

FUEL WOOD CONSUMPTION PATTERN IN BAUCHI STATE: A GUIDE FOR ENERGY PLANNERS IN NIGERIA

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ABSTRACT

This paper understudies fuel wood consumption pattern in Bauchi state. Ten local government areas were randomly selected for the research. Structured questionnaire was utilized as study instrument. Random sample of 98 respondents comprising of housewives, proprietors of bakeries, barbecues, restaurants, and firewood sellers were used for the study. The collected data were analyzed using the chi-square (χ^2) statistical tool. Findings reveal that due to the high cost of fossil fuels, majority of the inhabitants of the state rely on fuel wood for their domestic energy. Forty two per cent of the respondents entirely depended on fuel wood as their source of energy, and 54% depended on both fuel wood and fossil fuels, while 2% depended entirely on fossil fuels. Also, in removing the fuel wood from the forest, 79.6% of the people removed only branches, and the remaining 20.4% clear felled the entire trees. The results also confirm that 48% of the people collected their stock from family farm lands, while 30.6% collected from open forest, 10.2% collected from forest reserves, and 11.2% bought theirs from the market. Further revealed is the fact that 4.1% of the respondents acquired their wood supply weekly, while 66.3% obtained theirs more than twice weekly, and 29.6% used fuel wood daily. None of the respondents used less than 50kg of fuel wood weekly, and 89.9% showed their willingness for alternative energy sources if made available. Further more, among the various woody species that are used for fuel wood, nine are common, out of which three were found to be the most preferred species. The study particularly recommended that reforestation program should be intensified in the state, and alternative fuel resources should be provided for the people.

Keywords: fuel wood, consumption pattern, deforestation, reforestation, energy, Bauchi state.

INTRODUCTION

Fuel is important to man's existence on earth. The term is applied to materials that are capable of producing heat energy through the process of combustion. Men have discovered various ways of generating heat and light using primary energy sources, such as fossil fuels, hydropower, biomass and solar energy (Adegbulugbe and Akinbami, 1992). Energy plays a very important role in the development of all nations. In the urban sectors

and especially for industrial applications, petroleum products mainly provide the required energy, in contrast with the rural areas which are highly dependable on fuel wood as their main energy source. The rampant and indiscriminate cutting of trees to provide fuel wood appears to be posing a threat to the very survival of mankind. The magnitude of this threat can be gauged by the alarming rate of environmental degradation, and by the frenzied response of the

international community to the need for a sustained and coordinated action to reverse the trend (Sanda *et al.*, 1991).

Throughout the entire West African region, fuel wood provides the main source of energy for both rural and urban households. Firewood and charcoal provide the predominant sources of energy for small-scale processing enterprises such as palm oil production and fish smoking (Davidson, 1985). The Food and Agricultural Organization (FAO) (1994) asserted that there was no feasible alternative to wood as an energy source in several developing nations, where the rate of consumption could be many times the rate of production. The FAO (1981) depicted wood biomass as the major viable source of energy in several nations of the world.

The whole population of sub-Sahara Africa virtually relies on wood for basic energy needs. In Nigeria, over 95% of the population in the rural regions depends on fuelwood for domestic supply of energy (Fuwape, 1986). In the past 15-20 years, most of the utilized fuel wood were either collected from nearby bushes or bought from fuel wood dealers. For the rural people, they simply gather whatever they needed from the open savanna or forest woodlands, farmlands under fallow, communal lands around villages or from purely protected forest reserves (Mohammed, 1985). However, in cities, virtually every fuel wood consumer has to pay for the commodity, which is widely sold by dealers and middlemen in the wood market or by the roadside. The high demand for fuel wood makes its supply to drastically fall due to the increasing number of people that use the commodity

(Mohammed, 1985). As a result of its short supply, the price of fuel wood has also increased. In Niamey (Niger Republic) for example, the average working class family now spends nearly one quarter (1/4) of its annual income on fuel wood (Earl, 1975). Acute fuel wood scarcities are already being encountered in 18 African countries, 2 Asian countries and 6 Latin American countries thereby, affecting about 112 million people (FAO, 1986). Beside the problem of shortage, dependence on fuel wood also creates or aggravates environmental problems such as soil erosion, decline in water table, drought, and desert encroachment.

In view of the above, there is therefore an urgent need for a massive campaign to substitute fuel wood with other alternative fuels. However, before a viable substitution strategy can be evolved, there is a need to ascertain the existing relationship between fuel wood and possible substitutes such as gas, kerosene and electricity which are currently the most viable options. Findings of this research will particularly serve as guide for energy planners in Nigeria. The objectives of this research are:-

- (a) To determine the popular wood species that are being used as fuel wood in Bauchi State.
- (b) To determine the major reasons for the people's species preference.
- (c) To determine people's readiness for exploitation of alternatives to fuel wood.
- (d) To determine the level of awareness of the people about environmental problems associated with over-exploitation of the forest for fuel wood.

- (e) To determine the people's level of awareness, involvement and commitment to environmental protection and forest regeneration.

METHODOLOGY

Brief outlook on the study area

Bauchi State has total land area of 49,259.01km² with a population of 2,826,444. It is located between latitude 9° 30¹ and 12° 30¹ North of the equator and longitude 8° 50¹ and 11° East of the Greenwich meridian. The State has a typical tropical climate marked clearly by the dry and rainy seasons. The average annual rainfall is 700mm in the northern parts and 1300mm in the southern parts (Udo and Mamman, 1993). The wettest months are July, August, and September. Dry season starts in November and ends in April. This is a period of harmattan, a period when the dust trade wind from the Sahara desert has a marked drying effect on the vegetation and general climate of the state (Udo and Mamman, 1993). The state is predominantly Sudan Savanna. It is marked by short trees interspersed by usually short shrubs mostly in the northern parts of the State, but in the southern parts, the vegetation is thicker with tall grasses and much taller trees (Udo and Mamman, 1993).

Data Collection, Sampling Technique, and Analysis

Structured questionnaires, validated by senior scientists were used in data collection. Views of housewives, proprietors of bakeries, barbecues, restaurants, and firewood sellers were sought. Formal interviews were also held with the targeted respondents. The questionnaires were designed to extract the much needed infor-

mation from the respondents. The items contained in the questionnaires include among others, age and income of respondents, level of dependence on fuel wood, mode of fuelwood extraction, system of fuel wood utilization, common fuel wood, and preferred fuel wood species. The administration of the questionnaires was through personal contact with the respondents. Completed questionnaires were collected back from the respondents after one week.

Out of the twenty local government areas of Bauchi State, ten were selected using stratified random sampling technique. Table 1 shows the selected local government areas for the study. In each of the ten selected local government areas, twelve questionnaires were administered, with three for each of the group of respondents; viz: housewives, roasted meat (suya) sellers, proprietors of bakeries and restaurants, as well as firewood sellers. In all, 120 questionnaires were distributed in the ten selected local government areas, with 30 for each of the class of respondents. Out of this number, 98 questionnaires were received as follows: - housewives (20), suya sellers (30), proprietors of bakeries and restaurants (29), and firewood sellers (19).

The collected data were coded and subjected to chi-square (χ^2) statistical analysis to test for significant levels of dependence.

RESULTS AND DISCUSSION

Demographic data of respondents:

The percentages of the respondents (98) were made up of housewives (20.41) %, suya sellers (30.61%), proprietors of bakeries and restaurants (29.60%), and firewood sellers (19.3%). Among the respondents,

42.4% are females while 56.6% are males. Also 80% of them are married and the remaining 20% are single. Furthermore, 83.70% of the respondents are in the middle age class, while 6.1% are in the old age class, and 10.2% are in the adolescence class. In addition, 68.3% of the respondents earn less than N6,001 per month, and 3.1% earn above N7,000 per month. Table 2 depicts the age classes and the income groups of the respondents.

Fuel wood consumption pattern

Table 3 shows the level of dependence of the respondents on fuel wood. Ninety eight per cent of the respondents depend on the traditional fuels such as fuel wood for energy production in one way or the other, though most people claim the combination of fuel wood with fossil fuels for their energy requirements. As shown also in Table 3, 42% of the respondents wholly depend on fuel wood, while 54% depend on both fuel wood and fossil fuels, and 2% indicate no dependence on fuel wood. In removing the firewood from the forest, 79.6% of the people removed only branches for firewood and the remaining 20.4% clear felled the entire primary source of the firewood (tree) (Table 4). Table 4 also shows that 92.9% of the respondents do not debark the firewood before removal from the forest, while 6.1% debarked before removal from the forest, and the remaining 1% harvested the firewood along with the foliage. Majority of the people (48%) collected their stock from family farmlands, 30.6% from open forest nearest to them, 11.2% bought theirs from market and 10.2% cut from the nearest forest reserves (Table 5).

Table 6 reveals that only 4.1% of the respondents acquire their wood supply weekly, 66.3% obtain theirs more than twice weekly and the remaining 29.6% use firewood daily. None of the respondents uses less than 50kg of fuel wood weekly (Table 7). In addition 71.4% uses between 101 and 200kg of fuel wood per week, 10.2% between 50 and 100kg, and the rest of the respondents who occupied 18.4% burnt over 200kg of fuel wood per week (Table 7). Majority of the people (65.3%) cook with tripod stone stoves, 3.1% use earth ovens and 30.6% use metal stoves as means for household cooking (Table 8). The statistical analyses showed significant differences of all the variables at 5% level of probability.

Species preference

The findings of this research indicate that out of the varieties of tree species being used as fuel wood for energy in Bauchi State, nine species are the most common and these are: Marke (*Anogeisus leocarpus*), Tsamia (*Tamarindus indica*), Kadanya (*Vitellaria paradoxa*), Samji (*Ficus platiphylla*), Kiriya (*Prosopis africana*), Dorowa (*Perkia biglobossa*), Doka (*Isobertinia doka*), Taura (*Detarium macrocarpum*), and Kaiwa (*Diosperus mesphiliformis*). The result of the chi-square (χ^2) analysis shows that at $P < 0.05$, the most frequently used species in the various local government areas are significantly different. Furthermore, as evident in Table 9, the three most preferred tree species in the state are *Anogeisus leocarpus* (42.9%), *Vitellaria paradoxa* (15.3%) and *Prosopis africana* (10.2%). Table 9 also shows that 30.6% of the respondents were selective in species selection for firewood, 22.4% not selective (indiscriminate), while

the majority (47.0%) claimed to be both selective and indiscriminate.

The major reasons for the choices of species used as fuel wood in Bauchi state are availability, affordability, cultural and efficiency; with efficiency having the highest numerical strength of the respondent (43.9%), followed by affordability (36.9%) then availability (16.3%), and culture (3.1%) (Table 9). The result of the research also indicate that at $P < 0.05$ chi-square (χ^2) statistical analysis, the people of Bauchi state are willing to both accept alternative sources of energy apart from fuel wood and also willing to use other woody species outside their preferences.

Table 9 also shows that there is significant difference between those who indicate willingness (89.8%) and those that are unwilling (10.2%).

Awareness and participation in future tree planting programs

As depicted in Table 10, the level of awareness of the respondents about the consequences of indiscriminate and excessive deforestation was found to be significantly high. Ninety eight per cent of the

respondents show that they are fully aware of such consequences while only 2% claim ignorance. The research further indicated the people’s perception of the ways in which the environment could be adversely affected if forest resources are over exploited. The major environmental effect of over exploitation of forest resources, which the respondents are fully aware include changes in farm yield, soil status, vegetation cover, and climate. Further more, 36.4% of the respondents claim to be aware of change in climate, 34.7% change in forest cover, 20% change in farm yield and 9.2% change in soil status (Table 10).

Also in Table 10, the results of the research show that 20.4% of the respondents claim ignorance of tree planting programs and neither have they practiced the exercise personally, and 79.6% indicated awareness and participation in tree planting programs in both government organized programs and private schemes. Ninety eight per cent of the people show their willingness to take part in future reforestation programs and the remaining 2% indicated their unwillingness (Table 10).

Table 1: List of Randomly Selected Local Government Areas for the Study

S/No.	Local Government Area
1.	Zaki
2.	Dass
3.	Toro
4.	Ningi
5.	Darazo
6.	Misau
7.	Alkaleri
8.	Katagum
9.	Jama’are
10.	Gamawa

Table 2: Shows the Age Class and Income Groups of the Respondents

Variables	Frequency	Percentage (%)
Age classes of the respondents (yr)		
15-30	10	10.2
31-45	68	69.4
46-60	14	14.3
Above 60	6	6.1
Total	98	100
Income groups of the respondents		
Below N 5000	17	17.3
N 5001- N 5000	50	51.0
N 6001- N 7000	28	28.6
N 7001- N 8000	3	3.1
Above N 8000	0	0.00
Total	98	100

Table 3: Dependence on Fuel Wood

Variables	Frequency	%	Chi-square (x^2)*
Fuel wood only	42	42.9	df=2
Fuel wood and Fossil Fuel	54	55.1	x^2 Tabulated=6
No fuel wood	2	2.0	x^2 Calculated=23.1
Total	98	100	

* Significant ($P < 0.05$)

df-degree of freedom

Table 4: Mode of Extractions

Variables	Frequency	%	Chi-square (x^2)*
Mode of Extraction 1			
Clear felling	20	20.4	df=1 x^2 Tabulated=3.8
Pruning	78	79.6	x^2 Calculated=3.8
Total	98	100	
Mode of Extraction 2			
Wood (not debarked on site)	91	92.9	df=3
Wood (debarked on site)	6	6.1	x^2 Tabulated=7.8
Wood (along with foliage)	1	1.0	x^2 Calculated=12.4
Others	0	00	
Total	98	100	

* Significant ($P < 0.05$)

df = degree of freedom

Table 5: Sources of fuel wood

Variables	Frequency	%	Chi-square(x^2)*
Open forests	30	30.6	df=4
Forest Reserve	10	10.2	x^2 Tabulated=9.5
Family farmlands	47	48.0	x^2 Calculated=39.5
Market	11	11.2	
Others	0	0.00	
Total	98	100	

*Significant (P<0.05)

df = degree of freedom

Table 6: Rate of Acquisition

Variables	Frequency	%	Chi-square (x^2)*
Daily	29	29.6	df =2
More than twice weekly	65	66.3	x^2 Tabulated = 6
Weekly	4	4.1	x^2 Calculated = 14.2
Total	98	100	

*Significant (P<0.05)

df = degree of freedom

Table 7: Quantity Used Weekly

Variables	Frequency	%	Chi-square (x^2)*
Less than 50kg	0	0.00	df =3
50-100kg	10	10.2	x^2 Tabulated = 7.8
101-200kg	70	71.4	x^2 Calculated = 27.7
Above 200kg	18	18.4	
Total	98	100	

*Significant (P<0.05)

df = degree of freedom

Table 8: Burning systems used

Variables	Frequency	%	Chi-square (x^2)*
Tripod stone stove	64	65.3	df = 3
Metal stove	30	30.6	x^2 Tabulated = 7.8
Earthen oven	3	3.1	x^2 Calculated = 25.5
Others	1	1.0	
Total	98	100	

*Significant at $P < 0.05$)

df = degree of freedom

Table 9: Utilized Wood Species, Their Selection, Reasons for Preference, and willingness to Accept Alternatives to Fuel Wood

Variables	Frequency	%	Chi-square (x^2)*
The most preferred species being used for fuel wood			
<i>Anogeisus leocarpus</i>	42	42.9	
<i>Vitellaria paradoxa</i>	15	15.3	
<i>Diosperus mesphiliformis</i>	7	7.1	df = 8
<i>Prosopis Africana</i>	10	10.2	x^2 Tabulated = 15.5
<i>Ficus platiphyla</i>	6	6.1	x^2 Calculated = 47.5
<i>Perkia biglobossa</i>	6	6.1	
<i>Tamarindus indica</i>	5	5.1	
<i>Detarium macrocarpum</i>	3	3.1	
<i>Isobertinia doka</i>	4	4.1	
Total	98	100	
Species selection			
Indiscriminate	22	22.4	df = 2
Selective	30	30.6	x^2 Tabulated = 6
Both	46	47.0	x^2 Calculated = 12.7
Total	98	100	
Reasons for species preference			
Affordability	36	36.7	df = 3
Cultural	3	3.1	x^2 Tabulated = 7.8
Efficiency	43	43.9	x^2 Calculated = 22.6
Availability	16	16.3	
Total	98	100	
Willingness to accept alternative to fuel wood			
Yes	88	89.8	df = 1
No	10	10.2	x^2 Tabulated = 3.8
Total	98	100	x^2 Calculated = 13.1

*Significant at $P < 0.05$

df = degree of freedom

Table 10: Gives the Awareness of the Effect of Deforestation, Perception of Ways in which the Environment is affected, Awareness and Current participation in Tree Planting campaign, and Willingness to take Part in Future Campaign

Variables	Fre- quency	%	Chi-square (x^2)*
Awareness of the possible effect of excessive deforestation			
Yes	96	98.0	df = 1
No	2	2.0	x^2 Tabulated = 3.8
Total	98	100	x^2 Calculated = 8.7
The people's perception of ways in which the environment is affected			
Change in farm yield	20	20.4	df = 3
Change in climate	36	36.7	x^2 Tabulated = 7.8
Change in soil status	9	9.2	x^2 Calculated = 14.8
Change in forest cover	34	34.7	
Total	98	100	
Awareness and participation in current tree planting campaigns (TPC)			
Yes	20	20.4	x^2 Tabulated = 3.8
No	78	79.6	x^2 Calculated = 6.5
Total	98	100	
Willingness to participate in future tree planting campaigns (TPC)			
Yes	96	98.0	x^2 Tabulated = 3.8
No	2	2.0	x^2 Calculated = 8.7
Total	98	100	

*Significant (P<0.05)

df = degree of freedom

The heavy reliance of people in Bauchi state on fuel wood would continue because going by the lean monthly income of most people, coupled with high cost of fossil fuels and the inconsistent supply, and rapid population growth, fuelwood becomes the most reliable, and affordable source of domestic energy for household use. The collective effect of these trends is

the rampant removal of vegetation at a rate beyond the regenerating capacity of the forest and its attendant environmental degradation as a result of desertification and soil erosion. Although Table 5 shows that 48% of the respondents obtain their fuel wood supply from private lands, a significant number (40.8%) encroached into open forest reserves to meet their wood require-

ments, while only 11.2% pay for their supply. This result agrees with the work of Mohammed (1985), who reported that very few people pay for fuel wood in rural areas. Some authors (Sanda *et. al.*, 1991; Kilahama, 1989) reported that hardly is the commodity obtained freely, hence the high percentage of the respondents procuring the commodity from their private lands; because they can hardly obtain it free of charge.

Harvesting of wood from the forest was either indiscriminate or selective as evident in Table 9. Indiscriminate harvesting is induced by economic reasons, increase in the price of alternative fuels, the increasing distance from the forest to the settlements, and unavailability of desirable species; while selective harvesting was mainly due to preference. The implication of selective harvesting is that, preferred species which are already not in abundance (Table 9) would continue to disappear numerically which may result into total extinction of such species. This corroborates the work of FAO (1990), which reported an almost extinction of selected tree species due to preference.

Burning systems being used in the study area is another major contributing factor to the increased demand for fuel wood. The majority of people (65.3%) used tripod stone stoves which allow a small proportion of the emitted available heat of the bio-fuel to reach the food being cooked (Table 8). However, as learnt from Table 9 majority of the people (89.9%) have shown their willingness to accept alternative energy sources if made available, affordable, and easy to operate.

Most people of the study areas are fully aware of the various ways in which the environment could be affected if deforestation is allowed to continue. Although only little effort was made in reforestation programs in the past (APCU, 1991); majority of the respondents (98.9%) have shown their willingness to take part in future tree planting exercises (Table 10).

CONCLUSION AND RECOMMENDATIONS

The inhabitants of Bauchi state depend on the utilization of fuel wood as a source of domestic energy; as such they would be more responsive to campaigns on environmental sustainability, which promote fuel wood production. Although the level of some species preference is significant, majority of the people are willing to utilize alternative sources of energy, if made available and affordable. There is an urgent need to introduce more efficient burning systems to the people, as majority (65.3%) were found to be using stone stoves (Table 8). The issue of species preference demands an urgent resolution to guide against the complete loss of the preferred species. Further more, if the effort of government in curtailing the problem of rural to urban migration is to be realized, provision of social amenities such as water, roads, electricity, and means of transportation are just second to proper forest management and conservation as the later subject formed the bases for sustenance of rural economy.

Tree planting exercise that would ensure the steady supply of fuel wood is not strange to the people of Bauchi state as the study indicated. Government should therefore utilize the noble opportunity and

come up with community-based reforestation efforts. Planting of indigenous tree species most especially the most preferred species should be intensified, and research on the combustion properties of such fuel wood be carried out and the result be compared with the combustion properties of some exotic species being used for fuel wood. In planning and execution of any reforestation program, local people through their opinion leaders should be incorporated to enhance better understanding and success of such efforts.

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