta and Ogun states in the south receive a low supply of LPG, while about 40% of their households use fuelwood. In Rivers and Lagos states in the south and FCT, LPG supplies are ample and they are among the lowest users of fuelwood in the country. This is not surprising because these states are the most affluent in the country, each with various key functions (Lagos as the commercial centre of Nigeria; Rivers as the headquarters of the oil companies and the FCT as the seat of cultural government). Figure 3e suggests some irregularities in the supply of LPG, which seem to be confined to a few states.

Although Premium Motor Spirit (PMS) is not directly used as cooking fuel in Nigeria, its relevance to the procurement process for fuelwood cannot be overlooked¹. PMS supply affects the lifestyle of the people because the higher its price, the higher the cost of fuelwood and all other commodities, since the major form of goods delivery within the country depends on road transport (Odeleye, 2000: p. 43 & Nigerian Railway Corporation (NRC), 2010).

As outlined in figure 3f, only Lagos state and the FCT receive a substantial supply of PMS. A few states (North-Central and South-West) receive a moderate supply, while the majority receive a limited supply of the commodity. A comparison of PMS supply (figure 3f), with the household fuelwood usage (figure 3b) reveals that while Lagos state and FCT receive a large supply of PMS and use less fuelwood, the consumption pattern of the latter in other states does not consistently follow the supply pattern of PMS.

On a broader scale (figure 3c), the supply of modern cooking fuel in Nigeria is precarious, since the south receives more than the north. While this partially explains why the majority of the northern states predominantly depend on fuelwood for their cooking, a comparison of figure 3b with figures 3d-f shows that some states (both in the south and the north) that receive a substantial supply of certain modern fuels, also use a large amount of fuelwood for their cooking. Several questions arise from this, such as; why are there such differences in the fossil fuel supply among the various states? Or what factors are responsible for the differences in the use of fuelwood among the various states in Nigeria? Some of the possible answers to these questions are detailed below.

5.0 Discussion of Cartographic and Statistical Findings

5.1 Fuelwood Versus Other Cooking Fuel Types in Nigeria

The summary of the cooking fuels used by households in Nigeria (figure 3a), revealed that the southern parts of the country use more modern fuels (kerosene and gas) for their cooking than their northern counterparts, whose cooking fuel choice is related to the erratic supply of fossil fuel in the region.

Despite this variation in the most usable form of energy in the country, the use of fuelwood among households has become the accepted norm in most locations. While this situation is the same as observed in other developing countries (Kebede et al., 2010), the case of Nigeria requires close attention, because the size of its forest reserves has drastically reduced in recent times (see for example FAO, 2010: p. 21 & FAO, 2011: p. 3). The high levels of fuelwood consumption among households in the country reported here agree with the findings of Maconachie et al. (2009) and Adelekan et al. (2006) in both the northern and southern parts of Nigeria respectively.

Even though the total amount of fuelwood use in Kano and Kaduna states in the north far exceeds any other state in the country (see figure 3a), because of their population (first and third respectively in the country, with a combined total population exceeding sixteen million people- NPC, 2009), they have a similar proportion of fuelwood use as the rest of the northern states (over 65% of their households solely depend on this fuel- see figure 3b).

¹ PMS has relevance in terms of fuelling the vehicles that convey goods in the country and fuelling household power generators (small sets of generators) that the majority of households in Nigeria use in supplying temporary electricity in their homes (Adenikinju, 2003).

Similarly, the country's regions do not show any substantial variation in terms of the transition from the use of fuelwood to the use of modern cooking fuel. The explanation for this limited variation in the use of cooking fuel lies with the high price and unreliability in the supply of modern cooking fuel. These factors have favoured the reversion of the majority of the households from the use of modern cooking fuels back to traditional fuelwood in recent times (Maconachie et al., 2009 & Adelekan et al., 2006).

Some authorities have argued that the use of fuelwood is largely found in lower income families in the developing countries (Adelekan et al., 2006; Kowsari & Zerriffi, 2011 & Sovacool, 2011), which contrasts with the ways fuelwood is being used in the developed countries. Couture et al.'s (2012) study of the use of fuelwood for heating among families in France shows a reverse relationship between fuelwood use and income, because affluent families use fuelwood for pleasure rather than from necessity. The present findings contrast with both these studies, because the difference between the rich and the poor in terms of fuelwood use is negligible, especially in the northern states of Nigeria, where even the affluent families have to rely on fuelwood for their cooking, due to the shortage of modern fuel supply (Maconachie et al., 2009).

5.2 The Strategy of Fossil Fuel Distribution in Nigeria

Contrary to the energy ladder concept (figure 4) that assumes ready availability and uniform supply of all fuel types, so households can choose their cooking fuel based on their income level (Kowsari & Zerriffi, 2011)², the case of Northern Nigerian fossil fuel supply is different, because it is erratic and in some cases insufficient (Maconachie et al., 2009). This makes the 'choice' of cooking fuel by households a matter of availability, rather than the genuine selection between alternatives emphasised in the energy ladder (for example, see figures 3a, d & e).

Conversely, the analysis of the zonal distribution of fossil fuels in Nigeria (figure 3c above) shows an inconsistency in their distribution. For example, Lagos, Ogun and Oyo states in the South-West and Rivers and Delta states in the South-South have large concentrations of industries that can justify these two regions' having the largest shares of overall fossil fuel distribution in the south. However, in the north, although the North-Western states of Kano and Kaduna have the highest concentration of industries, they only receive 5.92% of the total supply of fossil fuels in the country.

Again, looking at the regional population distribution (see table 2), it is obvious that the distribution strategy for fossil fuels among the various states is not population dependent. For example, while the combined population of the southern part of the country is 46.4%, it receives about 68.18% of the total fossil fuel. In contrast, the north with a population of more than 52.6% (excluding Abuja) only receives 26.91%, while Abuja, with 1% of the population receives 4.91% of all fossil fuel.

Another factor that may affect the supply pattern of modern fuel is the concentration of oil related activity in the south. While this is true, the refineries in this region are not fully functional (Pipelines & Products Marketing Company (PPMC), 2010), which is why Nigeria has to rely on the importation of refined fossil fuel, while its crude is being exported. Also, there is a pump price regulatory body in the country, under the Petroleum Equalisation Fund Management Board (PEF (M) B) ³"to deal with the problem of cost differentials arising from the transportation of petroleum products to various parts of the country, based on a uniform pricing policy" (Ehinomen & Adeleke, 2012: p. 236).

There are also allegations of sabotage among the petroleum product supplying regulators that hampers the steady supply of fuel to the north. For example, a report in the cover story of Leadership newspaper edition of 02/08/2011 entitled "NUPENG uncovers fuel supply sabotage plot in North" (Alohan, 2011a), quoted the Kaduna Zonal executive of National Union of Petroleum and Natural Gas Workers (NUPENG) saying that; "we have painfully uncovered a grand design by a group of disgruntled elements who are not happy with the free flow of petroleum products in the entire northern states....., who have started making efforts to disrupt it by circulating false information around..., which we believed is a hidden plot to destabilise the free flow of petroleum products to the north".

² "The energy ladder emphasised that households choose to move up the ladder as soon as they can afford to do so" (Kowsari & Zerriffi, 2011: p. 7508).

³ It is a parastatal (organisation) in the Federal Ministry of Petroleum Resources established by Decree No.9 of 1975 (as amended by Decree No. 32 of 1989) to create a uniform petroleum products pump price policy in Nigeria.

A second report in the same newspaper's edition of 24/06/2011 (Alohan, 2011b) entitled; "*Kerosene scarcity: NNPC punctures IPMAN's lopsided allocation claim*", addressed similar issues. In the report, the NNPC's General Manager of the Public Affairs Division, Dr. Levi Ajuopnuma, faulted the claim made earlier by Alhaji Aminu (president of a factional group of Independent Petroleum Marketers Association of Nigeria (IPMAN) - i.e. independent petroleum retailers, see table 3), that accused NNPC of disproportionate allocation of kerosene in favour of the major marketers (selling organisations).

Although the claim was countered by the accused, the matter should have been investigated further, because it could be a possible reason for the uneven distribution of petroleum products between the south and the north (as shown in this study), since the total number of marketers is much higher in the south than the north (1,435 to 783 major marketers; & 4,881 to 3,063 independent marketers- see table 3). In addition, Ehinomen and Adeleke (2012: p. 241) faulted the distribution system of petroleum products in Nigeria as being ineffective due to the full control of the sector by the government. They therefore recommended the deregulation of the downstream sector of the petroleum industry, in order to allow private investors and entrepreneurs to fully participate in the sector, a situation that should lead to improved effectiveness in the distribution of the product.

It should be remembered that even the figures of the fossil fuel distributions provided by the NNPC (used in this study), may not reflect the true amount of the final products reaching the majority of the northern states. Again, this can be attributed to various allegations of misconduct and sabotage in the country's petroleum regulation sector. For example, earlier researchers have reported smuggling as the key factor responsible for the product shortage in the country (particularly the northern part- Odihi, 2003 & Garuba, 2010). However, in January, 2012, the Nigerian Government withdrew part of the fossil fuel subsidy, in an attempt to eradicate the misconduct of the petroleum marketers, by applying a fair price policy. The government believed this would remove the financial incentives for smuggling and increase supplies. Unfortunately, this has not proved to be the case because the northern states continue to witness shortages in the fossil fuel supply, while the prices of all other household commodities have increased by about 65 percent compared to their original price prior to the subsidy withdrawal (This Day Newspaper, 2012). These sharp price increases are attributed to the increase in the cost of transportation, which has risen by 100 percent or more. Another new factor is that both Niger and Chad Republic, once considered the best places to sell Nigerian smuggled products (Garuba, 2010), have recently started refining their petroleum products, while the Cameroun Republic (another smugglers' destination, particularly in the north), will shortly follow suit.

These recent positive developments in neighboring countries do not seem to have produced any major change in the fossil fuel shortages in Northern Nigeria to date. It is therefore, unclear at this stage whether this situation will start to change in future. It is difficult to completely discard the claims of earlier researchers that smuggling was a key factor in supply shortages in favour of the findings of this study, that there is a precarious distribution strategy, which favours some regions. However, only time can substantiate either or both of the two claims. It should also be noted that Odihi (2003) argued that the northern Borno state's share of modern fuel supply is sufficient for its requirements, particularly if the product is utilised properly in the state, rather than smuggled out. Such claims can only be objectively tested in the future, given that the circumstances in the neighbouring countries he claimed the products were smuggled to, have only changed recently.

5.3 The Driving Forces of Fuelwood Consumption in Nigeria

The high rate of unemployment in Nigeria (23.9% percent of Nigeria's population are unemployed- Eroke, 2012), is also relevant to the affordability of fossil fuel and the extensive use of fuelwood. A more recent development relating to poverty and social injustice in Nigeria is the emergence of "*Boko Haram*" in the north east (for a comprehensive discussion of the group's activities, refer to Amnesty International Report (Amnesty International, 2012).

The *Boko Haram* crisis has generated a huge debate in the country about the cause of the conflict and ways of resolving it. From the statements of leading stakeholders engaged in the debate, it is obvious that the majority of the arguments lean towards poverty and unemployment among youths in the northern region. These arguments are now widely circulated by the media. Attention has also centred on subsistence agriculture, on which they formerly depended, because this is no longer viable, especially with the increasingly high cost of fertilisers and other farming activities in the country (Porter et al., 2003).

The neglect of the agricultural sector in the region is attributed to a lack of commitment by the government in assisting farmers, by regulating the price of their crop outputs and the supply of fertilisers. This lack of support by the government in the past has pushed away many poor families from practicing full time agriculture. These reasons and of course, other "obvious" and "hidden" reasons (some of which have been discussed earlier) must have reduced the purchasing capabilities (of fossil fuels, even if they were made available) of most families in the region.

6.0 Conclusions

The data used in this analysis were generated some years ago (prior to the removal of the fossil fuel subsidy in January 2012), and may therefore not reflect the current situation in the country in terms of the distribution of fossil fuel and the relative inaccessibility of the product to the people. However, it can be argued that the increase of fossil fuel pump prices following the fossil fuel subsidy withdrawal, aggravated the suffering of the mass of the country's population who cannot afford the necessities of life (because of the increase in the prices of commodities, as a result of the country's reliance on road transport services). In this sense therefore, even the fuelwood consumption figures presented in this study may be lower than the current consumption situation.

Another issue is the scale (state level) at which the investigation was necessarily conducted. The varying sizes of the states considered in this analysis may have concealed localised but important differences, which have therefore not been identified and reported. However, the use of the state boundaries rather than Local Government Area (LGA) boundaries (which were provided by the census data) was a result of the unavailability of fossil fuel distribution information at a similar scale to the census data, despite several requests to the authorities to provide data at this level of disaggregation.

Overall, the study has explained important patterns of cooking fuel consumption and distribution in Nigeria. It has augmented the findings of the existing literature by analysing the high dependency on the use of fuelwood in some parts of the country. It has also provided some answers to the two specific questions posed at the end of section 4.2 as follows:

1) What factors are responsible for the differences in the use of cooking fuels among the various states of Nigeria?

The findings of this study reveal that the majority of the northern states of Nigeria predominantly use fuelwood for their cooking, while their southern counterparts use modern fuels. However, while there is a limited supply of modern cooking fuel in the country, the use of fuelwood in the majority of the northern states is related to the low supply of fossil fuel in the region.

2) Why are there differences in the fossil fuel supply among the various states?

No clear answer has been found as to why there are substantial differences in modern fuel supply, which favour a few states in the country. It has, however, been found that population size and industrial activities do not explain the high or low supply of modern fuels in the country.

The results here show that both modern and traditional cooking fuel types are extensively used in Nigeria, although to widely varying degrees. The northern states for example, are deprived of modern fuel supply and are therefore more dependent upon the traditional fuels for their cooking. This of course has implications for cooking fuel poverty, emanating from the fossil fuel supply strategy, which is precarious in the country.

While it has long been recommended that the use of fossil fuels in Nigeria should be encouraged over traditional fuels among households (Sambo, 2008a), this study has shown that the insufficient supply of fossil fuel in the north is causing most households to descend the energy ladder back to the use of fuelwood. For example, the use of gas for cooking is still seen in Nigeria as an opportunity to display the level of one's affluence (due to its high cost and low supply), which explains why it has not been a very popular cooking fuel option among many families (see figure 3a).

The current situation with modern fuel in Nigeria is expected to worsen in the future due to the recent price increases of PMS and LPG (as a result of partial subsidy withdrawal), which will make them too expensive for most families to use. Balouga (2012: p.34) noted that there is a lack of "coherence and consistency in the enforcement of government policy in the household energy sector, which has resulted [in] the high demand for fuelwood in Nigeria in recent times".

Unfortunately, the future supply of fuelwood in Nigeria (particularly the northern region) is unsustainable, because the country's forest resources are decreasing at an alarming rate (FAO, 2010 & FAO, 2011). Therefore, unless there is a change in the existing policy of fossil fuel distribution and pricing, the mass return of households to the use of fuelwood and charcoal for cooking will continue (Balouga, 2012). As accessible areas of forest decline, especially in northern states (see for example report of Forestry Management Evaluation and Coordinating Unit (FORMECU), 1996), it is inevitable that fuelwood collection will progressively extend beyond local borders.

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| S/No | Resource Type | Reserves (Natural Units) | Geographical Location | Production Level (Natural Units) | Utilization (Natural Units) |
|------|----------------------|--|---|---|---|
| 1. | Crude Oil | 36.22 billion barrels | South-South South-East South-West | 2.06 million barrels/day | 445,000 barrels/day |
| 2. | Natural Gas | 187 trillion standard cubic feet (SCF) | South-South | 7.1 Billion SCF/day | 3.4 billion SCF/day |
| 3. | Coal and lignite | 2.734 billion tonnes | Spread Nationally | insignificant | insignificant |
| 4. | Tar Sands | 31 billion barrels of oil equivalent | South-West | insignificant | - |
| 5. | Large Hydropower | 11,250 MW | North-Central | 1,938 MW (167.4 million MWh/day) | 167.4 Million MWh/day |
| 6. | Small Hydropower | 3,500 MW | Spread Nationally | 30 MW (2.6 million MWh/day) | 2.6 million MWh/day |
| 7. | Solar Radiation | 3.5 - 7.0 kWh/m2/day (485.1 million MWh/day using 0.1% Nigeria land area) | Spread Nationally | Excess of 240 kWp of solar PV or 0.01 million MWh/day | Excess of 0.01million MWph/day of solar PV |
| 8. | Fuelwood | 11 million hectares of forest and woodland | Spread Nationally | 0.110 million tonnes/day | 0.120 million tonnes/day |
| 9. | Nuclear Element | Not yet quantified | North-East | insignificant | - |

Table 1: Energy Reserves, Production and Utilisation in Nigeria

Sources: (i) Nigerian National Petroleum Corporation (NNPC); (ii) Renewable Energy Master plan (REMP); and (iii) Ministry of Mines and Steel Development (Adapted from Sambo, 2009).

Note: W= Watt; gives the power capacity; Wh= Watt-hour; gives the amount of energy produced or consumed; PV=Photovoltaic- The energy generated from the sun using solar panels; SCF= standard cubic feet; KW – kilowatt= 1000 MW; MW – Megawatt= 1000 KW; GW – Gigawatt= 1000 MW; TW – Terawatt= 1000 GW.

| Nigerian Geo-Political Zones ¹ | North Central States | North East States | North West States | South East States | South- South States | South West States |
|--|---|---|--|--|--|---|
| Distribution of States in each Zone | FCT Abuja, Benue, Kogi, Kwara, Nasarawa, Niger and Plateau | Adamawa, Bauchi, Borno, Gombe, Taraba and Yobe | Jigawa, Kaduna, Kano, Katsina, Kebbi, Sokoto and Zamfara | Abia , Anambra , Ebonyi, Enugu and Imo | Akwa Ibom , Bayelsa, Cross River, Delta, Edo and Rivers | Ekiti, Lagos, Ogun, Ondo, Osun and Oyo |
| Population Size | | | | | | |
| - | 20,369,956 | 18,984,299 | 35,915,467 | 16,395,555 | 21,044,081 | 27,722,432 |
| Total number of Households | 3,892,927 | 3,480,963 | 6,439,578 | 3,501,533 | 4,570,095 | 6,311,989 |
| Human Development summary statistics ² | | | | | | |
| Human Development Index (HDI) (measured on a scale of 0 to 1) | 0.49 | 0.332 | 0.42 | 0.471 | 0.57 | 0.52 |
| Human Poverty Index (HPI) (% of total population) | 34.65 | 48.90 | 44.15 | 26.07 | 26.61 | 21.50 |
| | cteristics ³ | istics ³ GDP ⁴ | | | | |
| | Density (Population/km ²) | | Rural | Per caj l) (PPP) (U | | Annual th rate (%) |
| | 166 | growth rate (%) 2.4 | 52 | / / / / | 099 | 6 |
| | Trends in ren | movals of wood pro | oducts 1990-200 | / | | |
| Industrial round wood - Tot $(1\ 000\ m3)^5$ | L | | Wood fuel- Total volume $(1\ 000\ \text{m3})^5$ | | | |
| 1990 2000 | 2005 | | 1990 20 | 000 | 2005 | |
| 9 321 10 831 | 10 831 | | 59 095 68 | 172 | 70 427 | |

Table 2: Socio-Economic Characteristics of Nigeria

¹ Figures from National Population Commission (NPC) (2009). ² Figures from NHDR Team 2008-2009, ³ Figures from FAOSTAT-PopSTAT (<u>http://faostat.fao.org/site/550/default.aspx#ancor</u>). ^{2&3} Source: Adapted from UNDP (2009: p. 71 & p.93). ⁴Per capita gross domestic product (GDP) is expressed at purchasing power parity (PPP). Figures from World Bank, IMF, UNSD and CIA. ⁵ Five year averages for 1988–1992, 1998-2002 and 2003–2007 respectively. ^{4&5}Source: Adapted from Food & Agriculture Organization of the United Nations (FAO), (2010).

Note: The figures for 2000 and 2005 of industrial round wood under Trends in removals of wood products 1990–2005 appear the same because of the effect of rounding the total figures to the nearest 1000. However, it is an indication that the variation in the industrial wood removal is quite small since 1990 compared to wood fuel.

| Geo - Political Zone | | Marketer type | Total No of Outlets |
|----------------------|-------|---------------|---------------------|
| | Major | Independent | |
| North Central | 355 | 1318 | 1673 |
| North East | 163 | 726 | 889 |
| North West | 265 | 1023 | 1288 |
| South East | 194 | 1227 | 1421 |
| South South | 224 | 1519 | 1743 |
| South West | 1017 | 2135 | 3152 |
| TOTAL | 2218 | 7948 | 10166 |

Source: Petroleum Products Pricing Regulatory Authority (PPPRA, 2004).

(http://www.pppra-nigeria.org/distributionsummary.pdf)

(Note: This information is based on the PPPRA's 2006 census. There are six major oil marketers in Nigeria-Oando Nig. Plc; Mobil oil Nig. Plc; Total Nig. Plc; African Petroleum Nig. Plc; Texaco Nig. Plc & Conoil Nig. Plc).



Figure 2: A Flow Chart Illustrating the Descriptive Analysis Conducted in this Study



Figure 4: The Classic Energy Ladder

Source: (Kowsari & Zerriffi, 2011: p. 7508).



Figure 3: Spatial Consumption and Distribution of cooking fuel in Nigeria

a) The proportion of cooking fuel types used among households in Nigeria (The symbols are not proportional to the population of each state);

b) Percentage of households using fuelwood for their cooking in the various states of Nigeria;

- c) Nigerian zonal fossil fuel distribution in 2010 ('000 litres);
- d) HHK distribution by states in 2010;
- e) LPG distribution by states in 2010; f) PMS distribution by states in 2010.