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The Cost and Consumption Pattern of Energy in Bakeries in Bauchi Metropolis

Babagana Zannah Audu
babaganazannah@yahoo.com
Umar Ibn Ibrahim El-Kanemi College of Education, Science and Technology, Bama, Borno State, Nigeria

Ahmed Aliyu
ahmedaliyu1987@gmail.com
National Identification Management Commission, Bauchi State, Nigeria

ABSTRACT

The study assesses cost and consumption pattern of energy by bakeries in Bauchi metropolis with a view to provide information for sustainable management of the environment. The data were obtained through both primary and secondary sources. Questionnaires was designed to get the pattern of different types of energy used by bakeries. One hundred copies of questionnaire were administered to the respondents of the bakeries identified. The totals of 40 bakeries were identified using snow-ball sampling method in Bauchi state, the rate of overdependence on woodfuel by owners of bakeries is a great concern. The findings show that Woodfuel and electricity were the main sources of energy used. Thirty-eight (38) bakeries were using woodfuel while two (2) use electricity. This is due to availability and affordability of woodfuel (N55 per bundle) than electricity (N29.8 per unit). It was found that the high cost is the main factor militating against the use of electricity for baking bread and hot-wet and cold-wet are the period with highly demand of energy for heating the ovens due to the dampness of the environment and also, are the season of high cost of woodfuel because, accessibility is difficult. It was recommended that government and stakeholders should subsidies other alternative source of energy like solar energy in order to reduce over dependency on woodfuel which affect the quality of environment, also modern oven that have chimney or other clean energy sources should be made available at subsidized rate, these may reduce the over dependency on forest resources as the only bank for woodfuel resources for the sustainability of the environment.

Keywords: *Cost Consumption Bakeries Energy Electricity*

1. INTRODUCTION

Woodfuel is a vital source of livelihood for a large proportion of the poor living in or close to the forest in most tropical countries. Wood harvesting for woodfuel is the third most important economic activity for the inhabitant of forest dependent area after farming and animal husbandry (food and agricultural organization 2008). There are diverse technical, environmental, social, cultural and economic reasons for choosing woodfuel as a source of energy (Horgan 2001). For many users, the choice depends on the availability and affordability of other energy options (Horgan, 2001).

The quest for rapid industrialization in the opinion of Hall and Reynolds, (2007) cannot be achieved without a strong and well developed energy resource base. That is, energy is a crucial element in the process of achieving sustainable economic development. Sorensen (1983) described Energy as a force multiplier that enhances man's ability to convert raw materials into useful products, providing varieties of useful services.

World Energy Consumption

The main source of world energy is from the sun. In 2012, the Environmental Impact Assessment (IEA) estimated that the world energy consumption was 155.505 terawatt-hours (Thw), out of this, approximately 22% is consumed in north America, 5% consumed in south and central America, 23% consumed in Europe and Eurasia, only 3% consumed in Africa and 40% consumed Asia as stated by U. S Energy Information Administration, (2009). This showed that the amount of energy consumed varies from one country to another country. Energy is a basic necessity of life for meeting domestic, social and industrial needs. Adequate and regular energy supply for industrial and domestic purposes are prerequisites for keeping socio-economic life moving. Ojinnaka, (2008) argued that the consumption of energy tracks with the national product. Hence, the scale of energy consumption per capita

is an important indicator of economic modernization. In general, countries that have higher per capita energy consumption are more developed than those with low level of consumption. Enger and Smith, (2004) stated that the industrialized nations use energy equally within three sectors i.e. residential, transportation and industrial as against the predominant use of energy for residential purpose (cooking and heating) by less developed countries. They further reported that the amount of energy required for commercial and residential use varies from country to country.

Making energy available to all and sundry in a particular society is a measure of level of economic development of that particular society. For example, in advanced economies like UK, USA and France, their populations have access to cheap and affordable energy supply because they are technologically advanced. The necessary energy infrastructures are available while the costs of energy are affordable by the majority of the people (Enger and Smith, 2004). There are divers technical, environmental, social, cultural and economic reasons for choosing woodfuel as a source of energy (Horgan 2001). For many users, the choice depends on the availability and affordability of other energy options (Horgan 2001).

Energy Consumption in Africa

Yahaya, (2002) stated that the poorer a country is, the greater its dependence on woodfuel. Almost all African countries rely on woodfuel for meeting their domestic energy needs (Sambo, 2005). Mead, (2005) and FAO, (2001) claimed that woodfuel harvesting in developing countries is so important that it rivals other sources of industrial energy such as electricity, principally among poor people in rural areas. Malimbwi *et al.,* (2001) reported that Woodfuel constitutes a major source of energy in most countries, both developing and developed countries. In most cases methods used to extract wood energy are not sustainable, leading to land degradation.

In addition, woodfuel had a share of between 60 and 86 per cent of African energy consumption, except South Africa. In most of the countries in Sub Sahara Africa, woodfuel accounts for 80 to 90 per cent of residential energy consumption. World Bank, (2000) reported that in sub-Saharan African countries, especially Nigeria, woodfuel is the dominant source of energy for cooking and other activities. Energy Commission Ghana, (2006) stated that woodfuels provide the bulk of the energy needs for most informal enterprises such as bread-baking, processing of oil-palm, brewing of local drinks, tobacco curing, traditional textiles (tie and dye, batik), traditional soap making and fish smoking.

Energy Consumption in Nigeria

Oni, (2014) argues that Nigeria, a country estimated to have a population of over 170 million people has varying temperatures, natural and physical features within its 923.78 thousand sq. km land mass. The country lies within a high sunshine belt and thus, has enormous solar energy and other solar related potentials. The resources in the North of the country in particular, provide a more viable potential for photovoltaic use, with insulation of up to 7 kWh/ m2/day. Average sunshine hours in Nigeria, are estimated at 12hrs per day. Hence, the country does have rich potentials for renewable energy (solar power production in particular). Given Nigeria's solar potentials, solar thermal applications, for which technologies already exist in the country, include solar cooking, solar water heating for industries, hospitals and households, solar evaporative cooling, solar crop drying, solar incubators and solar chick brooding (Oni, 2014). Akinboro *et al.,* (2012) explains that solar energy, an energy obtained from the sun, is the world's most abundant and cheapest source of energy available from nature. It is free and automatically renewable every day. Solar energy is available in two forms, namely Solar Thermal and Sola PV. Solar thermal is the direct application of solar energy to produce heat (Akinboro, *et al.,* 2012). Solar PV is the conversion of solar radiation to electricity using solar cell. The surprise, thus, remains how Nigeria is not a solar energy giant. This takes Nigerians to the major challenges to energy security (Akinboro *et al.,* 2012).

Wang, (2009) investigates the relationship between energy consumption and the Nigerian economy from the period of 1970 to 2005. The energy sources used to test for this relationship were crude oil, electricity and coal. By applying the co-integration technique, the results derived infer that there exists a positive relationship between current period energy consumption and economic growth. With the exception of coal which was positive, a negative relationship was noted for lagged values of energy consumption and economic growth. The implication of the study is that increased energy consumption is a strong determinant of economic growth having an implicit effect in lagged periods and both an implicit and explicit effect on the present period in Nigeria.

Energy Consumption in Northern Nigeria

Available records show that in northern Nigeria, the fuel consumption rate was given as 23.3 million cubic meters per year (Anderson and Abakah, 1990). As Gbadegesin (1995), has rightly observed the gradual removal of subsidy on petroleum products has heightened the problems of environmental degradation in Nigeria. Simonyan and Fasina (2013) reported that energy from biomass can potentially be an alternative approach to solving the country's electricity problem. Their estimation shows that Nigeria is capable of producing 2.01 EJ (47.97 Million tons of energy (MTOE)) from the 168.49 million tons of agricultural residues and wastes that can potentially be generated in a year. Converting the huge quantities of biomass resources to electricity will increase the energy supply, energy mix and balance of Nigeria.

Taru *et al.,* (2010) evaluated woodfuel marketing in Adamawa State and observed that the felling of trees for woodfuel (energy) consumption cuts across most rural and urban communities in sub-Saharan Africa. This activity denies the existence of forest trees and wood is burnt to produce carbon dioxide which is linked to climate change.

There are 19 states in Northern Nigeria and the Federal Capital Territory (FCT). Of this number, ten (10) states are already affected by desertification. The affected states include Bauchi, Gombe, Borno, Yobe, Jigawa, Kano, Katsina, Zamfara, Sokoto and Kebbi (Ayuba and Dami (2011). Acconding to Okoye and Ezeonyejiaku, (2010) Although the magnitude of this environmental hazard is not equal, as one moves further north, it becomes more severe. Therefore, the frontline states of northern Nigeria (Sokoto, Kebbi,

Zamfara, Jigawa, Borno, Katsina and Kebbi) experience severe desertification, while Bauchi, Gombe and Kano experience moderate desertification. Gbadegesin, (1995) revealed a high dependence of Fakai district of Sokoto state and Oshogbo in Oshun state of Nigeria on woodfuel and kerosene with consumption of households in twelve villages to the range of 105.7–195.0kg and 2.50–12.73 liters respectively while in Bauchi State of Nigeria, fire wood was found to be the dominant fuel source, contributing between 52.45% and 88.62% of the household and commercial budget (Ewah, 2014). Jekayinfa *et al.,* (2007) investigated the link between real incomes, inflation and woodfuel consumption. His regression analysis indicates that the quantity of woodfuel consumed is negatively correlated to real incomes and positively related to inflation levels.

Energy Consumption in the Urban and Rural Areas

In the opinion of Ubueh, (2007) forests contribute directly and indirectly to rural household livelihoods through the generation of income and employment from the sale and exchange of gathered and unprocessed non-timber forest products such as woodfuel. Kerosene and gas are not readily available due to inadequate supply in most Nigerian rural areas. Studies have shown that in Nigeria, harvesting of woodfuel contributes to deforestation at a rate of about 400,000 hectares per year. If this trend continues, the country's forest resources could be completely depleted by 2020 (Alli *et al.,* 2001 and Obueh, 2007).

Babanyara *et al.,* (2010) in their work Urbanization and the Choice of Woodfuel as a Source of Energy in Nigeria found out that the factors causing woodfuel demand in urban areas include, Rural-urban migration, Urbanization, Poverty, Hikes in prices of kerosene and cooking gas amongst others. Lawrence (1998) reported in her work''Socio-economic Analysis of Woodfuel Production and Utilization in Communities'' found that the raw materials for the processing and production of woodfuel found in almost all the five (5) communities selected for the study came from the natural forest People do not plant their own wood (trees) to use them as fuel for either domestic and/or commercial purposes.

Falola, (1998) in his work investigated woodfuel consumption in urban Kano, the rural urban trade in firewood, the ecology of wood fuel, and the management of wood resources in the hinterland. Reported that several factors account for the preservation of trees in Areas close to the urban centre. First, rising prices of firewood, together with subsidized petrol costs have made the increased distance acceptable to merchants. Second, resistance to wood cutting by the local farmers has stabilized off take within the local hinterland. The rural dwellers, whose needs are often basic, depend to a large extent on the traditional sources of energy for their domestic energy requirements, while the majority of the urban dwellers depend on traditional energy sources and fossil fuels. However, the high level of poverty and other socio-economic problems inhibit both the rural and urban dwellers from having access to adequate and reliable sources of energy for domestic purposes.

2. MOTIVATING FACTORS FOR ENERGY CONSUMPTION

(a) Education and Seasonality: Survey of the energy use in northern Nigeria by Silvinconsult, (1991) identified that any commercial centre that have little or no formal education (western education) consume more energy than those with background of formal education.

(b) Cultural Beliefs and Energy Consumption: Nierkik, (1998) reported that electricity was initially rejected in west and of South Africa, because people believe that the coming of electricity will chase away their ancestral sprits.

(c) Socio-economic, Demand and Supply Factor: According to Sepp, (1999) availability of different energy sources, different user's habits, available technology, energy price in relation to the household and commercial mean income, will determine the consumption pattern. The author sited example woodfuel and charcoal consumption as being directly related to their availability.

(d) Urban Rural Energy Dichotomy: Khennans, (1998) asserted that urban areas are responsible for the bulk of household energy consumption especially the conventional energy (electricity, petroleum products) and is also true for traditional form of energy such biomass. Biomass fuel not only provides energy for poor rural population but also to people with higher incomes.

Gana *et al.,* (2008) stated that, in Bauchi State of Nigeria; Kerosene is irregularly supplied and costly, hence, firewood and charcoal are the major alternative sources of energy. Woodfuel is also a source of income to many, hence, it is not only sold in the rural areas, but also in urban areas using trucks. Those who engage in this business at times employ the services of men to cut down trees and allow them to dry before they are sold. This has been contributing to desertification in Nigeria.

(e) Government Policy: Obueh, (2007) reported that the deregulation policy of Nigerian government on petroleum products has affected availability, use and consumption pattern of energy. Before 2003, kerosene was sold at ₦35, today it sold ₦100 per liter.

(f) Energy Population Dynamic: Rapid growing of world population has impact on energy consumption. (UNDP, 2002) The implication of foregoing scenario is increased demand for energy for more people and at a very alarming close interval of years. Sepp, (1999) summarized the world population growth thus: ''It took the world population millions of years to reach the first billion, then 123 years to the third, 14 years to the fourth, and 13 years to the fifth billion''.

3. MATERIAL AND METHODS

Introduction

The methodology adopted for this research such as research design, sources of data, sampling techniques, data collection techniques, and data analysis and presentation were presented in this chapter.

Sources of Data

The data were obtained through both primary and secondary sources. The primary sources are the data generated from questionnaire and Global Position System (GPS), while secondary sources data was collected from review of relevant literature such as books, and journals.

Research Design

The research design adopted is field surveys, where information on the type of energy used, factors influencing the energy choice, cost of alternative energy and consumption pattern of woodfuel among bakeries were derived using questionnaire and GPS was used for taking the coordinate of the bakeries.

Sampling Techniques

Forty (40) bakeries were identified using snow-balling sampling method. This is because the precise location of the bakeries is unknown. In each bakery identified, the respondent directed the researcher to the next bakery. Questionnaire was administered to the respondent in each bakery.

Data Collection Techniques

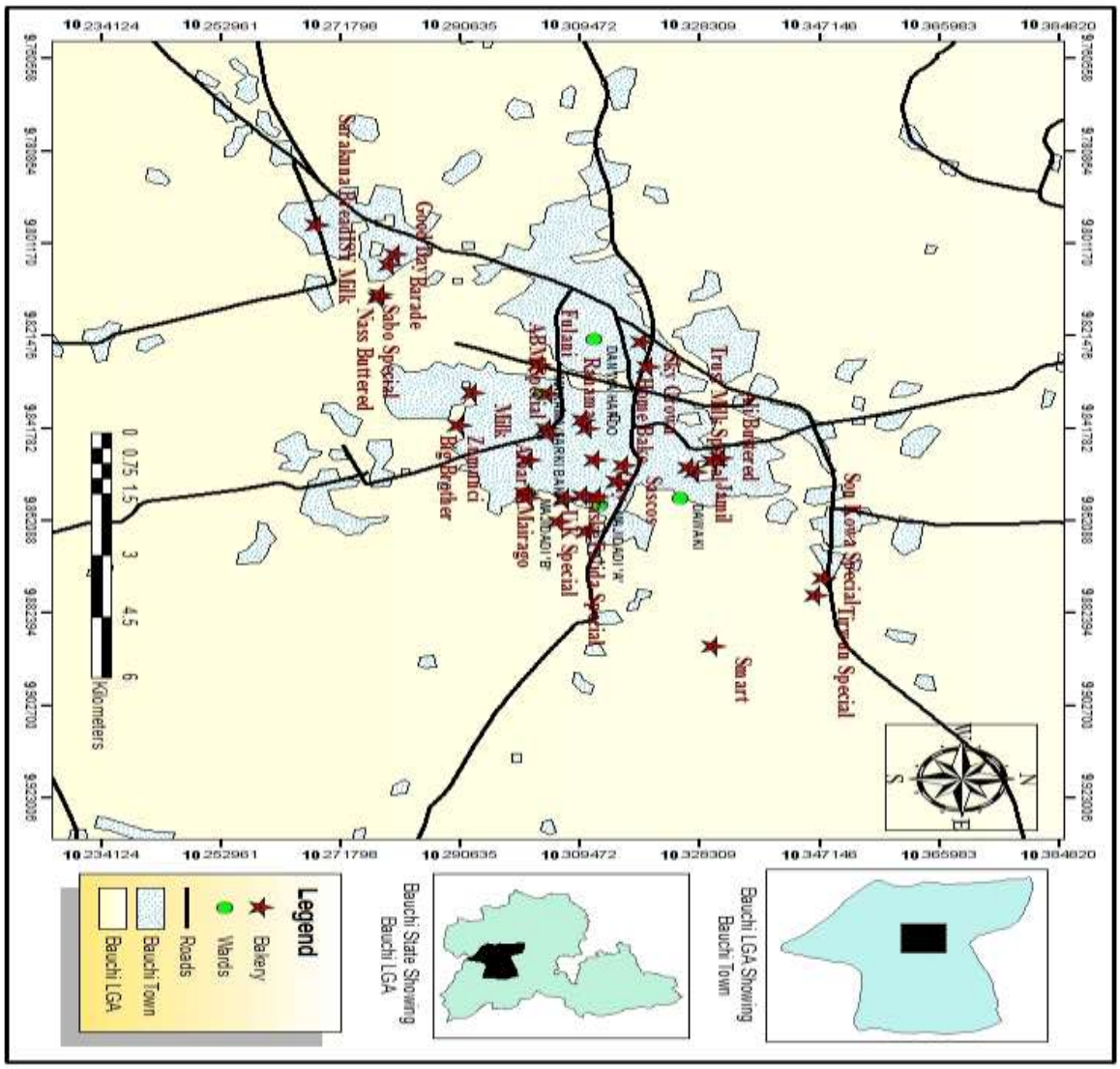
The questionnaire was administered to the identified respondents. The coordinate of each bakery identified was recoded using Global Position System (GPS) in order to determine the spatial distribution of bakeries in the area.

Data Analysis and Presentation

The data obtained from the questionnaire was analysed using descriptive statistics of frequency, Percentage (%) and mean while the result was displayed Tabular forms.

Spatial Distribution of Bakeries

Figure 1 The distribution of bakeries in Bauchi metropolis identified was mapped out as presented.



Source: Authors fieldwork and Department of Geography BUK (2018)

Source: Authors Fieldwork and Department of Geography BUK (2021)

Figure 1: shows that, Bauchi metropolis bakeries were located around Railway area while, others are located aroung Kobi, Sabuwar-Kasuwa, wunti, Kofar Idi, Central Market and Babangida square. Best of the spatial distribution of the bakeries presented in (figure 1) indicates that north-eastern part of the metropolis have higher concentration of bakeries which may probably be attributed to high population around the area and the area is also closed to the railline station where business activities are dominated.

Average Cost of Woodfuel (kg) and Electricity Unit (kwh)

The cost of woodfuel and electricity which are the only source of energy used for baking bread in Bauchi metropolis was presented in Table 1

Table 1. Average Cost of Woodfuel (kg) and Electricity Unit (kwh)

Energy Type	Unit of Measure	Average Cost (₦)
Woodfuel	Bundle (kg)	55.00
Electricity	Unit (kwh)	29.80

Source: Field Survey (2021)

Table 1 presented that the average cost of a bundle of woodfuel which weigh about 3.30kg with 6 pieces' cost (₦55.00) is much less compared with the average cost of a unit (kwh) of electricity (₦ 29.80). Based on the result, one bundle of woodfuel is equal to 2 unit (kwh) of electricity in terms of price. In regard to this result, Paul, (2008) reported that the use of woodfuel has been on the increase due to increase in cost and scarcity of alternative source. Similarly, Adedayo (2005) reported that the over dependence on woodfuel for energy is cheaper because of its relative low price and ease of accessibility.

Temporal Analysis of Energy

The temporal energy consumption is: hot-wet, hot-dry, cold-dry and cold-wet and were presented in Table 2

Table 2 Temporal Analysis of Seasons

Temporal Analysis of Seasons	Frequency	Percentage(%)
Hot-wet	17	42.50
Hot-dry	02	05.00
Cold-dry	06	15.00
Cold-wet	15	37.50
Total	40	100.00%

Source: Field Survey (2021)

Table 2 based on the data collected from the field, the result shows that, 42.50% energy is consumed during the hot-wet season, followed by cold-wet 37.50, the consumption of bread is higher at these period due to cold and a lot of woodfuel is needed for production and for heating the oven due to dampness of the environment. While during the hot-dry and cold-dry only 20.00% energy are consumed, the temperature is higher and there is market for bread but not much as during hot-wet and cold-wet seasons. You can see that season is the main factor that determining energy consumption pattern, also within the season there are factors that determining energy consumption changes such as: Market flow of bake, Market day of neighbouring village, working of other bakeries,

Factors Responsible for Energy Consumption Changes within the Season

The factors responsible for energy consumption within the season such are: market flow of bake, market day of neighbouring village, and working of other bakeries, were presented in Table 3

Table 3 Factors Responsible for Energy Consumption Changes within the Season

Season for Changing	Number of Bakeries	Percentage(%)
Market flow of bake	10	25.00
Market day of neighboring village	25	62.50
Working of other bakeries	5	12.50
Total	40	100%

Source: Field Survey (2021)

From the Table 3 it is shown that within the season, market of neighbouring village (62.50%) is the main factor that changes the consumption of bread, the higher the consumption the greater the production. Increase in level of production will lead to more energy consumed (Ronald, 1976).

Determinant Factor Shaping the Woodfuel Cost

Factors that determine woodfuel cost are: season, cost of transportation, location of bakeries are the factor that determine the woodfuel cost and were presented in Table 4.8

Table 4 Determinant Factor Shaping the Woodfuel Cost

Determinant Factor of Woodfuel Cost	Frequency	Percentage (%)
Season	36	90.00
Change in transportation cost	2	05.00
Location of the bakeries	1	02.50
Others (specify)	1	02.50
Total	40	100%

Source: Field Survey (2021)

Table 4 Respondents views; season (90.00%) is the main determinant factor of woodfuel cost. The reason is because, the roads to the forests are muddy and not motorable therefore, a lot of woodfuel is stored for this period to be used. Ronald, (1976) said that, some times the price of good is determined by how this good is demanded in the society. Added that the higher the demand the greater the price.

4. CONCLUSION

The bakeries in Bauchi metropolis are sparsely distibuted in the area and depend wholy on woodfuel for energy due to its cheapness and availabilty and high cost of other alternative is the factor militating against the use of other energy around the area. The consumption pattern of woodfuel is seasonal because of the demand of the bakeries products depend also on the season of the year. It was concluded that the small scale bakeries dominated (57.50%) among the metropolis bakeries.

5. RECOMMENDATION

Based on the findings, the following recommendations were suggested in the area.

1- Government should provide a bar land for bakers to plant trees before they finish cutting one side another side has grown. This will maintain the ecology of the environment.

2- Government should also subsidies the electricity price for bakeries to reduce over dependency on woodfuel.

3- Government and stakeholders should provide modern facilities in affordable price or loan through corporative to harness other alternative energy such as solar energy in order to reduce the over dependency on woodfuel which reduces the quality of environment.

4- The stakeholders should establish or construct more bakeries particularly around Wunti, Central market, new and old GRA and Babangida square because of the availability of electricity in the area, therefore, electricity can be used to reduce the pressure on woodfuel as a source of energy to bakeries located around the area.

5- Where falling of trees is necessary use of axe should be adopted because it enables the pad lopped to regenerate naturally but machine should be avoided because pad lopped die completely.

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