ENERGY COMMISSION OF NIGERIA

TECHNICAL REPORT
(No.: ECN/EM/2019/01)
ON
PILOT TESTING OF RESIDENTIAL WOODFUEL SUPPLEMENTARY MODULE IN NIGERIA

SUBMITTED TO

INTERNATIONAL RENEWABLE ENERGY AGENCY (IRENA)

ABU DHABI,

UNITED ARAB EMIRATES

DECEMBER, 2019

December, 2019

Energy Commission of Nigeria
Plot 701C Central Business District
PMB 358, Garki
Abuja, Nigeria
E-mail: dg@energy.gov.ng; website: www.energy.gov.ng
Contact: Prof. Eli Jidere Bala

International Renewable Energy Agency (IRENA)
Abu Dhabi, United Arab Emirates

This project is funded by the International Renewable Energy Agency (IRENA)**.** The views expressed herein can in no way be taken to reflect the official opinion of the IRENA

Project Chairman
Prof. E.J. Bala, DG/CEO

Project Supervisor
Dr. Roseline Kela, Director, EMTMD Dept.

Project Manager
Sulu B.F. Ibrahim, Deputy Director, EMTMD Dept.

Secretariat and Logistics
Ahmad Tijjani, Abbas I. Musa,Alaya-Ibrahim Sherifat, Adisa Bukola George, Idowu Olokungbemi

Layout and Typesetting
Ahmad Tijjani, Alaya-Ibrahim Sherifat, Ogbole Joyce Elagboji and Al-Amin Haruna Anani

Compilation
Ahmad Tijjani, Abbas I. Musa, Alaya-Ibrahim Sherifat, Adisa Bukola George, Idowu Olokungbemi, Zahira Aminu.

Survey Team
Head: **Sulu B.F. Ibrahim**

State Supervisors**: Engr. Jude C. Asogwa**and**Mr Samuel A. Aku**

Enumerators
AladireY.Yekini, Garba M. Saleh, Usman I.Ndaceko, Farida A. Umar, Aisha S. Ingawa, Ahmad Tijjani, Abbas I. Musa, Inusa B. Muhammad, Maryam A. Bulama, Alaya-Ibrahim Sherifat, Amina A. Ibikunle, Adisa Bukola George, Sanusi S. Sani,Muktar Ahmed,Ibrahim Idako A.,Gloria E.Jonah, Aminu A. Tukur, Olasusi A. Kayode, Nafisa A. Aminu, Bako Chonoko I., Ignatius J. Yamma.

Survey Data Processing
Garba M. Saleh, Usman I.Ndaceko, Farida A. Umar, Ahmad Tijjani, Abbas I. Musa, Inusa B.Muhammad, Alaya-Ibrahim Sherifat, Amina A. Ibikunle, Adisa Bukola George, Sanusi S. Sani, Idowu Olokungbemi, Ibrahim Idakwo A., Zahira Aminu.

ABBREVIATIONS AND ACRONYMS

ACSO	Assistant Chief Scientific Officer
ACTO	Assistant Chief Technical Officer
CSO	Chief Scientific Officer
CSPro	Census and Survey Processing System
DD	Deputy Director
EAs	Enumeration Areas
ECN	Energy Commission ofNigeria
FCT	Federal Capital Territory
GDP	Gross Domestic Product
GHG	Green House Gases
HH	Households
HHHs	Household Heads
HTO	Higher Technical officer
IMCCDD	Inter Ministerial Committee onCombating Desertification and Deforestation
IPCC	Inter-governmental Panel on Climate Change
IRENA	International Renewable Energy Agency
FAO	Food and AgricultureOrganization
LGAs	Local Government Areas
LPG	Liquefied PetroleumGas
NAGGW	National Agency for Great Green Wall
NBS	National Bureau of Statistics
NPoP	National Population Commission
NYSC	National Youth Service Corps
NW	North West
PSO	Principal Scientific Officer
SSO	Senior Scientific Officer
SPSS	Statistical Package for Social Sciences
UNDP	United Nations Development Programme
WSM	Woodfuel Supplementary Module

TABLE OF CONTENTS

List of Tables

List of Figures

FOREWORD

The demand for modern energy has continued to increase not only in Nigeria but in other developed and developing countries of the world due to increasing population, improved standard of living and growth of industries. However, fuelwood and charcoal, a biomass energy resource account for a very large proportion of the final energy consumption in Nigeria. In addition to the large number of households depending on fuelwood and charcoal, many cottage industries also depend on biomass for their thermal energy supply. However, there is a general paucity of data on the production, modes of acquisition, trade and consumption of fuelwood and charcoal in the country.

In furtherance to the execution of its mandate and drive to bridge this data gap, the Energy Commission of Nigeria (ECN) responded and applied to an international Call for Expression of Interest on Household Fuelwood Survey by the International Renewable Energy Agency (IRENA) in July, 2017.Consequently, a project agreement was signed between ECN and IRENA in March, 2019 for the pilot testing of residential woodfuel supplementary module (WSM) in Nigeria. Nigeria is divided into six (6) geo-political zones, and the North-western zone was chosen for the preliminary pilot study. The WSM is developed by the Food and Agriculture Organization (FAO) of the United Nations to assist countries in gathering quality data in a cost-effective way. The project aimed to improve residential woodfuel use data in Nigeria as well as the possible eventual adoption of WSM as a universal residential module to ensure compatibility and acceptability of data.

Also, the results obtained would serve as a preliminary study towards fuelwood consumption survey in other geopolitical zones in the country for the purposes of national policy formulation and recommendations of necessary and appropriate interventions.

Outcome of this study could also be utilized by relevant authorities/organizations to design specific intervention measures for urban, peri-urban and rural areas in promotion of other clean cooking systems as well as in addressing environmental challenges resulting from uncontrolled felling of trees for either firewood or charcoal production.

While we thank IRENA for the opportunity, we hope that this report would assist in consolidating national and international efforts in preservation of the environment and diversification of climate friendly energy mix.

Prof. Eli JidereBala, FNSE, FAEng
Director General/CEO
Energy Commission of Nigeria

ACKNOWLEDGEMENT

The Energy Commission of Nigeria and its project team wish to express gratitude to the International Renewable Energy Agency (IRENA) for the approval to conduct the pilot testing of residential woodfuel supplementary module (WSM) in Nigeria. Our appreciation also goes to the Director General/CEO of ECN for his kind leadership, support and guidance from beginning to the completion of the project. We also appreciate the collaboration of the National Bureau of Statistics (NBS) for the participation of its staff in both data collection and training on relevant softwares for data analysis.

We equally acknowledge the role of National Population Commission that provided us with the list and even maps of all enumeration areas (EAs) in North West zone for the purpose of the survey. Their guidance in using systematic sampling technique for final selection and identification of the covered EAs is also highly appreciated. In the same manner, we thank the various ward heads, district heads and other community leaders in all the covered EAs for their kind cooperation and for ensuring the safety of our enumerators during the survey exercise.

Also worthy of our appreciations were the young men and women who served as guides to the interviewers for their patience and time. Without them, smooth access to the respondents could have been virtually impossible in view of cultural and religious restrictions regarding households in the zone. Other residents that participated as our respondents are also recognized. We salute them for their time, patience and confidence in the exercise, without which all efforts would have been in vain.

Lastly, we salute the resoluteness of our enumerators comprising of our Scientific Officers, National Youth Service Corps (NYSC) members and industrial training (IT) students for their various efforts during the pre-survey, conduct of the survey and post-survey assignments.

Dr. (Mrs.) Roseline Kela
For the Project Team
Energy Commission of Nigeria

EXECUTIVE SUMMARY

Energy Commission of Nigeria (ECN) applied to an international Call for Expression of Interest on Household Fuelwood Survey by the International Renewable Energy Agency (IRENA) in July, 2017 which was successful. Consequently, a project agreement was signed between ECN and IRENA in March, 2019 for the pilot testing of residential woodfuel supplementary module (WSM) in Nigeria.

The survey covered the North-west geopolitical zone of Nigeria which is the largest of the six (6) geopolitical zones of Nigeria with an estimated population of about 48.9 million people. The zone comprises of states with similar cultures, history, background and close territories made up of seven states; Jigawa, Kaduna, Kano, Katsina, Kebbi Sokoto and Zamfara states with a total number of 186 Local Government Areas (LGAs) and 158,924 Enumeration Areas (EAs).

A total of 220 enumeration areas (EAs) in the zone were selected using systematic sampling technique representing 0.14% of the EAs. Due to prevailing security reasons however, the whole of Zamfara State, some local government areas in Katsina and Sokoto States as well as Kaduna South Senatorial District were excluded at the time of commencement of the survey and therefore only 125 of the 220 EAs were sampled and data collected.

The survey commenced with the training of 21 enumerators in two Batches in March, 2019, this was followed immediately by 1st phase of data collection in April, 2019 in three states; namely Jigawa, Kaduna and Kano states covering a total of 87 enumeration areas. While the second phase of data collection was conducted and concluded in June, 2019 in Katsina, Kebbi and Sokoto states covering 37 enumeration areas. A total of 799 questionnaires were successfully administered and accepted, while 20 questionnaires were rejected.

The results obtained indicated that majority of households in the zone consumed an average monthly of 388 kg of fuelwood either through outright cutting/collection from nearby forests or purchase/spending average sum of ₦6, 684 ($20) in the zone where majority of residents live on less than 1 USD a day. With the reported monthly income of N18,000 or less, the fuelwood expenditure is certainly a cause of concern for many residents especially those living in urban areas who does not have the option of collection.

Using an estimated population of 48,942,307 people (NBS, 2017) in the North West zone and the survey-established average household size of 10.58 heads, the fuelwood and charcoal consumption per capita is computed at 1.185kg/day and 0.27kg/day respectively. This is slightly below the national fuelwood consumption per capita of 1.264Kg/day (IMCCDD, 2000).Similarly, an approximate total of 58,018.83tonnes of fuelwood and 13,551.20tonnes of charcoal are estimated to be consumed daily in the zone.

For energy conversion technology in cooking, the survey revealed that the inefficient three-stone open fire stove is the most commonly used conversion technology in the zone.

This system according to IPCC, 1996 has only 40% energy efficiency resulting in the excessive smoke emission that has both health and environmental implications. Consequently, 74.4 % of the respondents reported being affected by injuries and other health issues resulting from fuelwood collection and usage. The associated carbon dioxide emission was also computed at 112,297 tCO_2per day in the zone.

Fuelwood production was also found to come mostly (61.4%) from direct wood (wood from forests, plantations, agricultural tree crops). This obviously has direct impact on the scarce forests in the region resulting in desert encroachment, population migration and competition for scarce fertile land resource with concomitant violence and insecurity. It may also justify the inclusion of almost all the states in the zone into the ongoing National Great Green Wall programme of the government, aimed at planting of wall trees at certain areas to replace the lost forests.

Uncommon words/terms in the questionnaire are recommended for translation into the dominant language of the survey area because this assisted the enumerators on the field in satisfactorily rendering of questions to respondents.

At the completion and the subsequent analysis of the survey results, it is concluded that the survey has confirmed the validity and suitability of the questionnaire developed by the FAO for the purpose of fuelwood consumption survey. Although some sections were modified to suit local peculiarities, major aspects of the questionnaire remained untouched and were used to capture the required data. It could therefore be concluded that the questionnaire is validated and recommended for further use in future fuelwood surveys.

CHAPTER ONE

1.0 INTRODUCTION

1.1 Background

In Nigeria, fuelwood and charcoal account for a very large proportion of the final energy consumption in all sectors of the economy, especially the residential and services sectors. In addition to large number of households, many cottage industries also depend on fuelwood and charcoal for their thermal energy supply. The over-dependence on fuel-wood for energy is mainly because of its relatively low prices and easy accessibility when compared to other conventional energy resources.

Other reasons include constraints in the supply of the conventional fuels to the growing population with a large segment of people unable to afford the cost of conventional fuels such as kerosene, liquefied petroleum gas (LPG) and electricity. Fuelwood is consumed in diverse ways and at different levels of the society in both rural and urban areas. Household production and use of traditional fuels is also associated with negative health impacts, especially for women and children. Additionally, collection/production and transportation of fuelwood is often arduous and can prevent allocation of time to higher value pursuits.

Fuelwood production, trading and consumption are largely unregulated. They are not generally marketed formally and their recorded contribution to Gross Domestic Product (GDP) is therefore limited and unknown. There is general lack of mainstream economic interest in fuelwood and in collection of related statistics. The Energy Commission of Nigeria (ECN) however is keen on tracking the fuelwood sector in Nigeria. ECN has conducted a National Fuelwood Survey in 1999, survey of Fuelwood Consumption in the Federal Capital Territory, Abuja in 2015 and in North Central geopolitical zone (Kogi, Kwara and Niger states) in 2017. Through these surveys, ECN possessed basic data on fuelwood consumption pattern in Nigeria and is therefore qualified for partnership with international development partners on fuelwood consumption surveys.

It is against this background that the Energy Commission of Nigeria requested for the technical assistance and grant for the implementation of the International Renewable Energy Agency (IRENA) household fuelwood survey module.

1.2 Choice of Survey Location

The proposed survey covered the North-west geopolitical zone of Nigeria. North West is the largest of the six (6) geopolitical zones of Nigeria and covers more than a quarter of the total population of Nigeria. The zone comprises of states with similar cultures, history, background and close territories made up of seven states; Jigawa, Kaduna, Kano, Katsina, Kebbi Sokoto and Zamfara states with a total number of 186 Local Government Areas (LGAs) and 158,924 Enumeration Areas (EAs).

1.3 Statement of the Problem

The negative impact of fuelwood utilization to the environment cannot be overemphasized in the sense that deforestation and desertification have become a major concern in the country as fuelwood demand largely exceeds the available renewable woody biomass in the selected states.

Fuelwood is largely obtained from the natural forest (communal forest, forest reserves or some private forests) free or at the payment of small fees to the landowners. The present situation is that wood extraction from the forest has led to a situation where forest increment obtained by natural regeneration is far less than the volume of wood extracted from the forests annually. With supplies diminishing and consumption growing, there is the likelihood of facing major challenges in terms of difficulty in obtaining firewood and the resultant consequences arising from forest depletion or massive tree felling without replenishment.

Fuelwood has the potential to play a role in sustainable development and could be far from becoming extinct as an energy source. Therefore, improved fuelwood consumption statistics are essential. Improved statistics will facilitate development of policies and programmes aimed at improving access to sustainable energy sources and sustainable natural resource management. Benefits to the international community through GHG emissions reduction may also be possible and with global responses to climate change having been galvanized by agreement at COP 21 in Paris, significant increases in international financing for climate change are expected in the coming years. In programming this funding accurate statistics will be invaluable.

However, there is paucity of data on the quantity of fuelwood consumption in Nigeria which will assist in deploying these and other necessary measures to minimize fuelwood use. It is only the existence of a comprehensible data on the fuelwood utilization in the country will provide the desired information needed to tackle the negative environmental impact of fuelwood utilization.

1.4 Justification

A survey to determine the existing fuelwood consumption data in Nigeria is not only critical but necessary. The survey may however not attain national coverage at an instance due to large population to be covered, inadequate resources and manpower. It in this regard that this survey was restricted the aforementioned states in the North West geo-political zone where there is relative security and high prevalence of fuelwood use. All the states fall within the Great Green Wall Programme conceived by the African Union (AU) to address land degradation and desertification, boost food security and support communities to adapt to climate change in the Sahel-Sahara region of Africa. The National Agency for Great Green Wall (NAGGW) of Nigeria has been established with mission to halt and reverse land degradation, prevent depletion of biological diversity, ensure that by 2025, ecosystems are resilient to climate change and continue to provide essential services that would contribute to human welfare and poverty eradication.

1.5 Objectives

The objectives of the survey are:

- To study the consumption pattern by different categories of fuelwood users;
- To determine the socio-economic characteristics of respondents to include but not limited to variables such as demographic, occupation, age, educational level, income level, etc;
- To determine current energy sources in terms of categories to feature types of energy stacking e.g. combined usage of different energy sources such as charcoal, fuelwood, gas, electricity, etc maximum of four levels;
- To study the energy consumption pattern in terms quantity and price;
- To establish relationship test (cross tabulations between energy consumption and household size, income level, education level, type of stove, cooking hours, etc)
- To determine the level of awareness on the environmental impact of fuelwood consumption;
- To determine the rate and level of awareness and penetration of alternatives to fuelwood;
- To assess the existing environmental protection management mechanism vis-avis the fuelwood consumption management;
- To provide a basis for interaction with relevant authorities on how to minimize fuelwood consumption.

CHAPTER TWO

2.0 LITERATURE REVIEW

According to the National Population Commission (NPoC), a household consists of a person or group of persons living together usually under the same roof or in the same building/compound, who share the same source of food and recognize themselves as a social unit with a head of household (NPoC, 2006). The 2006 national census exercise, which was the last official census in Nigeria, put the population of Nigeria at 140,431,790 people with 30,541,248 households. Nigeria has two distinct seasons, a rainy season commencing from April to October and a dry season from November to March. The vegetation extends from the Guinea Savanna in the southern part of the State to the Sudan Savanna in the northern part.

In Nigeria, the population uses fuelwood either for cooking or heating purposes, and both household and non-household sectors in all the ecological zones of the country demand fuelwood. In the household sector, fuel wood is the domestic energy for cooking and to a lesser extent for space heating, especially during the cold season. The non- household sector consists of institutions (hospitals, prisons and schools), food industries (restaurants, bakeries) and craft industries (pottery, blacksmith, burnt bricks factories) and this sector consume a significant proportion of fuel wood (Adedayo*et al*., 2008).

Independence of their number and size, household members process food items before consumption. Although, some of the food items like fruits and vegetables may be consumed raw, the fact still remains that most of the food items must be either smoked; cooked, dried or heated before consumption hence the relevance of fuel in the life of every household is not debatable. Apart from food processing, Jatau*et al*. (2006) stated that the economic activities of most societies depend on the availability of fuel because according to the author, it is a necessary ingredient of social, political and physical development. As a developing economy, the major sources of cooking fuel in Nigeria are firewood (fuelwood), electricity (electric stoves, electric heater, and electric cooker), charcoal, kerosene and cooking gas (Liquid Petroleum Gas).

Despite the abundance of natural resources like oil, gas and high potential for hydro-electric power in Nigeria, report by Maduka (2011) indicated that Nigeria relied so much on traditional energy sources like firewood (fuelwood), bagasse and crop residues for her daily energy needs. An estimated 55% of Nigeria's primary energy requirements according to Maduka (2011), come from firewood, biomass, charcoal and animal waste and these are primarily used for heating and cooking at home. Also, Nigeria's fuel wood consumption according to Maduka (2011) is about 80 million cubic meters. This shows that biomass fuel is the commonest source of household energy in Nigeria. The demand for energy has continued to increase not only in Nigeria but in other developed and developing countries of the world due to increasing population, improved standard of living and growth of manufacturing industries (Adedayo*et al*., 2008).

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 localized 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 (2008), 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).

2.1 Fuelwood and 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- NPoC, 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.

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).

2.2The Driving Forces of Fuelwood Consumption in Nigeria

The rate of unemployment in Nigeria is also relevant to the affordability of fossil fuel and the extensive use of fuelwood (Eroke, 2012). It is established that consumers could buy fuelwood of as low as N50 or N100 for a small-sized family meal in contrast to either LPG or kerosene that are more expensive.

Some previous researches 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 way's 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).

CHAPTER THREE

3.0METHODOLOGY

The survey was guided by cluster method which seeks to estimate fuelwood consumption in a given location. The descriptive nature of the design and sequential strategy will provide answers to the questions of whom, what, when, where and how in association with the research objective. In addition, information concerning the current status of fuelwood and charcoal consumption will aid to describe "what exists" by making casual inferences based on the findings of the study.

3.1 Survey Area

The survey covered the North-west geopolitical zone of Nigeria. North West is the largest of the six (6) geopolitical zones of Nigeria and covers more than a quarter of the total population of Nigeria. The zone comprises of states with similar cultures, history, background and close territories made up of seven states; Jigawa, Kaduna, Kano, Katsina, Kebbi Sokoto and Zamfara states with a total number of 186 Local Government Areas (LGAs) and 158,924 Enumeration Areas (EAs).

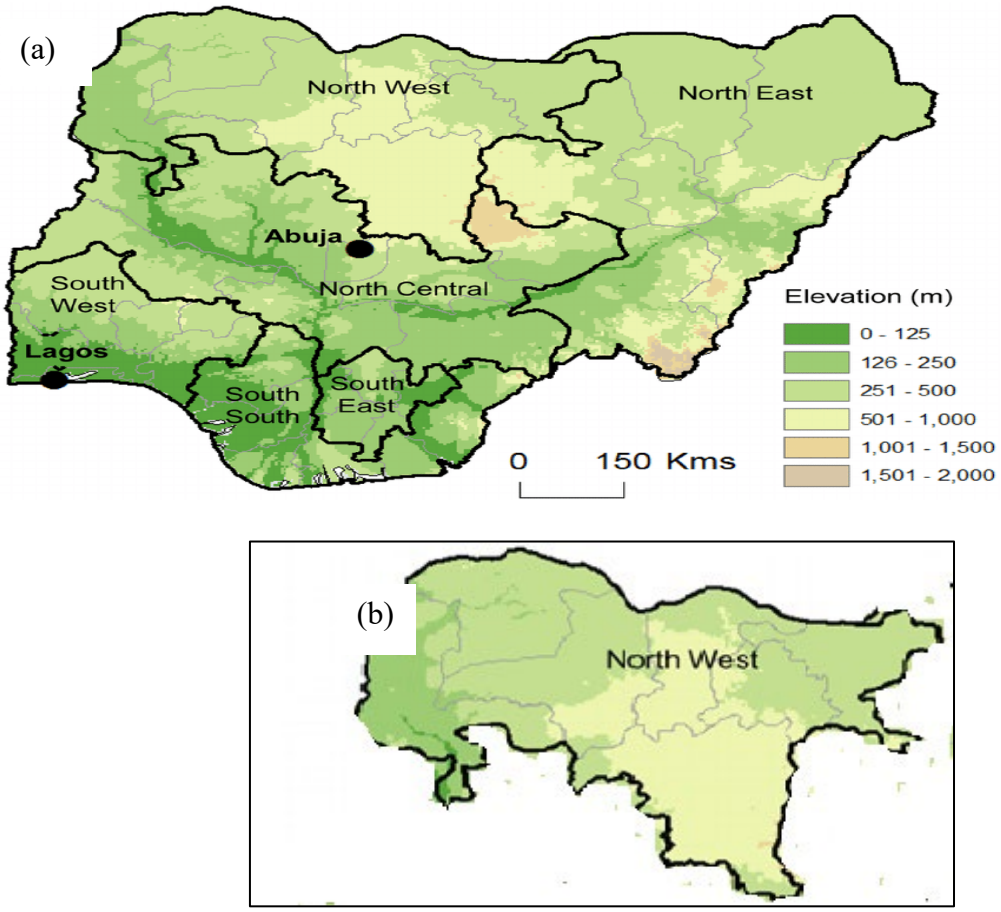


Figure 3.1.1: Map of (a) Geopolitical Zones of Nigeria and (b) North-West Zone

Source: National Oceanic and Atmospheric Administration (NOAA)

3.2Survey Design

In fulfillment of project agreement between Energy Commission of Nigeria (ECN) and the International Renewable Energy Agency (IRENA), the implementation of the "**Pilot Testing of**

Residential Woodfuel Supplementary Survey in the North West Geopolitical Zone of Nigeria" commenced with the training of 21 enumerators in two Batches in March, 2019. The training was immediately followed by data collection in April, 2019 in three states; namely Jigawa, Kaduna and Kano states covering a total of 87 enumeration areas and the second leg of data collection was concluded in June, 2019 in Katsina, Kebbi and Sokoto states covering 37 enumeration areas. In all 819 completed questionnaires were returned out of which only 20 were rejected, consequently 97.6% were considered valid.

3.2.1Existing Stratifications

Nigeria is divided into six geo-political zones and North-West was selected for the survey. The zone consists of seven States: Jigawa, Kaduna, Kano, Katsina, Kebbi, Sokoto and Zamfara.

The zone is stratified further into Senatorial Districts, according to which the enumeration areas were grouped. A total of 220 enumeration areas (EAs) in the zone were selected using systematic sampling technique representing 0.14% of the EAs. However, Zamfara State, some local government areas in Katsina and Sokoto States as well as Kaduna South Senatorial District were excluded due to security reasons. Eventually, of the 220 EAs initially selected, only 125 were finally considered for the survey as shwn in table 3.2.1. It should be noted that the enumeration areas used were adopted from the 2006 national census enumeration areas used by the National Population Commission of Nigeria.

Table 3.2.1: Selection of Enumeration Areas

	LGA	Enumeration Areas			Remarks
		Total	Initial	Final	
Jigawa	27	21,070	29	28	An enumerator per enumeration area per day.
Kaduna	23	21,791	30	15	
Kano	44	36,302	50	45	
Katsina	34	33,316	46	15	Two (2) enumerators per enumeration area per day.
Kebbi	21	16,641	23	15	
Sokoto	23	12,779	18	7	
Zamfara	14	17,025	24	0	
Total	186	158,924	220	125	
Sampling Interval = 722					

3.2.2Training of enumerators in survey and data collection methods

Prior to commencement of data collection, the enumerators were provided both classroom and field training for effective participation in the survey. They were also introduced to the various survey equipments to be used in the survey in order to familiarize themselves with their use. The training consisted of classroom training, group field training, and individual field training and test-running of the questionnaire.

The enumerators and supervisors were trained in two (2) batches:

i. Batch A – 11 enumerators and 1 supervisor.
ii. Batch B – 10 enumerators and 1 supervisor.

3.2.3Classroom Training

The training was conducted in 2 days on the questionnaire content and administration. Participatory training method was adopted; participants read the questions in turn and explained what they understood by the questions while the facilitator put them through and gave final remarks on each question.

Hands on practical demonstration, measurement of moisture content using hygrometer, location of enumeration area and its coordinates, weighing of fuelwood and charcoal were conducted.

3.2.4Field Training

During the field training, the enumerators were equipped on:

i. How to gain easy and safe access to the community;
ii. How to identify and use the map of the enumeration area;
iii. How to establish and select households for interview;

3.2.5Field Training Day 1

- All the enumerators and a supervisor in a batch went to the same location (Bwari town, FCT) as a group.
- The enumerators were guided on paying courtesy visit to the traditional ruler as the most easy and secured method of gaining access to the community and securing of reliable local guide.
- At the location, each enumerator was given a map of an enumeration area to locate and thereafter systematically selected two (2) households for the interview while a supervisor went around to monitor the enumerators and also to give them necessary assistance.
- At the end the facilitator reviewed the exercise with the enumerators; identified areas of challenges and gaps were corrected.

3.2.6Field Training Day 2

- Each enumerator was assigned to a different location and each administered questionnaire in the four systematically selected households.
- It should be noted that the day 2 was meant to serve as training and test-running of the questionnaire.

3.2.7Areas that were emphasized during Training

Section S1A. Fuelwood Use

i. Question 1a. Purposes of Fuelwood Use

The different purposes of fuelwood uses were emphasized during the training because, to many enumerators-trainees, such classification was new and hence, many did not pay particular attention to the definition of various purposes. This became necessary because understanding the differences is central to the success of data collection.

ii. Question 1d. Usual daily amount and challenges of disaggregation

Many households did not separate the fuelwood or charcoal used for different purposes; in such a situation, means of disaggregating the quantity of fuel given by the respondent were devised. Below are some hints that were employed to disaggregate the quantity into various uses.

Step 1.Most often combinations of purposes were:

i. Cooking + Other Domestic Uses
ii. Cooking + Other Domestic Uses + Commercial Uses

It should be noted that it was important that the enumerators took note of the concrete activity under "**other domestic uses**" of a particular household and frequency of cooking or use of fuelwood daily, once or twice or thrice; the information was very valuable in disaggregating the fuelwood or charcoal use into various purposes. From our experience, boiling water for bathing is the most often "other domestic uses" and it is deeply integrated with cooking.

Step 2.Example 1
A household of 6 – 10 persons consumes 15kg of fuelwood daily.

Scenario1: Cooking and other Domestic Uses

Assumptions

- The household uses 15kg three times daily;
- It consumes 5kg each time;
- Boils water for bathing only in the morning and uses about 40% of 5kg for the purpose (other domestic uses) = 2kg
- Final disaggregation
  i. Cooking = 13kg ⟶ 87%
  ii. Other domestic uses = 2kg ⟶ 13%

Scenario 2: Cooking and other Domestic Uses

Assumptions

- The household uses 15kg twice daily;
- It consumes 7.5Kg each time;
- "Other Domestic Uses" that is boiling water for bathing = 40% x7.5kg = 3kg
- Final disaggregation
  a. Cooking = 12kg
  b. Other domestic uses = 3kg

Attention: Additional information that was helpful included asking the respondents about some of the things listed below and their responses were noted on the page margin of the questionnaire; such information guaranteed better disaggregation.

- Frequency of cooking daily;
- Type of meals cooked;
- Duration of cooking.

Scenario 3: Cooking and Commercial Uses

a. Information on time spent in cooking for the household and time spent on commercial use also aided the disaggregation process**.**

b. Household size that is cooked for and the average number of customers served also aided the disaggregation process**.**

c. Quantity of food cooked or size of pot for each (cooking and commercial use) also helped in disaggregation.

d. It should be noted that substantial number of household's separate fuel/charcoal acquisition for Cooking and Commercial – and by extension Agricultural and Cultural/Religious Uses – hence, disaggregation is only needed where the sources are joint.

Scenario 4: Cooking and Agricultural Uses

Most respondents have good knowledge of fuel use for Agricultural purpose; hence there was no need for disaggregation.

iii. Question 1d. "Usual daily amount"

Caution onQuestions 1b and 1d
Question 1.b – In how many days (in the last one month)?
Question 1.d – Usual daily amount, Kg
Clarification:

- **"Usual daily amount"** meant quantity of fuelwood used in a usual day of the days mentioned in question '1b'; all the days being equal. It was not average value.
- **Common mistake:** to obtain Total (kg) under Question 1.d; enumerators were advised not to multiply:
  → Total (kg) (Q1.d) = No of days (Q1.b) x No. of bundles (Q1.d) x Kg per bundle (Q1.d)(A)
  but to do as follows:
  → Total (kg) (Q1.d) = No. of bundles (Q1.d) x Kg per bundle (Q1.d) (B)

iv. General Instruction given to the enumerators on S1A. "Fuelwood Use", S1B. "Fuelwood Acquisition" and S1C. "Fuelwood Sales"

- The enumerators were instructed not to be particularly concerned about the other two sub-sections during interview but to concentrate on the sub-section on which interview is being conducted; for instance, when asking questions about fuelwood use (S1A), linking it with acquisition (purchase or cut, or collection)or sale shouldn't be of concern then; though, any information given was to be noted.
- However, enumerators were instructed to cross check if the quantities under all the sub-sections of S1 (Fuelwood) and S2 (Charcoal) matched; that is the summation of quantities under use and sales should match the quantities acquired through various means, and in case there is no match, the enumerator should know (ask) why and note the reason by the page margin of the questionnaire.

v. Other instructions:

- For security and safety of the enumerators, they were strictly instructed to conduct interview outdoor only, and always employ the service of local guide appointed by the local authority.

vi. It was noted that Sections 1 and 2 are factually the same, one for fuelwood and the other for charcoal hence, observations under S1 also hold for corresponding questions under S2.

vii. Observations

- It was noted during the field training, questionnaire test-running and survey that some households produce very low-quality charcoal when using fuelwood; charcoal thus produced was not classified as charcoal production because of conversion technology and its very low energy content.

The quantity (kg) and cost reported under questions 1d, 5, 6, 9, 14c, 19c, 22 and 32cis for a usual daily amount; while the quantity and cost reported under questions 16,17, 26, 34 and 35 is total per month.

3.3Responsibility of Field Supervisor

The under listed responsibilities were informed by the instructions given to the supervisors during the training and the experiences of the field trips (Batches A and B).

- During field visit, the supervisor went through the completed questionnaire thoroughly, interacted with the enumerator on some of the responses that were not very clear or seem incorrect or just to ensure the enumerator understood what he/she reported before the completed questionnaire was endorsed.
- The supervisor informed the enumerator about his/her observations/corrections.
- The supervisor endorsed in the space provided on the first page of the questionnaire after certifying that the questionnaires were adequately completed.
- A supervisor was responsible for the accuracy of the questionnaires endorsed by him/her.

3.4Conduct of household woodfuel survey

During the second and third weeks of April, 2019 first field trip of the survey was conducted in 87 enumeration areas in Kaduna, Kano and Jigawa States by 11 enumerators; a total of approximately 435 households were interviewed.

Ten (10) enumerators conducted survey in Katsina, Sokoto and Kebbi states in June 2019. Feedbacks from the first trip informed that it is better two (2) enumerators work together in an enumeration area; hence, the ten covered 37 enumeration areas in the three states – 15 in Katsina and Kebbi state each, and 7 in Sokoto state, amounting to 370 households or administered questionnaires.

3.5Feedbacks on Survey Process

The questionnaire is comprehensive and bridged some of the gaps identified during the 2015 survey of fuelwood consumption in Abuja FCT conducted by ECN, especially in the area of accounting for the woodfuel consumption for household based commercial activity.

When recommendations and suggestions in different parts of the report are incorporated taken into consideration, the questionnaire will emerge as a very good instrument to collect information on woodfuel use, sales, acquisition and related matters in the residential sector.

3.6 Completion of Survey and Method of StatisticalAnalysis

The returned 819 questionnaires were subjected to thorough verification methods out of which 20 were rejected and 799 (97%) were considered valid for analysis. During the verification, correctness and completeness of entries, conflict of entries across related questions, unit of measurement, and clarity of entries were the parameters scrutinized.

The questionnaire was converted into the digital format usingCensus and Survey Processing System(CSPro) for data entry and collation, whileStatistical Package for Social Sciences(SPSS)and Microsoft excel were used for the analysis, which was followed by report writing on the obtained results.

3.7Training on Census and Survey Processing System(CSPro) and Statistical Package for Social Sciences (SPSS) for Data Analysis

The training was held on 16th – 19th September 2019 with three (3) staff of National Bureau of Statistics (NBS) as resource persons, while 13 staff of the Commission participated as trainees. It was organized in order to develop the capacity of the project team members on CSPro and SPSS tools for effective analysis of survey data. The questionnaire used to capture responses during the survey was converted into the digital format using CSPro for data entry and collation. The entered data was cleaned and concatenated during the training and handed over to the team at the end of the training.

3.7.1Calculation of NW total daily consumption (NW_{TDC}) in Kg

$$NW_{TDC} = \frac{NW_p \times R_P \times HH_{ADC}}{HH_{AS}}$$

Where;

NW_{TDC} = NW Total Daily Consumption

NW_P = NW Population =48,942,307 (NBS, 2017)

R_P = Percentage of Respondents;

HH_{ADC} = Household Average Daily Consumption,

HH_{AS} = Average HouseholdSize

3.7.2Calculation of NW Daily Consumption per Capita (NW_{DCpC})

$$NW_{DCpC} = \frac{NW_{TDC}}{NW_P}$$

Where;

NW_{DCpC} = NW Daily Consumption per Capita

NW_{TDC} = NW Total Daily Consumption

NW_P = NW Population = 48,942,307 (NBS, 2017)

3.7.3Calculation of NW CO_2 Emission

Carbon emission from the non-renewable biomass woody biomass	=	Quantity of non-renewable biomass	X	Net calorific value of the non-renewable biomass	X	CO_2 emission factor for the biomass fuel

- Net calorific value of non-renewable biomass ($NCV_{biomass}$) = 0.015 TJ/tonne (IPCC default value for fuel wood 1996)
- CO_2 emission factor for the biomass fuel = 109.6 tCO_2/TJ (IPCC default value for biomass from IPCC 1996).

CHAPTER FOUR

4.0SURVEY RESULTS AND ANALYSIS

4.1 Demographic and Socio-economic Information

A total of 795 households were enumerated during the survey with Jigawa having 18.1%, Kaduna 9.2%, Kano 26.9%, Katsina 19.5%, Kebbi 17.5% and Sokoto with 8.8%. The number of households enumerated by states is captured in Table 4.1 below.

Table 4.1: Number of Enumerated Households

STATE	Frequency	Percentage	Valid Percentage	Cumulative Percentage
Jigawa	144	18.1	18.1	18.1
Kaduna	73	9.2	9.2	27.3
Kano	214	26.9	26.9	54.2
Katsina	155	19.5	19.5	73.7
Kebbi	139	17.5	17.5	91.2
Sokoto	70	8.8	8.8	100.0
Total	795	100.0	100.0	

The survey covered 15 senatorial districts and 100 local governments in the zone. Kano central senatorial district had the highest number of households enumerated at 114, while Jigawa south-west had 15 household enumerated being the lowest, Katsina municipal local government had 31 enumerated households, the highest while Tsanyawa and Dandi both had 1 the lowest number of households by local governments in the zone respectively.

4.1.1 Layouts

Based on the layout of the survey area, it was observed that the rural setting had the highest number of households enumerated at 57.9 %, followed by the unplanned (urban) with 23.9 % while the planned (urban) had 8.4%, unplanned (peri-urban) had 5.3% and planned (peri-urban) had 4%. Shanty had the least with 0.5%. These findings are depicted in Figure 4.1.1:

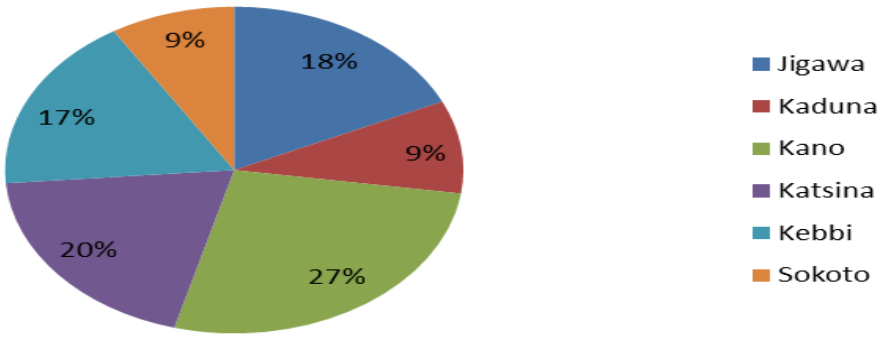


Figure 4.1.1: Distribution of Enumerated HHs by States

Table 4.1.1: Layout of the Area

Layout	Frequency	Percent	Valid Percent	Cumulative Percent
PLANNED (URBAN)	67	8.4	8.4	8.4
UNPLANNED (URBAN)	190	23.9	23.9	32.3
PLANNED (PERI-URBAN)	32	4.0	4.0	36.4
UNPLANNED (PERI-URBAN)	42	5.3	5.3	41.6
RURAL SETTING	460	57.9	57.9	99.5
SHANTY AREA	4	.5	.5	100.0
Total	795	100.0	100.0	

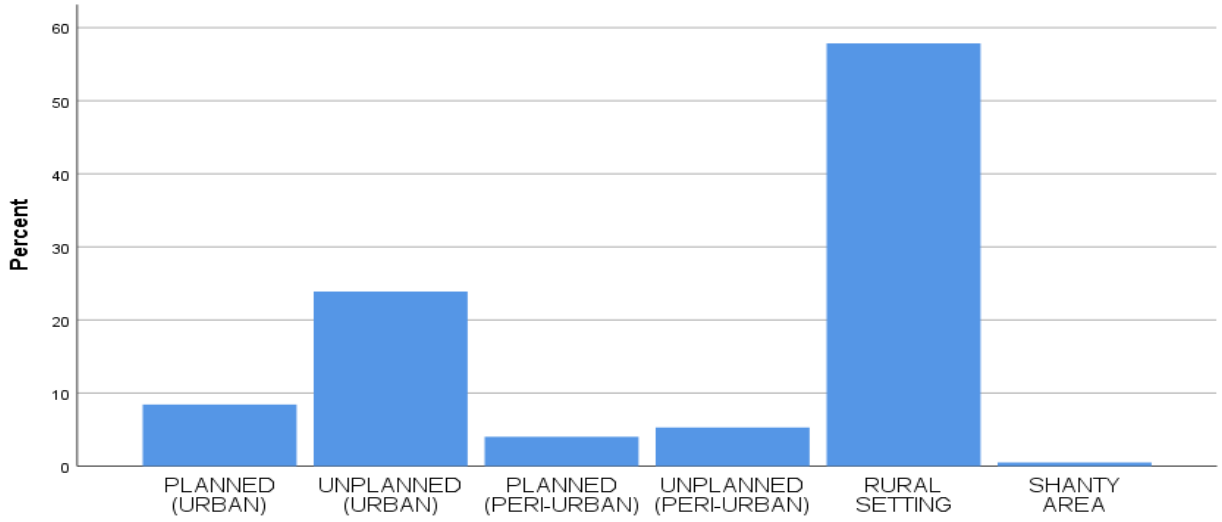


Figure 4.1.2: Distribution of Type of Layout in the Zone

The same trend can also be observed for all the states with the rural setting layout being the largest area covered as shown in Figure 4.1.3

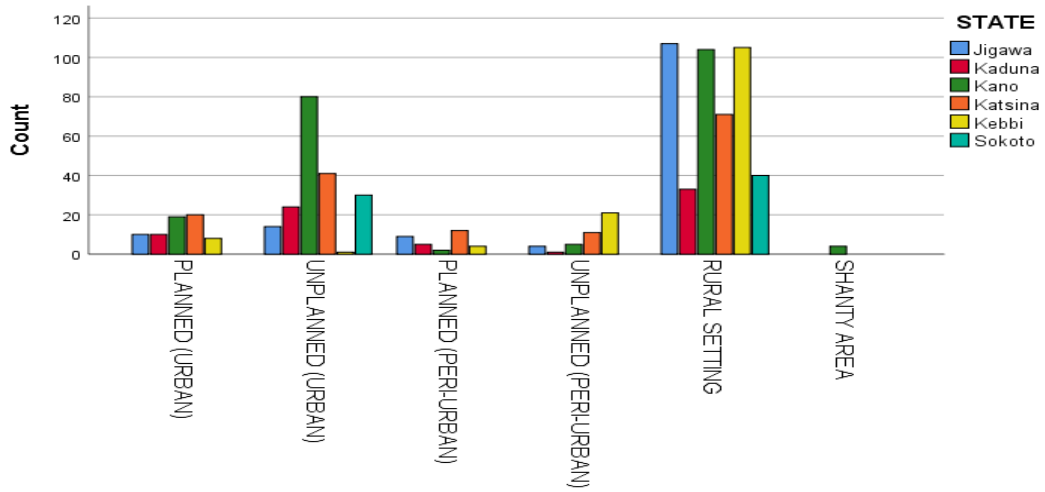


Figure 4.1.3 Distribution of Type of Layout in the States

4.1.2 Gender of Household Heads

The genders of household heads (HH) were found to include both male and female in the zone. Male gender however is the largest at 731 (91.9%) while the number of female household heads was 64 (8.1%). The number of household heads by states was observed as follows: Jigawa had 143 males and 1 female; Kebbi had 133 males and 6 females; Kaduna had 56 males and 17 females; Kano had 196 males and 18 females; while Katsina had 140 male and 15 female household heads.

From table 4.1.2 below, it can be observed that there are much more male than female household heads, and also Jigawa had the highest while Kaduna had the lowest percentage of male household heads. Alternatively, Kaduna had the highest and Jigawa had the lowest percentage of female household heads in the zone.

Table 4.1.2: Gender of the Household Head

Gender	Frequency	Percent	Valid Percent	Cumulative Percent
Male	731	91.9	91.9	91.9
Female	64	8.1	8.1	100.0
Total	795	100.0	100.0	

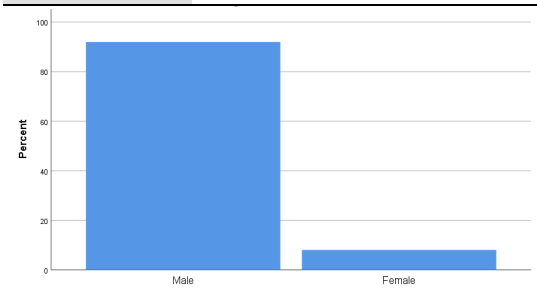


Figure 4.1.4: Distribution of HH gender

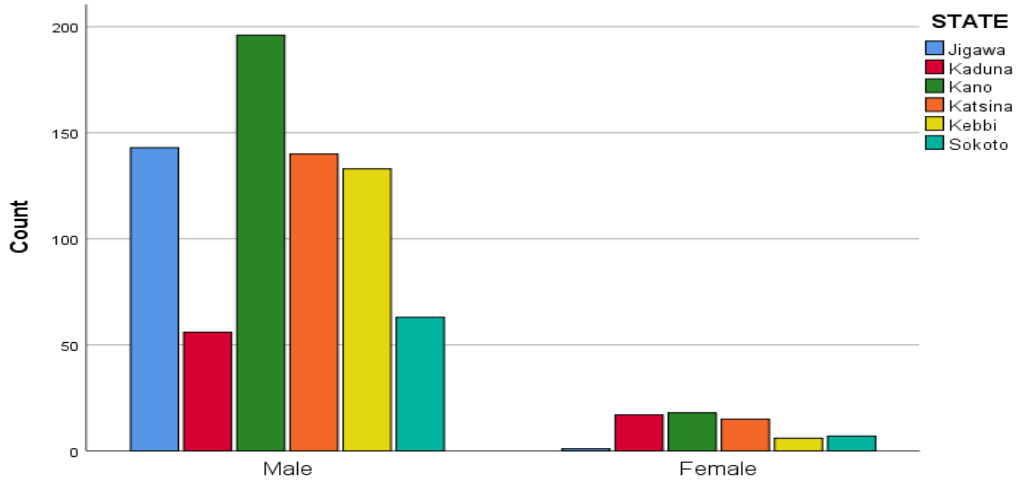


Figure 4.1.5: Distribution of Household Head Gender in States

This trend can be observed across all the states, senatorial districts, local government areas and all the layouts under the purview of the survey.

4.1.3Age of Household Heads

For the purpose of the survey, HH ages were grouped into ranges, namely: 25 and below; 26 to 40; 41 to 60 and 60 and above. The range of 25 and below had 14 respondents; that of 26

to 40 had 248 respondents; that of 41 to 60 had 413 respondents while the range for 60 and above, had 120 respondents. Table 4.1.3 below shows the typical age of household heads where the dominant age of household heads was within the range of 41 to 60, followed by age 26 to 40 and age 60 and above. Kano state recorded the highest number of all the ages respectively across the various ranges.

Table 4.1.3: Age Ranges of the Household Head

Age Range	Frequency	Percent	Valid Percent	Cumulative Percent
25 and above	14	1.8	1.8	1.8
26 To 40	248	31.2	31.2	33.0
41 To 60	413	51.9	51.9	84.9
Above 60	120	15.1	15.1	100.0
Total	795	100.0	100.0	

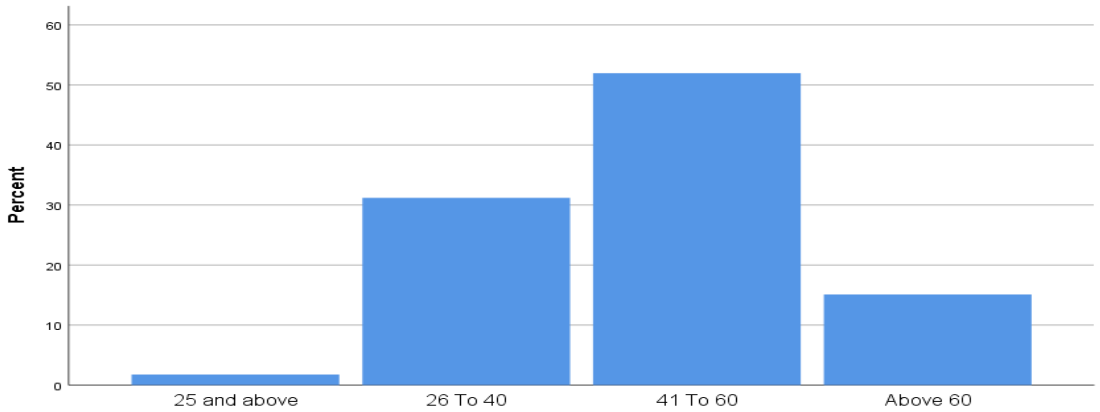


Figure 4.1.6: Age Ranges of the Household Head

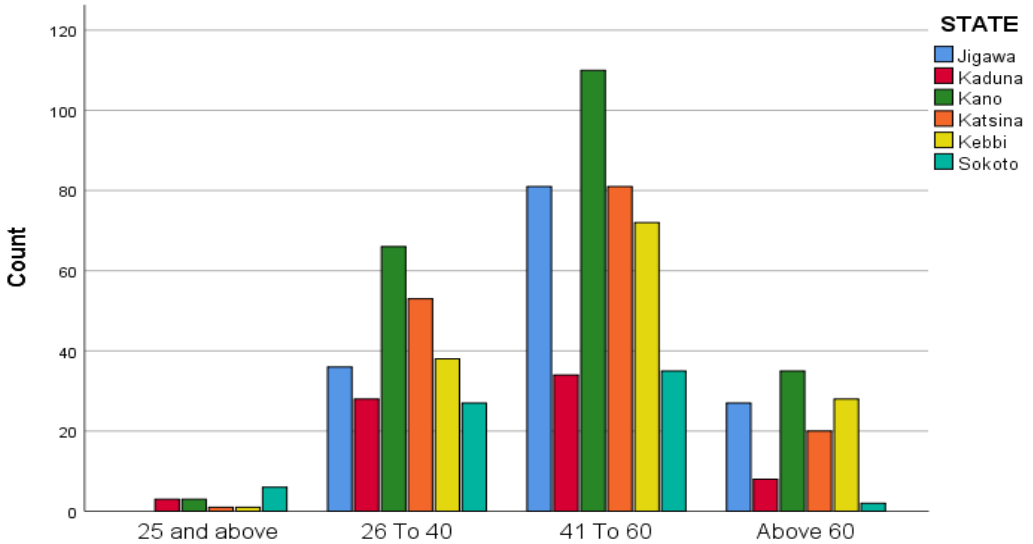


Figure 4.1.7: Age Ranges of the Household Head in the States

4.1.4Education Level of Household Heads

Again, for the purpose of the survey, respondents were asked their education level which was categorized as follows: Informal (Adult/Mass Education, Islamiyyah), Primary, Secondary, Tertiary, Post Tertiary and the option of No Education was also included.

As shown in Figure 4.1.8, Informal category had the highest number of respondents in the zone with 40.5% followed by Secondary education category with 17%, Tertiary category with 16.4%, Primary category had 14.6% and No Education category had 9.7% while Post Tertiary had 1.5%.

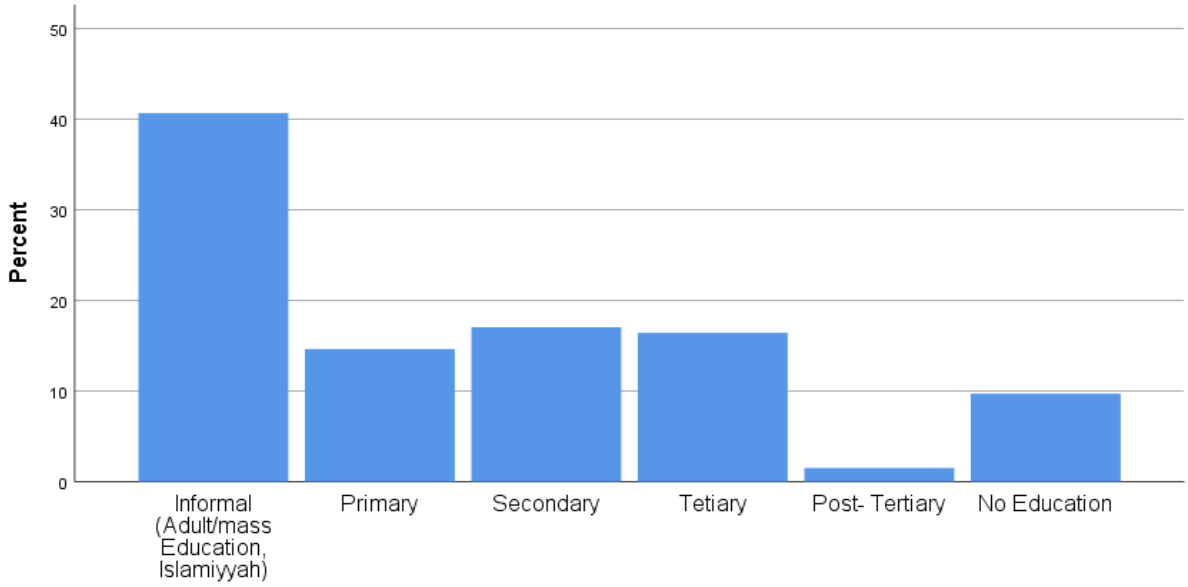


Figure 4.1.8: Education level of HH in the Zone

It can also be deduced that the Informal Category were mostly situated in the rural area as shown in Figure 4.1.9; the Primary category were mostly in the rural and parts of the unplanned (urban) likewise the Secondary category; Tertiary category was observed in rural, planned and unplanned (urban) while No Education category was also predominantly in the rural areas. It was only Post Tertiary category that was noticeable mainly in the urban areas (planned/unplanned).

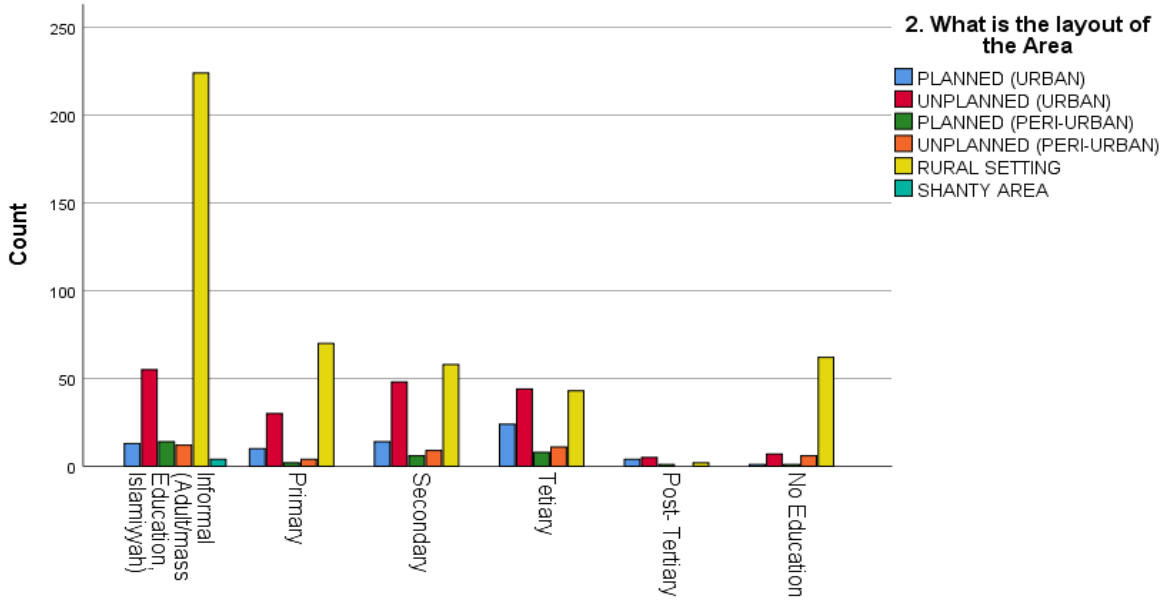


Figure 4.1.9: Education level of HH in the Layouts

Across states, it was observed that the Informal category was highest in Kano, followed by Jigawa and then, Kebbi. For the Primary category, Jigawa had the highest prevalence, then Kano and Katsina. As for the Secondary school category, Kano had the highest followed by Katsina and Jigawa. Katsina, Kano and Jigawa had the predominance of the Tertiary category while Kano and Kebbi had more of Post Tertiary category. No Education category was predominantly captured in Kebbi and Sokoto states.

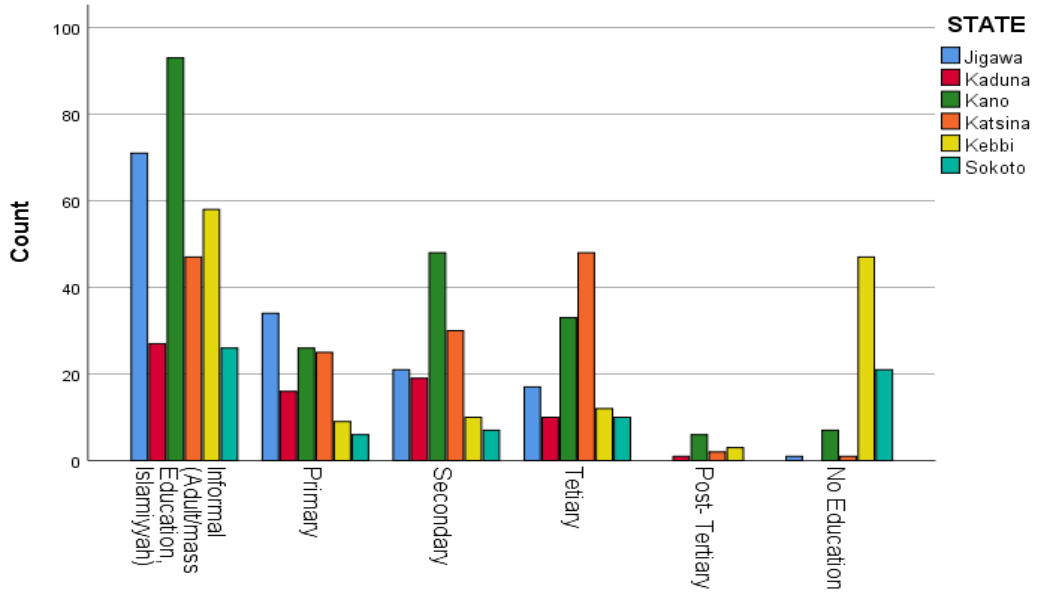


Figure 4.1.10: Education level of HH in the States

4.1.5 Income of Household Heads

For the purpose of this survey, some ranges of monthly income in Nigerian currency Naira, were adopted, namely: Less or equal to 18,000; 18,001 – 48,000; 48,001 – 79,000; 79,001 – 98,000; 98,001 – 190,000; 190,001and above.

As shown in Figure 4.1.11, the range with the highest number of occurrences was 18,001 – 48,000 with 41.8% followed by less or equal to 18,000 with 32.5%. The range of 48,001 –

79,000 had 17.2% while that of 79,001 – 98,000 had 4.5%. Finally, the range of 98,001 – 190,000 was little at 3%.

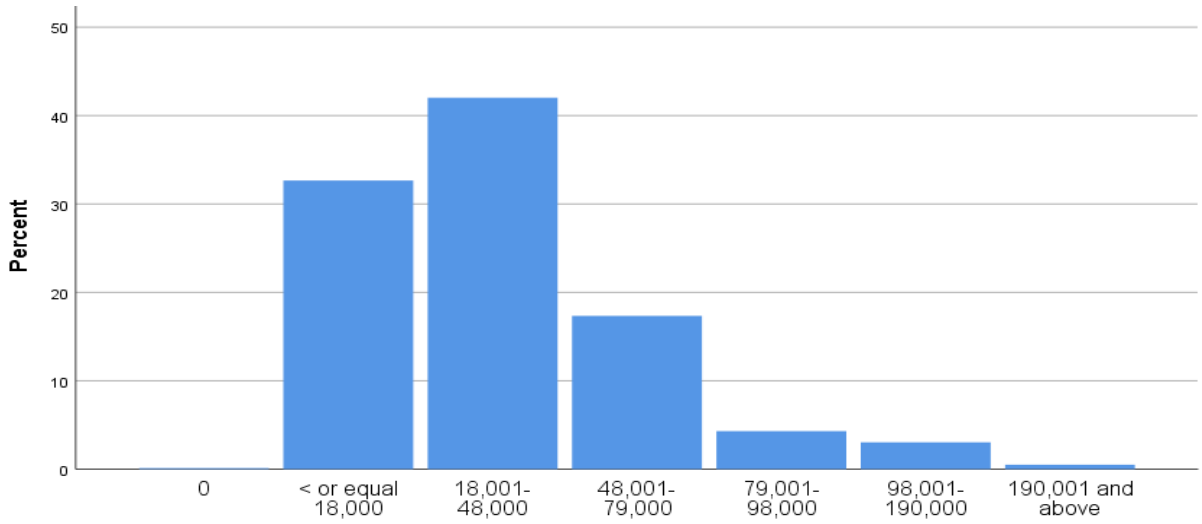


Figure 4.1.11: Ranges of Monthly Incomes of HH in the Zone

From the layout, it was observed rural had the highest number of the less or equal to 18,000 and 18,001 – 48, 000 income ranges. The range of 48,001 – 79,000 was also observed having more occurrences for rural and unplanned (urban) likewise the range of 79,001 – 98,000. The planned and unplanned (urban) had more for the 98,001 – 190,000 and 190,001 and above ranges as shown in Figure 4.1.12.

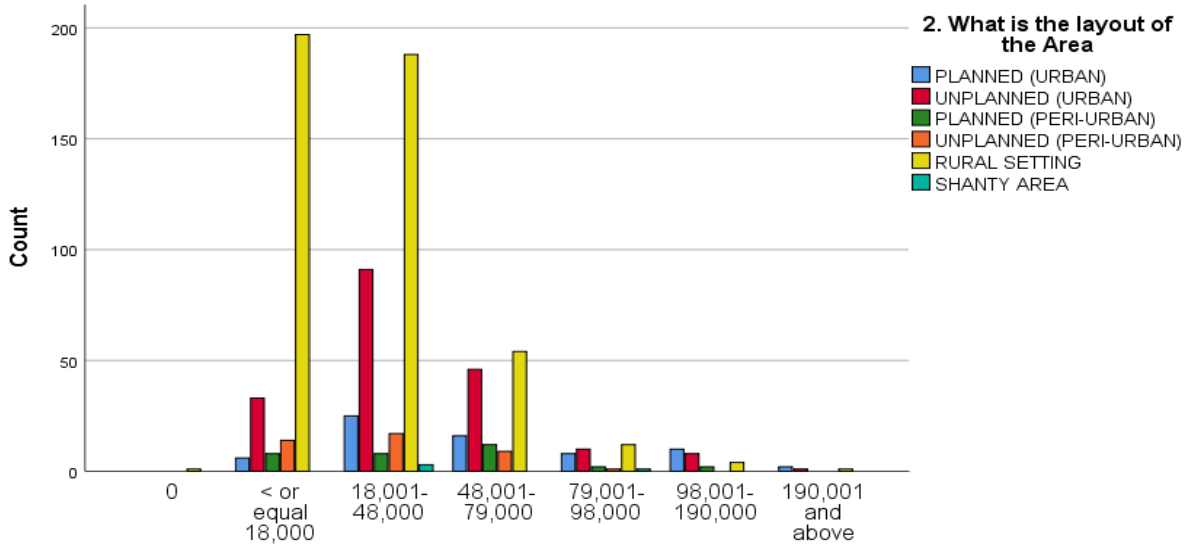


Figure 4.1.12: Ranges of Monthly Incomes of HH in the Layouts

For states as shown in Figure 4.1.13, Kebbi had the highest number for less or equal to 18,000 followed by Kano and Sokoto. Kano, Jigawa and Katsina were predominant in the 18,001 – 48,000 and 48,001 – 79,000 ranges. It was also observed that Kano and Katsina had the greater number for the 79,001 – 98,000 and 98,001 – 190,000 ranges.

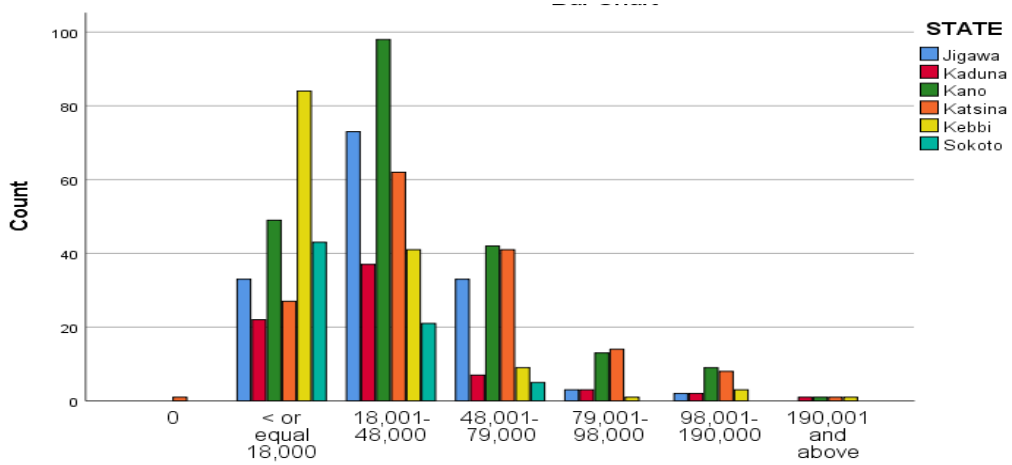


Figure 4.1.13: Ranges of Monthly Incomes of HH in the States

4.2Fuelwood Acquisition

4.2.1Fuelwood Acquisition in the North West Zone

From Table 4.2.1 and Figure 4.2.1, it could be seen that the fuelwood consumed for all purposes in the zone is mostly purchased (64.2 %) by households. The most prevalent purchases range between 201kg and 300kg (16.4 %) and between 0 and 100kg (15.3 %) of fuelwood monthly. The average monthly fuelwood purchase by households in the North West Zone is 426kg as also shown in Table 4.2.1.

Table 4.2.1: Quantity of Fuelwood Purchased in the North West Zone

Fuelwood Quantity (kg)	Number of Household	Percent
0 - 100kg	75	15.3
101kg - 200kg	69	14.1
201kg - 300kg	80	16.4
301kg - 400kg	44	9.0
401kg - 500kg	41	8.4
501kg -600kg	49	10.0
601kg - 700kg	18	3.7
700kg - 800kg	32	6.5
801kg - 900kg	19	3.9
901kg - 1000kg	4	0.8
1001kg - 1100kg	5	1.0
1101kg - 1200kg	14	2.9
above 1200kg	39	8.0
Total	489	100
Average Quantity of Fuelwood Purchased (kg)	426	

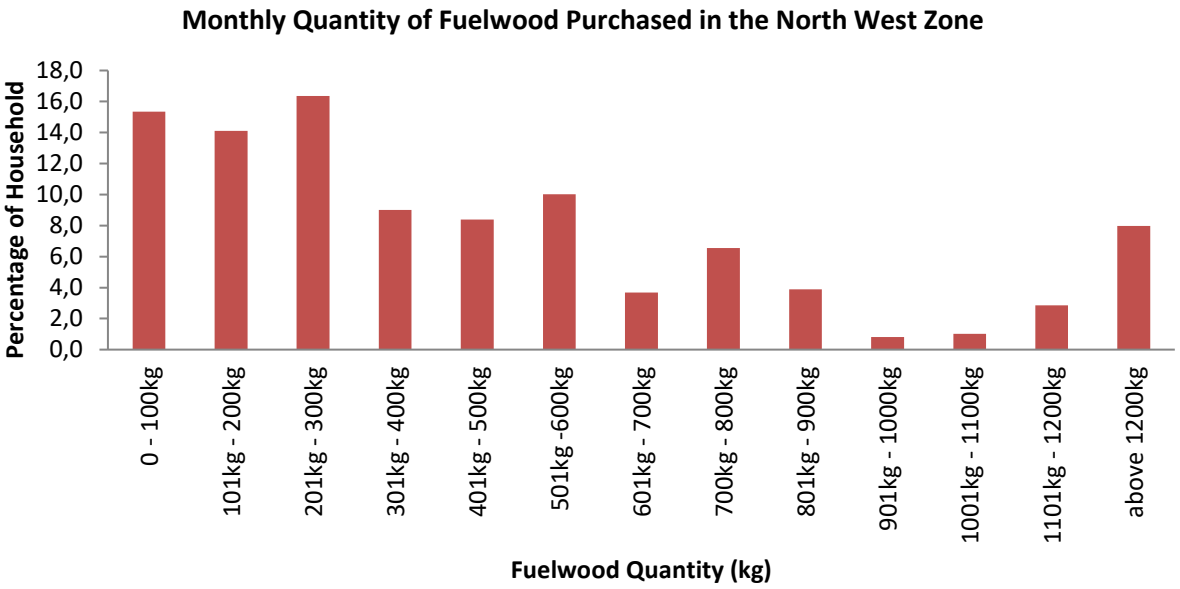


Figure 4.2.1: Monthly Quantity of Fuelwood Purchased in the North West Zone

In states, Table 4.2.2 and Figure 4.2.2 showed that the average fuelwood purchased by households in Jigawa, Kaduna, Kano, Katsina, Kebbiand Sokoto States are 660, 482,801, 525,349 and 300kg respectively. This indicates that Jigawa and Kano States have the highest rate of fuelwood acquisition while Kebbi and Sokoto States have the lowest rate.

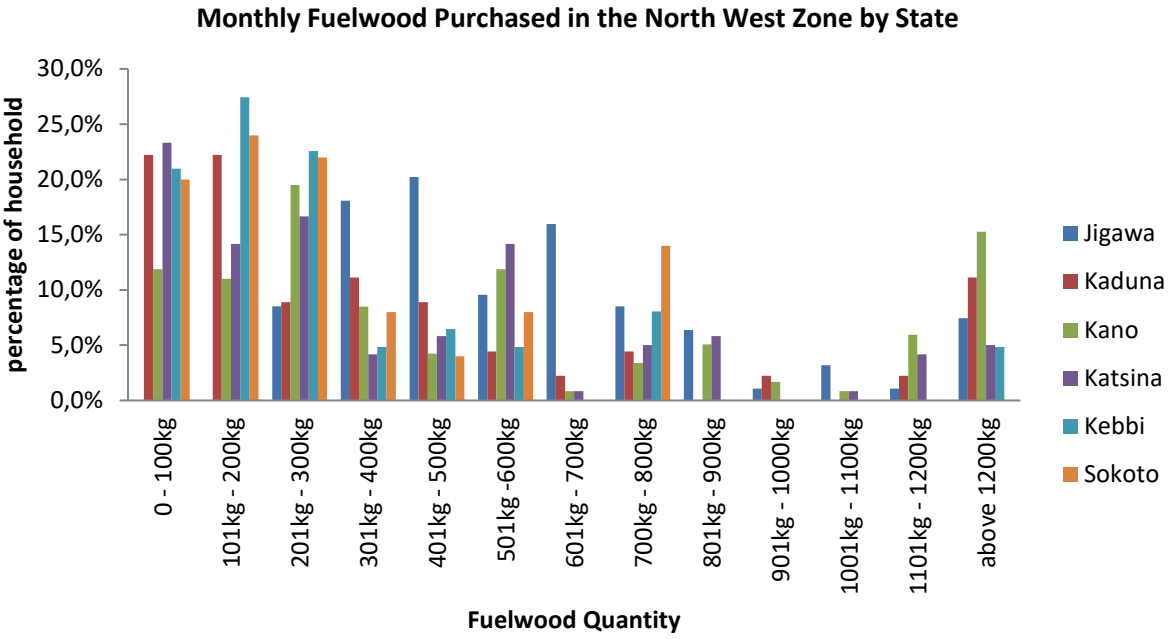


Figure 4.2.2: Monthly Quantity of Fuelwood Purchases in the States

Table 4.2.2 Monthly Fuelwood Purchased in the States

Quantity	Jigawa	Kaduna	Kano	Katsina	Kebbi	Sokoto	Total
0 - 100kg	0	10	14	28	13	10	75
101kg - 200kg	0	10	13	17	17	12	69
201kg - 300kg	8	4	23	20	14	11	80
301kg - 400kg	17	5	10	5	3	4	44
401kg - 500kg	19	4	5	7	4	2	41
501kg -600kg	9	2	14	17	3	4	49
601kg - 700kg	15	1	1	1	0	0	18
700kg - 800kg	8	2	4	6	5	7	32
801kg - 900kg	6	0	6	7	0	0	19
901kg - 1000kg	1	1	2	0	0	0	4
1001kg - 1100kg	3	0	1	1	0	0	5
1101kg - 1200kg	1	1	7	5	0	0	14
above 1200kg	7	5	18	6	3	0	39
Total	94	45	118	120	62	50	489
Average Quantity Purchased (kg)	660	482	801	525	349	300	

Table 4.2.3: Monthly Fuelwood Purchased by Layouts

Quantity	PLANNED (URBAN)	UNPLANNED (URBAN)	PLANNED (PERI-URBAN)	UNPLANNED (PERI-URBAN)	RURAL SETTING	TOTAL
0 - 100kg	13	18	3	9	32	75
101kg - 200kg	4	17	5	6	36	68
201kg - 300kg	5	23	1	5	46	80
301kg - 400kg	6	17	1	1	20	45
401kg - 500kg	5	13	1	3	19	41
501kg -600kg	4	16	4	2	22	48
601kg - 700kg	2	4	0	2	12	20
700kg - 800kg	0	8	1	0	23	32
801kg - 900kg	0	4	1	0	14	19
901kg - 1000kg	1	1	0	0	2	4
1001kg - 1100kg	0	0	1	0	4	5
1101kg - 1200kg	0	4	0	0	10	14
above 1200kg	3	10	3	2	20	38
Total	43	135	21	30	260	489
Average (kg)	553	573	576	391	586	

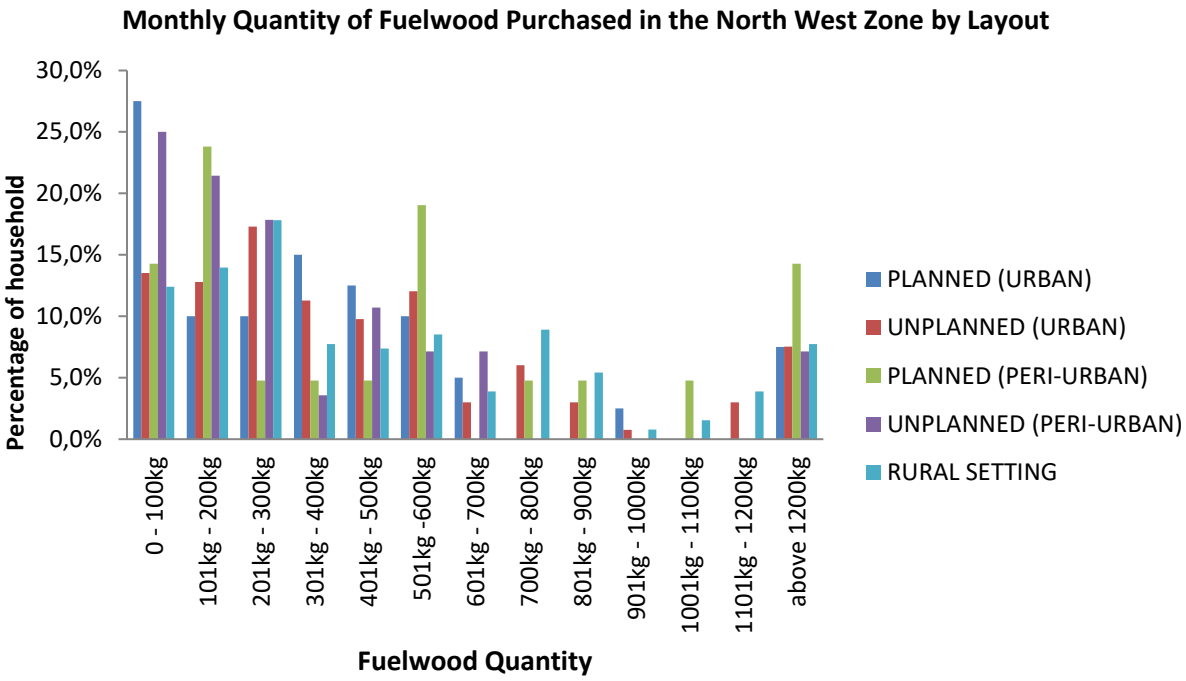


Figure 4.2.3:Quantity of Fuelwood Purchased in the North West Zone by Layout

4.2.2Monthly Fuelwood Purchased in the North West Zone by Layout

Fuelwood purchase is higher in Planned Peri-Urban and Rural layouts as depicted in Figure 4.2.3. The average monthly fuelwood purchased by households in Planned (Urban), Unplanned (Urban), Planned (Peri-Urban), Unplanned (Peri-Urban) and Rural Setting are 553, 573, 576, 391 and 586kg respectively.

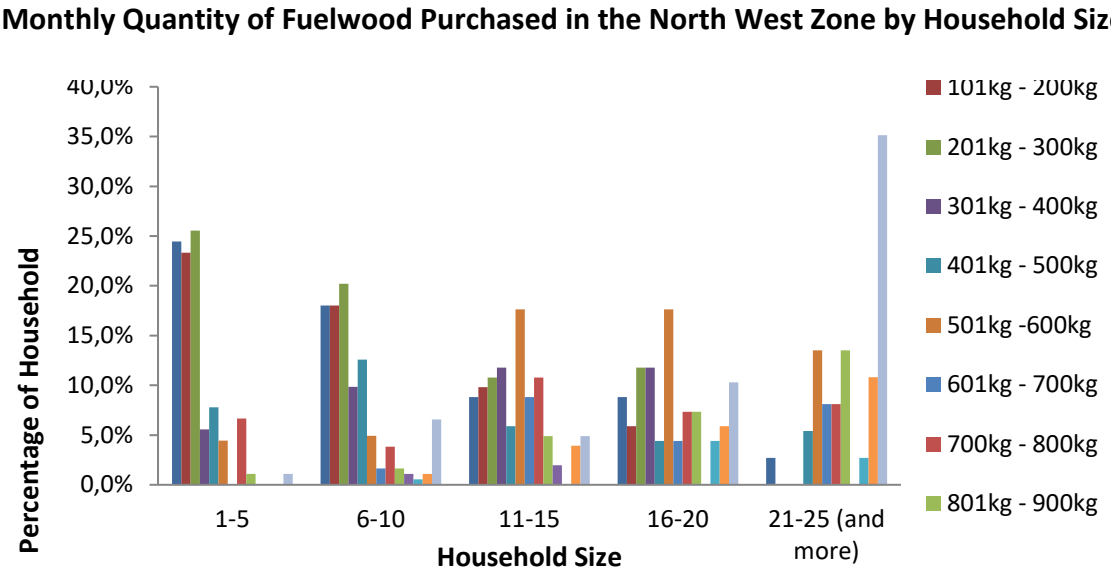


Figure 4.2.4: Monthly Quantity of Fuelwood Purchased in the Zone by Household Size

4.2.3Monthly Fuelwood Purchased in the North West Zone by Household Size

Figure 4.2.4 revealed that fuelwood purchase is higher in households with members ranging from 21 to 25. The average monthly fuelwood purchased by households with members

ranging from 1 to 5, 6 to 10, 11 to 15, 16 to 20 and 21 to 25 are 273, 472, 614, 692 and 1402kg respectively.

4.2.4Fuelwood Acquisition in the North West Zone by Wood Type

Table 4.2.4 shows the percentage of household fuelwood purchased in the North West Zone by wood type. The study revealed that households purchased 61.4% of direct wood (wood from forests, plantations, and agricultural tree crops), 2.3% of indirect wood (wood chips, sawdust, and other industrial by-products) and 4.2% improved fuelwood (pellets, briquettes, other improved fuelwood). This indicates that households mostly purchase wood from forests, plantations and agricultural tree crops.

Table 4.2.4: Percentage of Household Fuelwood Purchases in the North West Zone

Type of Wood	Fuelwood Purchases (%)	Non-Fuelwood Purchases (%)	Total
Direct wood	61.4	38.6	100
Indirect wood	2.3	97.7	100
Improved fuelwood	4.2	95.8	100

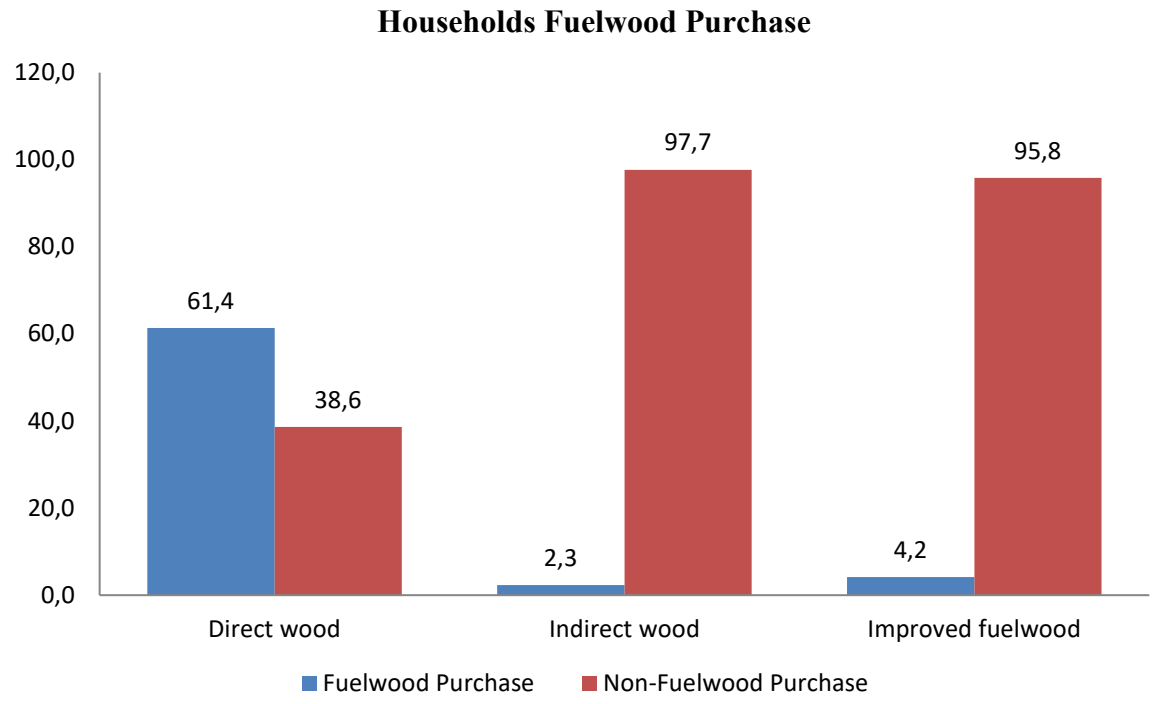


Figure 4.2.5: Percentage of Households Fuelwood Purchases in the North West Zone

4.2.5Monthly Fuelwood Expenditure by Households in the North West Zone

Table 4.2.5 shows the monthly fuelwood expenditure by households in the North West Zone. It was observed that 28.3% of households spent between ₦4001 and ₦6000 monthly on fuelwood while 1.6% spent between ₦12001 and ₦14000. The average monthly fuelwood expenditure by households in the North West Zone is ₦6, 684.

Table 4.2.5: Monthly Fuelwood Expenditure by Households in the North West Zone

Monthly Fuelwood Expenditure (₦)	Number of Households	Percentage
0 - 2000	94	19.3
2001 - 4000	119	24.4
4001 - 6000	138	28.3
6001 - 8000	22	4.5
8001 - 10000	35	7.0
10001 - 12000	28	5.7
12001 - 14000	9	1.6
14001 - 16000	10	2.1
16001 - 18000	13	2.7
above 18000	21	4.3
Total	489	100.0
Average Expenditure		₦6,684

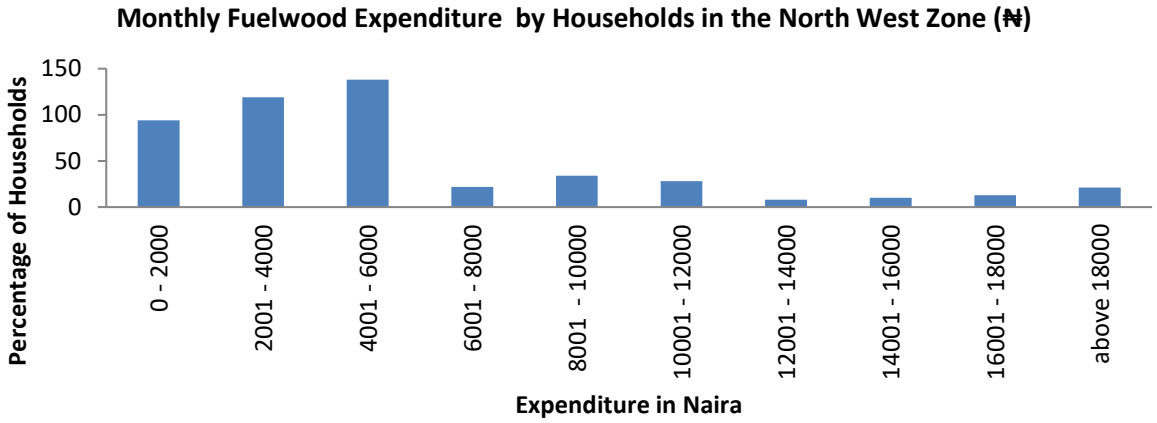


Figure 4.2.6: Monthly Fuelwood Expenditure by Households in the North West Zone

4.2.6 Monthly Fuelwood Expenditure by Households in the States

Table 4.2.6 and Figure 4.2.7 presents the monthly fuelwood expenditure by households in the States covered during the survey. It indicates that households in Kaduna State have the highest monthly expenditure on fuelwood having a monthly average of **₦9, 528** while Sokoto State has the lowest with **₦3, 158**.

Table 4.2.6: Monthly Fuelwood Expenditure by Households in the North West Zone by State

Monthly Fuelwood Expenditure (Naira)	Jigawa	Kaduna	Kano	Katsina	Kebbi	Sokoto	Total
0 - 2000	6	13	18	21	20	16	94
2001 - 4000	15	11	31	26	17	19	119
4001 - 6000	42	11	28	33	14	10	138
6001 - 8000	9	3	4	3	1	2	22
8001 - 10000	8	0	15	7	4	1	35
10001 - 12000	6	2	5	10	4	1	28
12001 - 14000	1	0	2	6	0	0	9
14001 - 16000	1	0	2	7	0	0	10
16001 - 18000	2	1	4	5	1	0	13
above 18000	3	4	10	3	1	0	21
Total	93	45	119	121	62	49	489
Average Expenditure(₦)	6682	9528	7843	7128	4343	3158	

Monthly Fuelwood Expenditure by Households in the North West Zone

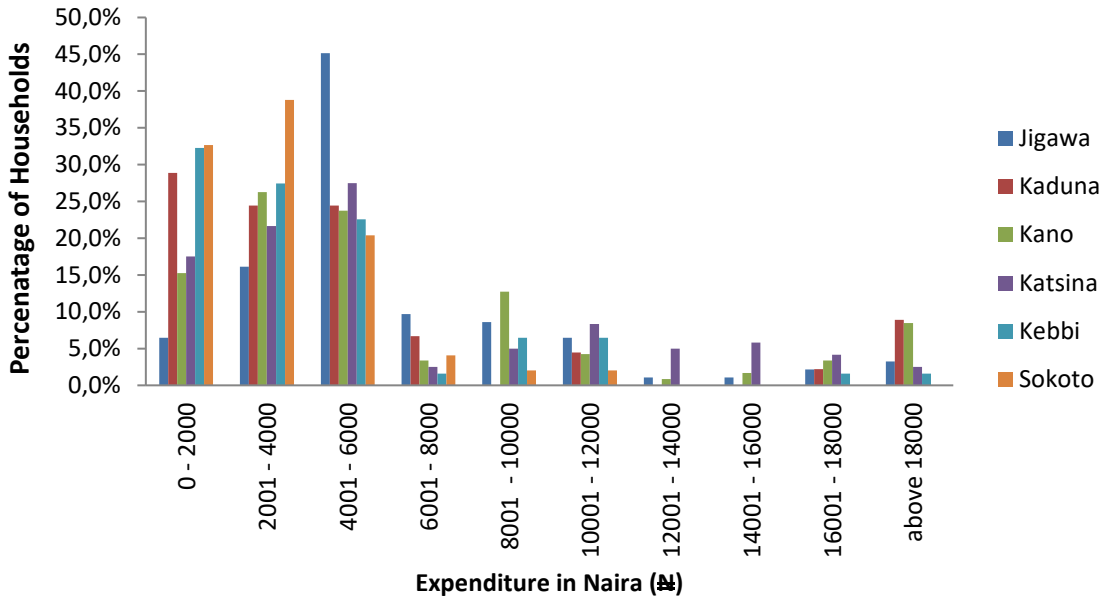


Figure 4.2.7: Monthly Fuelwood Expenditure by Households in the States

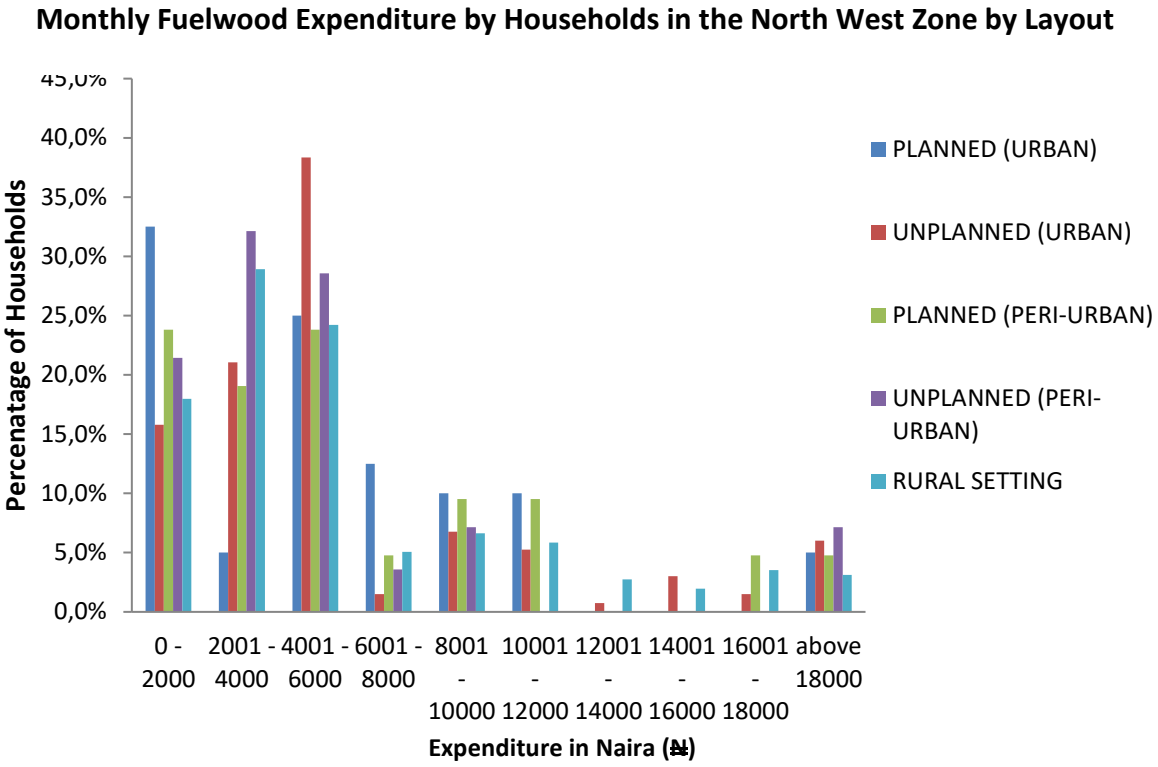


Figure 4.2.8: Monthly Fuelwood Expenditure by Households in the Layouts

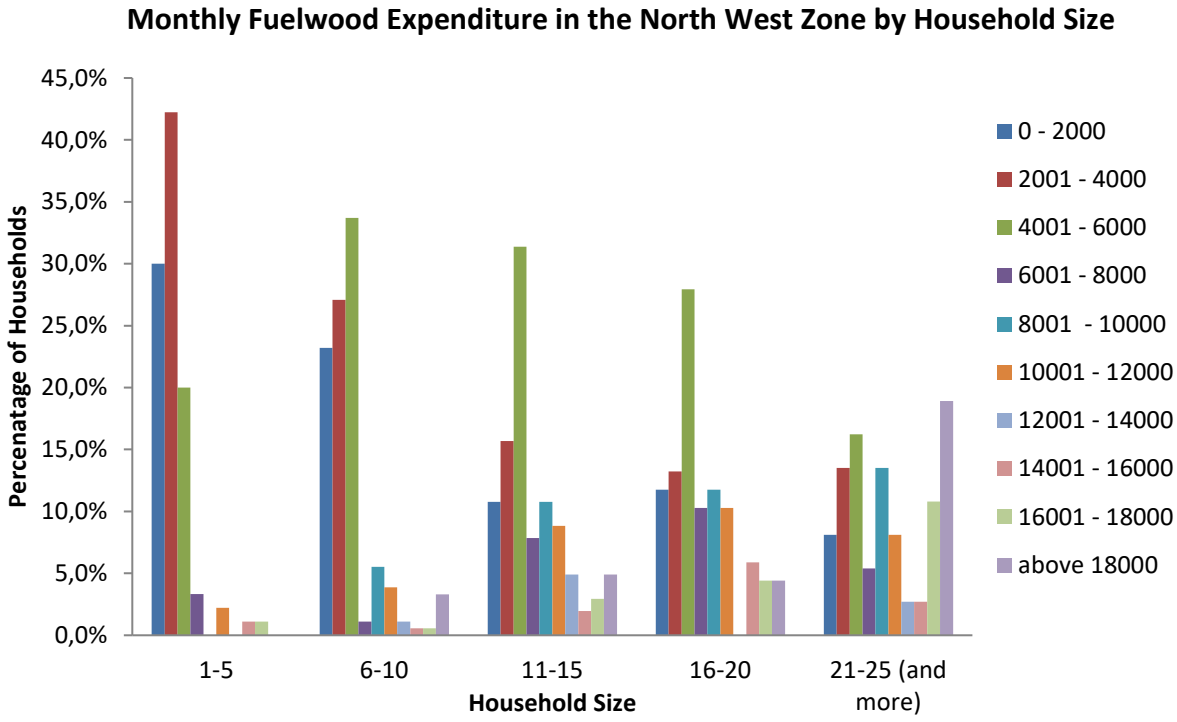


Figure 4.2.9: Monthly Fuelwood Expenditure in the North West Zone by Household Size

As presented in Figure 4.2.8, households in Planned (Urban), Unplanned (Urban), Planned (Peri-Urban), Unplanned (Peri-Urban) and Rural Setting spent an average of **₦6,400,₦8,170,₦6,167,₦5,063** and **₦6,049** monthly on fuelwood respectively. This shows that Planned and Unplanned Urban Layouts have the highest expenditure while Unplanned Peri-Urban has the lowest.

Similarly, households with members ranging from 1 to 5, 6 to 10, 11 to 15, 16 to 20, and 21 to 25 spent an average of **₦3,456**;**₦6,174**; **₦7,512**;**₦7,726 and ₦11,107** respectively as depicted in Figure 4.2.9. This reveals that households with members ranging from 21 to 25 have the highest expenditure on fuelwood.

4.2.7 Households that Cut/Collected Fuelwood in the North West Zone

Table 4.2.8 shows the percentage of households that cut/collected fuelwood in the North West Zone and it revealed that 35.8% of households cut/collected fuelwood as is also shown in figure 4.2.10.

Table 4.2.8: Percentage of Households that Cut/Collected Fuelwood in the North West Zone

Fuelwood Cut/Collected	Frequency	Percent
Yes	284	35.8
No	509	64.2
Total	**793**	**100.0**

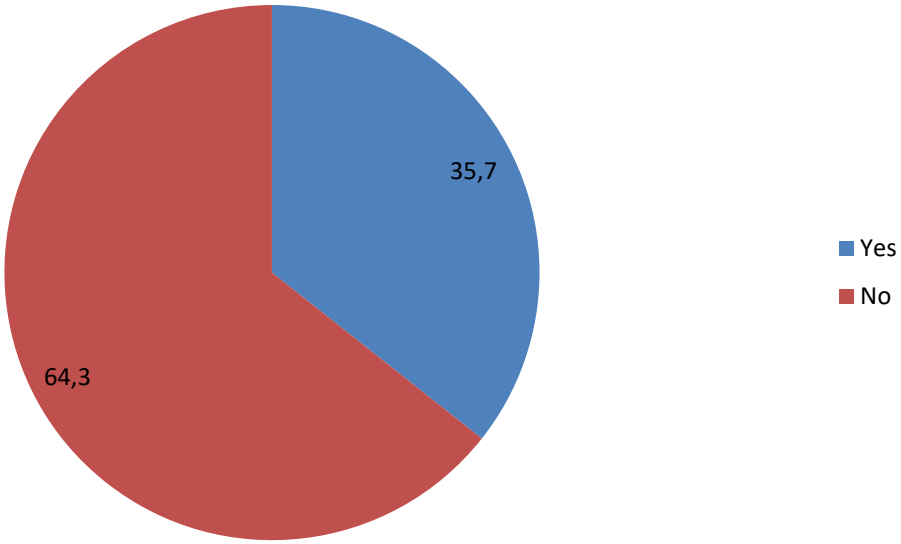


Figure 4.2.10: Percentage of Households that Cut/Collect Fuelwood in the North West Zone

Table 4.2.9: Percentage of Households that Cut/Collected Fuelwood in the States

Fuelwood Cut/Collected	Jigawa	Kaduna	Kano	Katsina	Kebbi	Sokoto	Total
Yes	49	19	66	29	95	26	284
No	95	54	146	125	44	45	509
Total	144	73	212	154	139	71	793

4.2.8 Households that Cut/Collected Fuelwood in the States

Figure 4.2.11 showed that Kebbi State has the highest number of households (68.3%) that cut/collected fuelwood; this is followed by Sokoto, Jigawa, Kano and Kaduna States with 35.7, 34 30.8 and 26% respectively. Katsina State has the least with 18.8% of households that cut/collected fuelwood.

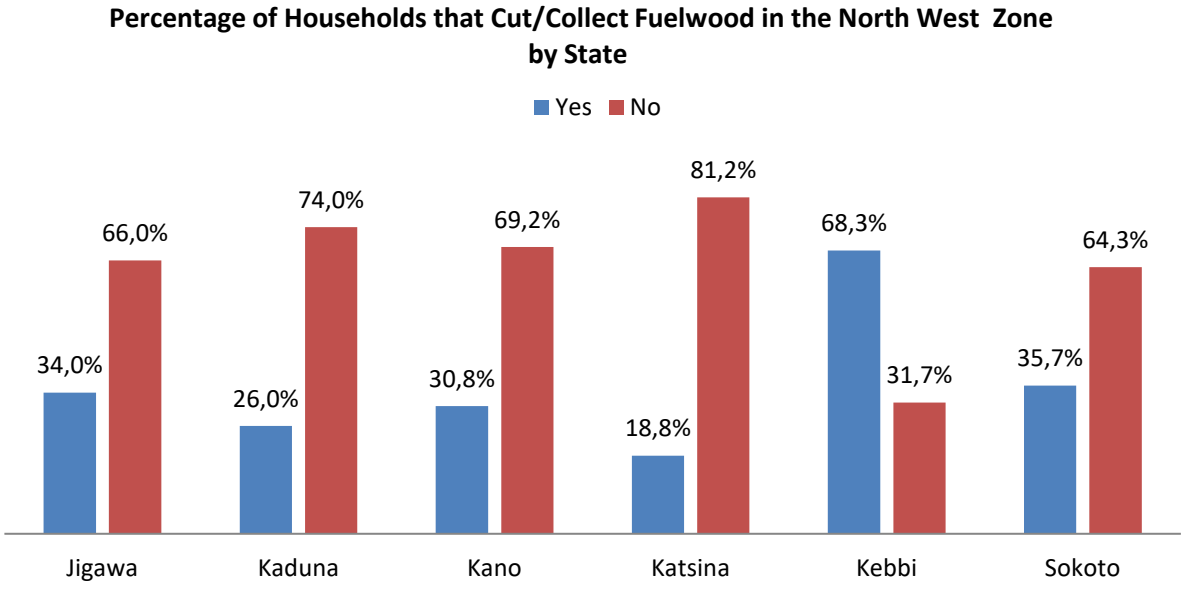


Figure 4.2.11: Percentage of Households that Cut/Collected Fuelwood in the States

4.2.9 Households that Cut/Collected Fuelwood in the Layouts

All households in Shanty area only cut/collected fuelwood while 53.4 and 61% of households in Rural and Unplanned Peri-urban respectively cut/collected fuelwood as can be seen in Figure 4.2.12. Planned and Unplanned Urban layouts have the least with 4.6and 3.7% respectively.

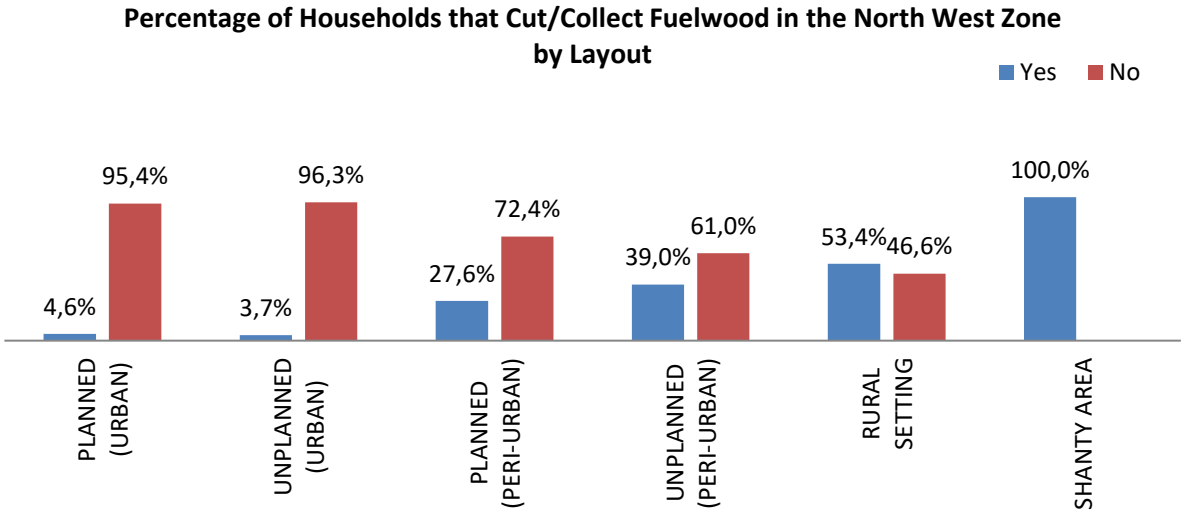


Figure 4.2.12: Percentage of Households that Cut/Collected Fuelwood in the Layouts

4.3Location of Wood mainly Cut/Collected in the North West Zone

As indicated in Figure 4.3.1, 52.1% of wood cut/collected was from natural forest; 42.3% came from their own farm; 3.1% was wood from bush, river banks, and other wild systems. 1% reported collecting their own fuelwood from other locations while wood from forest plantation; other agricultural land; urban/village area, roadside; construction sites, dumps have the least with 0.3% each.

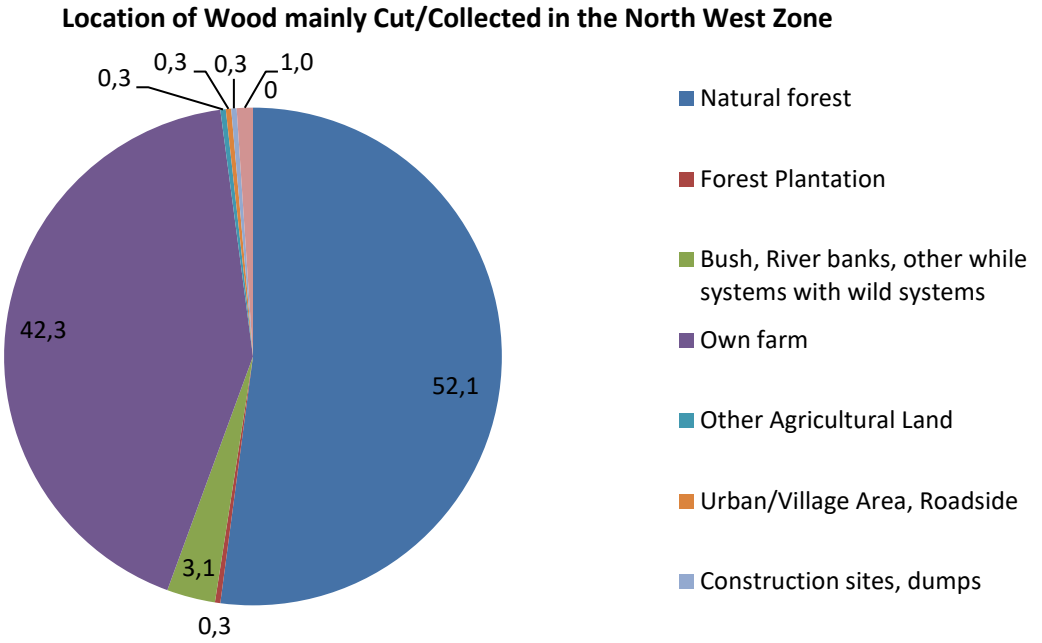


Figure 4.3.1: Location of Wood mainly Cut/Collected in the North West Zone

4.4 Acquisition of Fuelwood through Payment-in-kind, Barter, Gift, Borrow and others

As shown in Table 4.4.1 a, almost all households (99%) in the North West Zone do not acquire fuelwood through Payment-in-kind, Barter, Gift, Borrow, and others. This indicates that fuelwood consumed in the North West Zone is either purchased or cut/collected.

Table 4.4.1: Households that acquired Fuelwood through Payment-in-kind, Barter, Gift, Borrow and others in the North West Zone

Households that acquired Fuelwood through Payment-in-kind, Barter, Gift, Borrow, and others.	Number of Households	Percent
Yes	8	1.0
No	785	99.0
Total	**793**	**100.0**

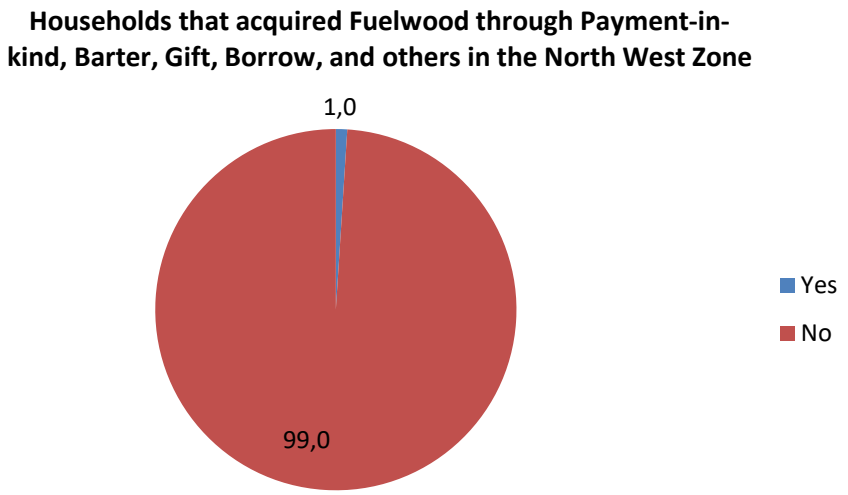


Figure 4.4.1: Households that acquired through Payment-in-kind, Barter, Gift, Borrow, and others in the North West Zone

4.5 Quantity of Fuelwood Cut/Collected in the Zone

Figure 4.5.1 and Table 4.5.1 showed that 28.2, 27.1and 22.2% of households cut/collected between 0 – 200, 201 - 400 and 401 – 600kg of fuelwood monthly respectively. This indicates that the average monthly fuelwood cut/collected by households in the North West Zone is 534kg.

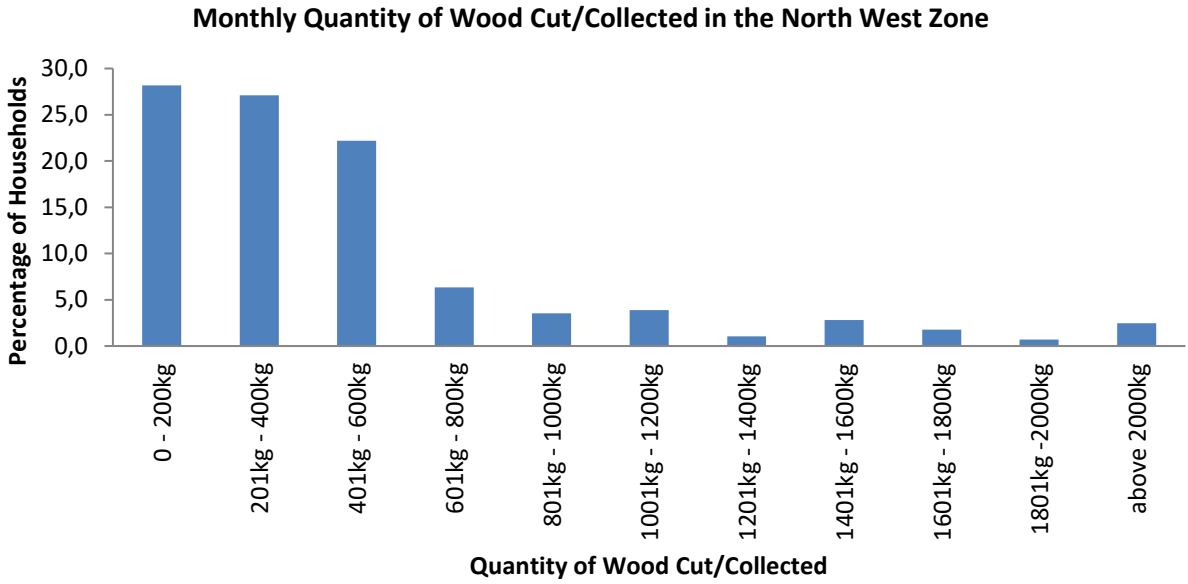


Figure 4.5.1: Monthly Quantity of wood Cut/Collected in the North West Zone

Table 4.5.1: Monthly Quantity of Wood Cut/Collected in the North West Zone

Monthly wood Cut/Collected	Frequency	Percent
0 - 200	80	28.2
201kg – 400kg	76	27.1
401kg - 600kg	62	22.2
601kg - 800kg	19	6.3
801kg - 1000kg	10	3.5
1001kg - 1200kg	12	3.9
1201kg - 1400kg	3	1.1
1401kg - 1600kg	8	2.8
1601kg - 1800kg	5	1.8
1801kg -2000kg	2	0.7
above 2000kg	7	2.5
Total	284	100.0
Average Quantity of Wood Cut/Collected	534kg	

4.6 Quantity of Fuelwood Cut/Collected in the States

As shown in Table 4.6.1 and Figure 4.6.1, the average wood cut/collected in a month by households in Jigawa, Kaduna, Kano, Katsina, Kebbi and Sokoto States are 644, 366,322, 707, 626and 446kg respectively. This clearly shows that Katsina State has the highest number of households that cut/collected fuelwood while Kano Sate has the lowest.

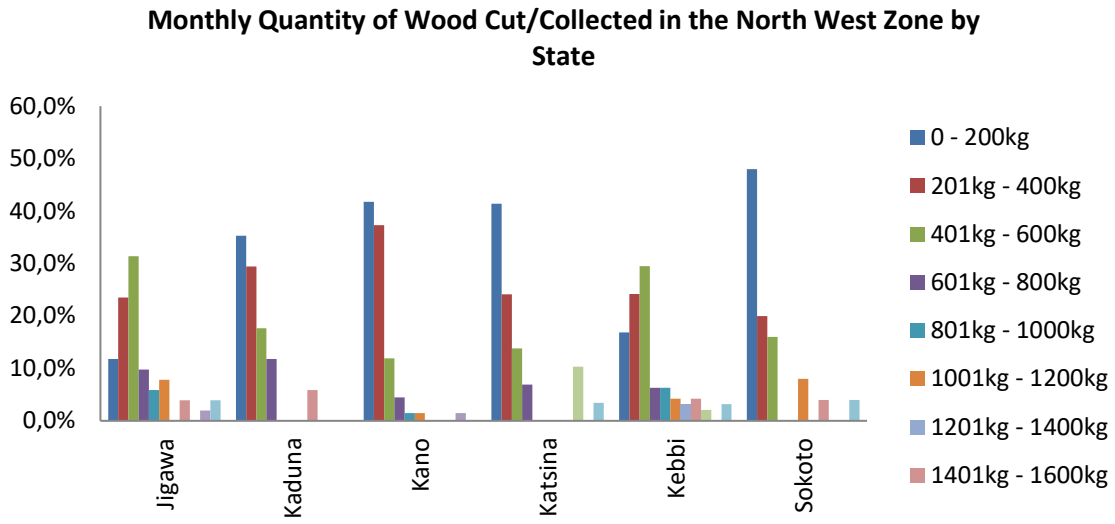


Figure 4.6.1: Monthly Quantity of Wood Cut/Collected in the North West Zone by State

Table 4.6.1: Monthly Quantity of wood Cut/Collected in the North West Zone by State

Monthly wood Cut/Collected	Jigawa	Kaduna	Kano	Katsina	Kebbi	Sokoto	Total
0 - 200kg	6	6	28	12	16	12	80
201kg - 400kg	12	5	24	7	23	5	76
401kg - 600kg	16	3	8	4	27	4	62
601kg - 800kg	5	2	4	2	6	0	19
801kg - 1000kg	3	0	1	0	6	0	10
1001kg - 1200kg	4	0	1	0	4	3	12
1201kg - 1400kg	0	0	0	0	3	0	3
1401kg - 1600kg	2	1	0	0	4	1	8
1601kg - 1800kg	0	0	0	3	2	0	5
1801kg -2000kg	1	0	1	0	0	0	2
above 2000kg	2	0	0	1	3	1	7
Total	51	17	67	29	94	26	284
Average Quantity (kg)	644	366	322	707	626	446	

4.7 Quantity of Fuelwood Cut/Collected in the Layouts

The average quantity of wood cut/collected in a month by households in the Planned (Urban), Unplanned (Urban), Planned (Peri-Urban), Unplanned (Peri-Urban), Rural Setting and Shanty Area are 131, 166, 412, 280, 574 and 466kg respectively. This indicates that Rural and Shanty layouts have the highest and lowest number of households respectively that cut/collected fuelwood.

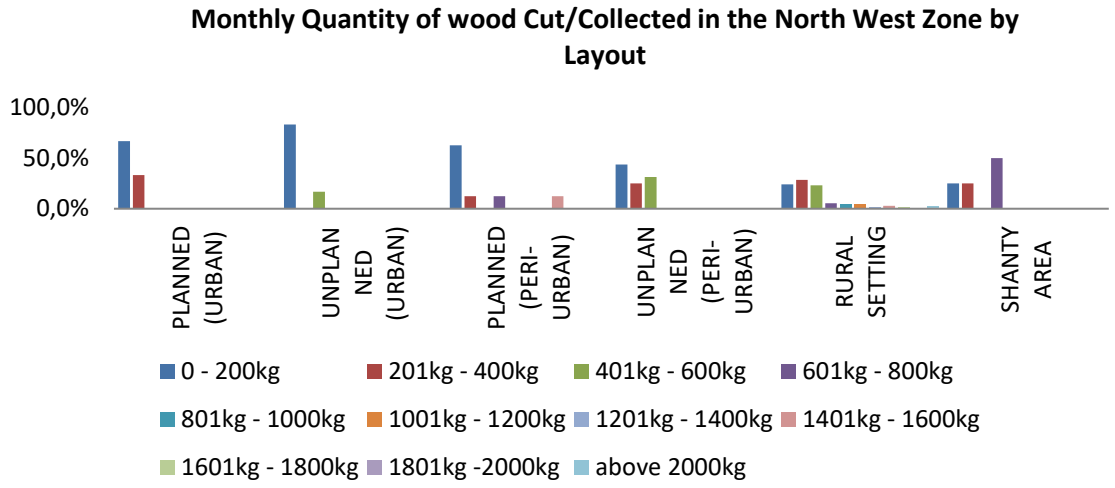


Figure 4.7.1: Monthly Quantity of wood Cut/Collected in the North West Zone by Layout

4.8 Fuelwood Consumption

4.8.1 Fuelwood Consumption in the North West Zone, States and Layouts

Table 4.8.1 presents households fuelwood consumption for all purposes in the surveyed areas of North West Zone. The result obtained from the study revealed that most households (90.7%) in the North West Zone used fuelwood for cooking, space heating and other domestic uses including agricultural, commercial, and cultural/religious purposes, while 9.3% of households do not use fuelwood. This implies that fuelwood tends to be the dominant fuel type used by households in the North West Zone.

Table 4.8.1: Fuelwood Consumption for all Purposes in the North West Zone

Fuelwood Type	Number of Household	Percentage (%)
Fuelwood Use	719	90.7
Non-Fuelwood Use	74	9.3
Total	**793**	**100**

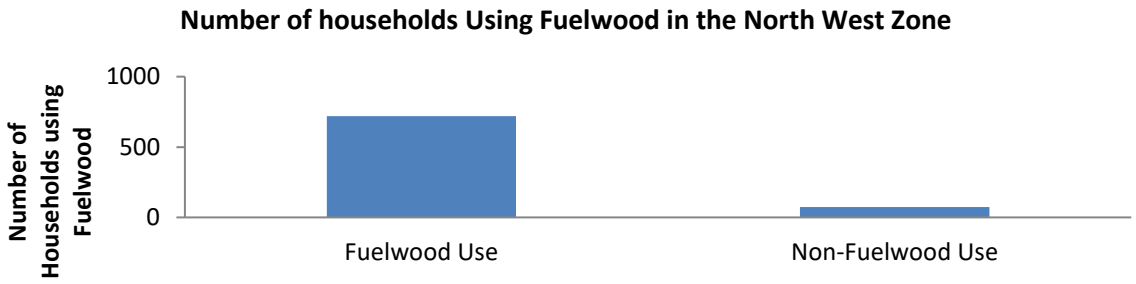


Figure 4.8.1: Number of Households Using Fuelwood in the North West Zone

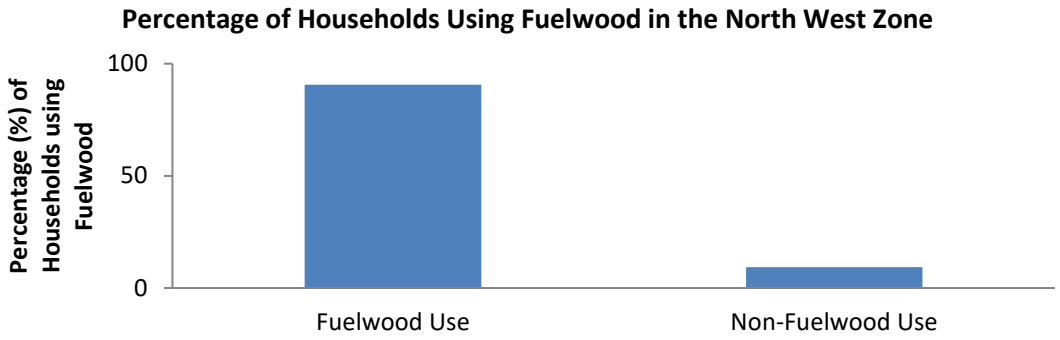


Figure 4.8.2: Percentage of Households Using Fuelwood in the North West Zone

4.8.2 Fuelwood Consumption for all Purposes in States

From Figure 4.8.3, it was observed that the highest rate of fuelwood consumption comes from Jigawa and Kebbi States each State having 98.6% of households using fuelwood while States with the lowest rate are Kaduna and Kano each State having 80.8% of households using fuelwood.

Table 4.8.2: Households Using Fuelwood in the North West Zone by State

Fuelwood Type	State						
	Jigawa	Kaduna	Kano	Katsina	Kebbi	Sokoto	Total
Fuelwood Use	141	59	172	145	137	65	719
Non-Fuelwood Use	2	14	41	10	2	5	74
Total	143	73	213	155	139	70	793

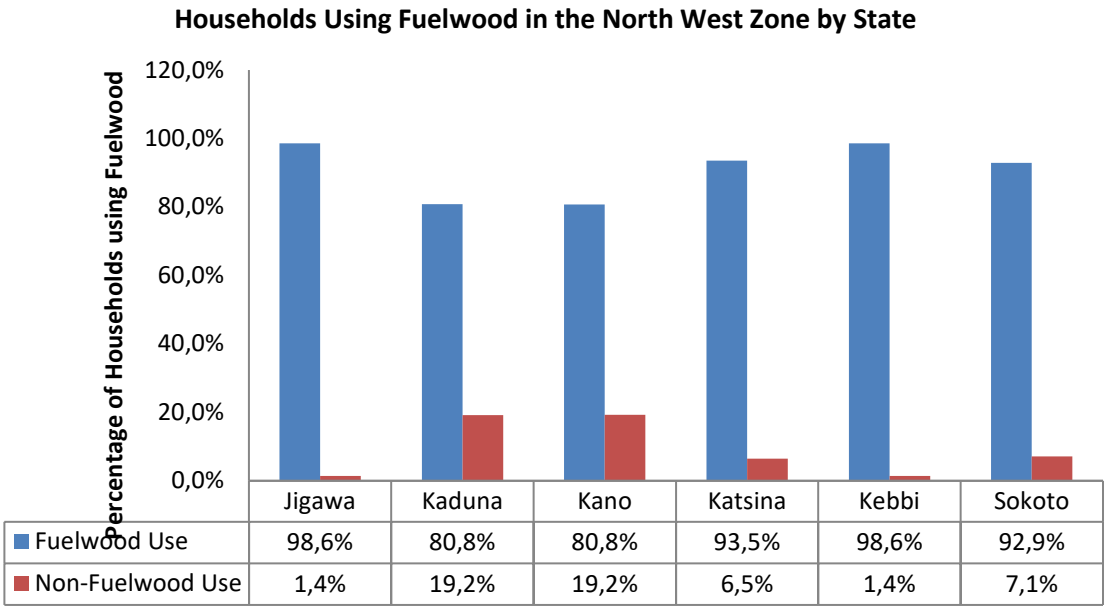


Figure 4.8.3: Households Using Fuelwood in the North West Zone by State

4.8.3 Fuelwood Consumption for all Purposes in the Layouts

As depicted in Figure 4.8.3, the Rural, Shanty, and Peri-Urban Areas account for the larger portion of fuelwood use in the North West Zone while Planned and Unplanned Urban Layouts have the least number of households using fuelwood. This may not be unconnected with the use of other fuel types in the urban areas.

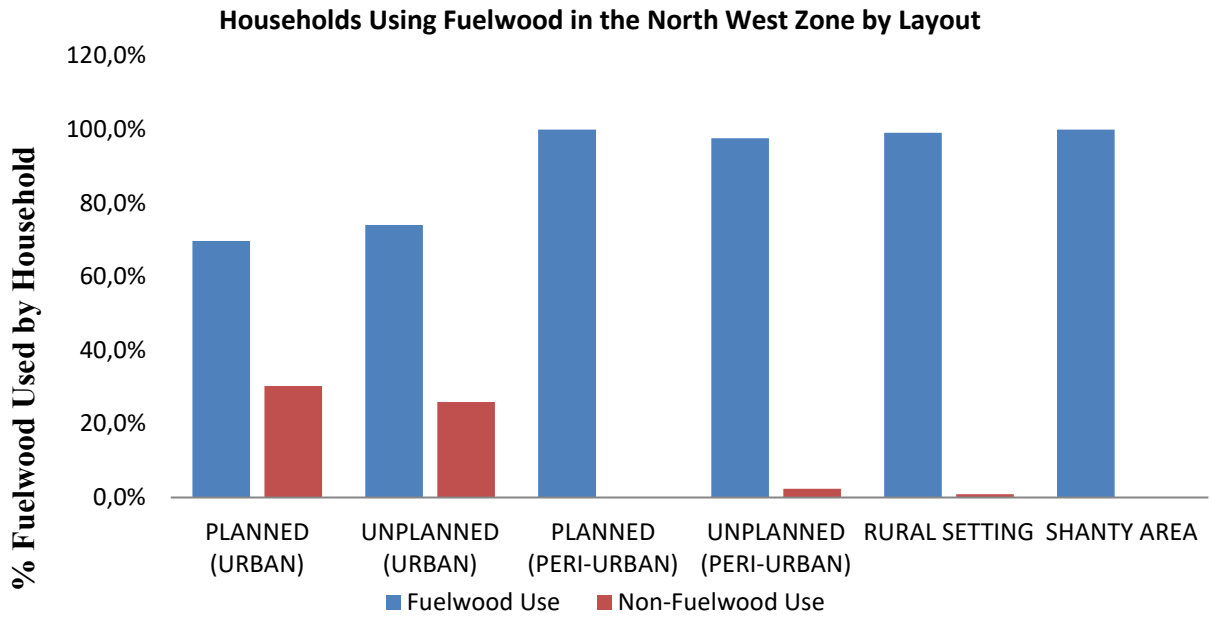


Figure 4.8.4: Households Using Fuelwood in the North West Zone by Layout

Table 4.8.3:Households Using Fuelwood in the Layouts

Fuelwood type	PLANNED (URBAN)	UNPLANNED (URBAN)	PLANNED (PERI-URBAN)	UNPLANNED (PERI-URBAN)	RURAL SETTING	SHANTY AREA	TOTAL
Fuelwood Use	46	140	32	41	456	4	719
Non-Fuelwood Use	20	49	0	1	4	0	74
Total	**66**	**189**	**32**	**42**	**460**	**4**	**793**

4.8.4 Fuelwood Consumption for Different Purposes in the North West Zone

Table 4.8.4 shows the percentage of fuelwood consumption for cooking, space heating, other domestic uses, agricultural uses, commercial uses and cultural/religious uses in the North West Zone. It indicates that 69, 16.5, 10.6, 3.2, 0.4, 0.3% of fuelwood consumption is for cooking, other domestic uses, commercial uses, cultural/religious uses, space heating and agricultural uses respectively. This shows that fuelwood is predominantly used for cooking in the North West Zone.

Table 4.8.4: Percentage of Fuelwood Consumption for Different Purposes in the Zone

Fuelwood Purpose	Number of Household	Percentage (%)
Cooking	709	69.0
Space heating	4	0.4
Other Domestic uses	170	16.5
Agricultural uses	3	0.3
Commercial uses	109	10.6
Cultural/Religious uses	33	3.2
Total	1028	100.0

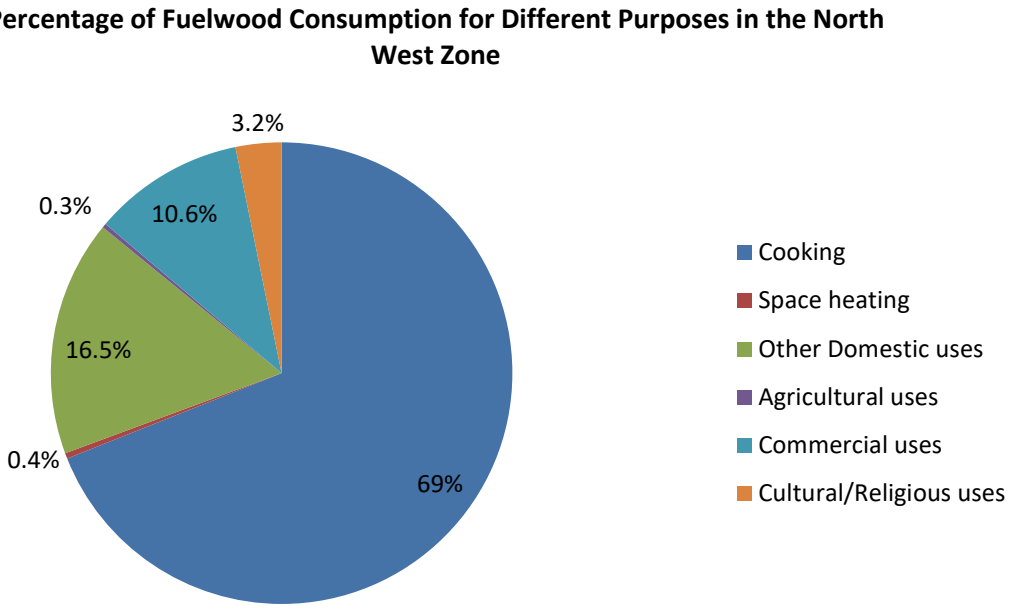


Figure 4.8.5: Percentage of Fuelwood Consumption for Different Purposes in the Zone

4.8.5 Fuelwood Consumption for Different Purposes in the States

As shown in Figure 4.8.6, 64 % of households in Jigawa State used fuelwood for cooking, 13.6 % for other domestic uses like lighting, boiling water for bathing, laundering, ironing, and smoking against insects while 12.3, 9.5 and 0.5% of households used fuelwood for cultural/religious uses, commercial uses and space heating respectively. However, no household was reported using fuelwood for agricultural uses.

Cooking accounts for 47.9% of fuelwood consumption in Kaduna State while 37.3% for other domestic uses, 13.2% for commercial uses and 1.7% for cultural/religious uses. No household used fuelwood for space heating and agricultural uses as depicted in Figure 4.8.6.

In Kano State, Cooking takes 68.3% of fuelwood consumption followed by other domestic uses with 21.3% while commercial and agricultural uses take 10% and 0.4% respectively. As

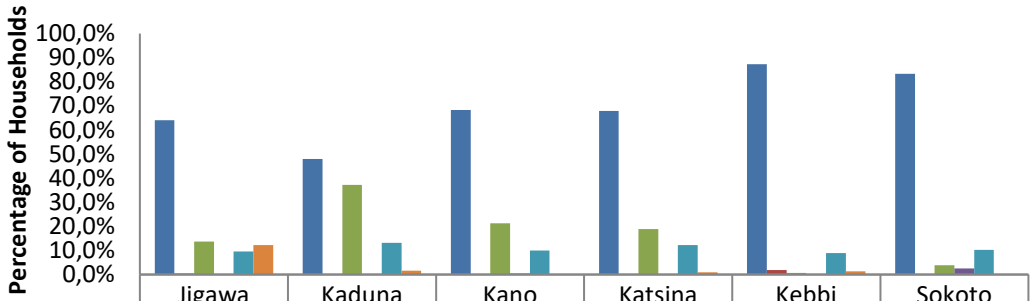
shown in Figure 4.8.6, no household used fuelwood for space heating and cultural/religious uses.

Figure 4.8.6 revealed that majority of households (67.9%) in Katsina State used fuelwood for cooking while few households (0.9%) used fuelwood for cultural/religious uses. It was also recorded that no household used fuelwood for space heating and agricultural uses.

Cooking has the highest fuelwood consumption rate in Kebbi State with 87.3% as depicted in Figure 4.8.6. This was followed by commercial uses, space heating, cultural/religious uses and other domestic uses with 8.9, 1.9, 1.3 and 0.6% respectively. No household was reported using fuelwood for agricultural uses.

83.3% of households use fuelwood for cooking in Sokoto State while 10.3, 3.8 and 2.6% of households used fuelwood for commercial uses, other domestic uses and agricultural uses respectively as shown in Figure 4.8.6. Conversely, no household employed fuelwood for space heating and agricultural uses.

Percentage of Fuelwood Consumption forDifferent Purposes in the North West Zone by State

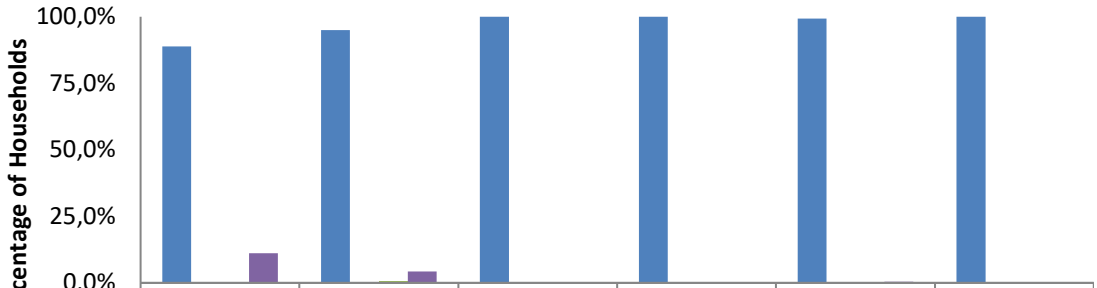


	Jigawa	Kaduna	Kano	Katsina	Kebbi	Sokoto
Cooking	64,1%	47,9%	68,3%	67,9%	87,3%	83,3%
Space heating	0,5%	0,0%	0,0%	0,0%	1,9%	0,0%
Other Domestic uses	13,6%	37,2%	21,3%	18,9%	0,6%	3,8%
Agricultural uses	0,0%	0,0%	0,4%	0,0%	0,0%	2,6%
Commercial uses	9,5%	13,2%	10,0%	12,3%	8,9%	10,3%
Cultural/Religious uses	12,3%	1,7%	0,0%	0,9%	1,3%	0,0%

Figure 4.8.6: Percentage of Fuelwood Consumption for Different Purposes in the States

4.8.6 Fuelwood Consumption for Different Purposes in the Layouts

In all the layouts, Fuelwood is primarily used for cooking as shown in Figure 4.8.7. Commercial uses accounts for 11.1 and 4.3% of household fuelwood consumption in the Planned and Unplanned Urban Layouts while Commercial and Space heating uses accounts for 0.4 and 0.2% of household fuelwood consumption in Rural Area. The use of fuelwood for cooking, space heating and commercial uses in Rural Area can be attributed to the availability and accessibility of fuelwood in the area.



	PLANNED (URBAN)	UNPLANNED (URBAN)	PLANNED (PERI-URBAN)	UNPLANNED (PERI-URBAN)	RURAL SETTING	SHANTY AREA
Cooking	88,9%	95,0%	100,0%	100,0%	99,3%	100,0%
Space heating	0,0%	0,0%	0,0%	0,0%	0,2%	0,0%
Other Domestic uses	0,0%	0,7%	0,0%	0,0%	0,0%	0,0%
Commercial uses	11,1%	4,3%	0,0%	0,0%	0,4%	0,0%

Figure 4.8.7: Percentage of Fuelwood Consumption Purposes in the Layouts

4.9Monthly Fuelwood Consumption

4.9.1Monthly Fuelwood Consumption for all Purposes in the North West Zone

Table 4.9.1 and Figure 4.9.1 present the monthly quantity of fuelwood consumed for all purposes in the North West Zone. It was observed that about 57% of households in the North West Zone used between 0 and 300kg of fuelwood monthly for all purposes while 1.7 and 1.9% of households used between 1201 and 1500, and above 1500kg respectively. This revealed that majority of households use between 0 and 300kg of fuelwood monthly in the North West Zone for various purposes.

The average monthly quantity of fuelwood consumed by households in the North West Zone monthly is 388kg as shown in Table 4.9.1.

Table 4.9.1: Monthly Fuelwood Consumption for all Purposes in the North West Zone (kg)

Quantity in Kilogram (kg)	Number of Households	Percentage (%)
0-300	587	57.4
301-600	261	25.5
601-900	102	10.0
901-1200	37	3.6
1201-1500	17	1.7
1501 and above	19	1.9
Total	1023	100.0
Average Monthly Consumption (kg)	388	

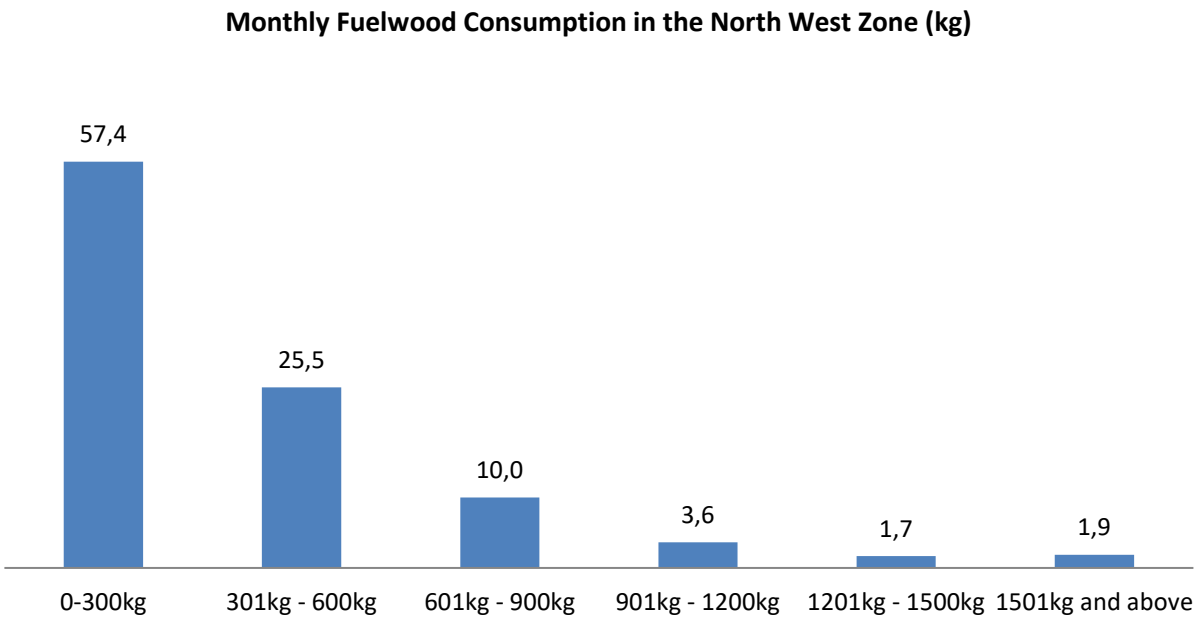
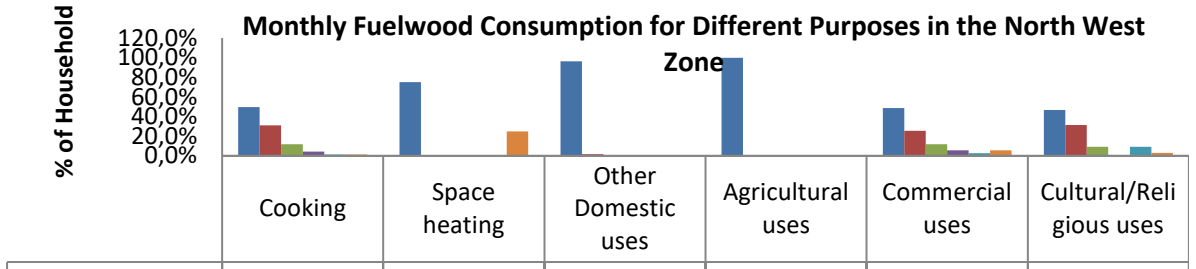


Figure 4.9.1: Monthly Fuelwood Consumption for all Purposes in the North West Zone (kg)

4.9.2 Monthly Fuelwood Consumption for Different Purposes in the North West Zone

Table 4 presents the monthly fuelwood consumption for different purposes in the North West Zone. It shows that households used an average of 422, 468, 152, 53, 526 and 453 of fuelwood monthly for Cooking, Space heating, Other Domestic uses, Agricultural uses, Commercial uses and Cultural/Religious uses respectively. Cooking, Commercial and Cultural/Religious uses of fuelwood account for most fuelwood consumption in all the states. The high rate of consumption for commercial uses can be attributed to the use of fuelwood by cottage industries.



	Cooking	Space heating	Other Domestic uses	Agricultural uses	Commercial uses	Cultural/Religious uses
0-300kg	49,8%	75,0%	96,4%	100,0%	48,6%	46,9%
301kg- 600kg	31,1%	0,0%	1,8%	0,0%	25,7%	31,3%
601kg - 900kg	11,9%	0,0%	0,6%	0,0%	11,9%	9,4%
901kg - 1200kg	4,4%	0,0%	0,0%	0,0%	5,5%	0,0%
1201kg - 1500kg	1,4%	0,0%	0,6%	0,0%	2,8%	9,4%
above 1500kg	1,4%	25,0%	0,6%	0,0%	5,5%	3,1%

Figure 4.9.2: Monthly Fuelwood Consumption for Different Purposes in the North West Zone

Table 4.9.2: Monthly Fuelwood Consumption for Different Purposes in the North West Zone

Quantity in Kilogram (kg)	Cooking	Space heating	Other Domestic uses	Agricultural uses	Commercial uses	Cultural/Religious uses	Total	%
0-300kg	352	3	162	2	53	15	587	57.4
301kg-600kg	220	0	3	0	28	10	261	25.5
601kg - 900kg	85	0	1	0	13	3	102	9.9
901kg - 1200kg	31	0	0	0	6	0	37	3.6
1201kg - 1500kg	10	0	1	0	3	3	17	1.7
1501kg and above	10	1	1	0	6	1	19	1.9
Total	708	4	168	2	109	32	1023	100
Average (kg)	422	468	152	53	526	453		

4.9.3 Monthly Fuelwood Consumption in the North West Zone by Layout

As shown in Figures 4.9.3, 4.9.4 and 4.9.5 consumption for cooking and commercial activities is highest in Planned Urban, Unplanned Urban and Rural Areas. The high consumption rate may not be unconnected with the presence of cottage industries such as bakery.

Planned Peri-Urban, Unplanned Peri-Urban and Shanty Areas consumed between 0 and 1200kg of fuelwood monthly for cooking purposes only.

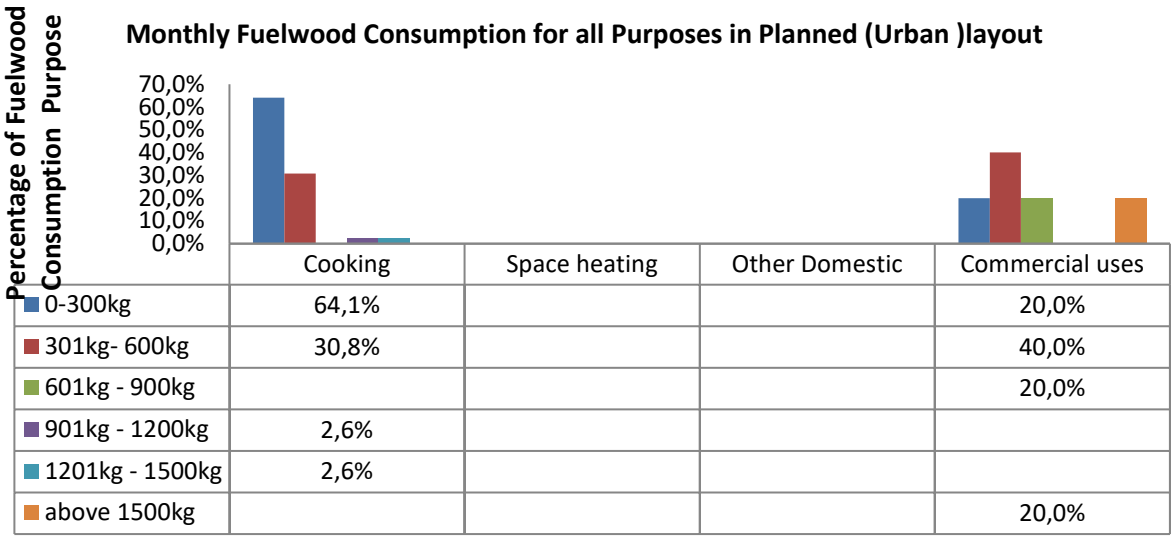
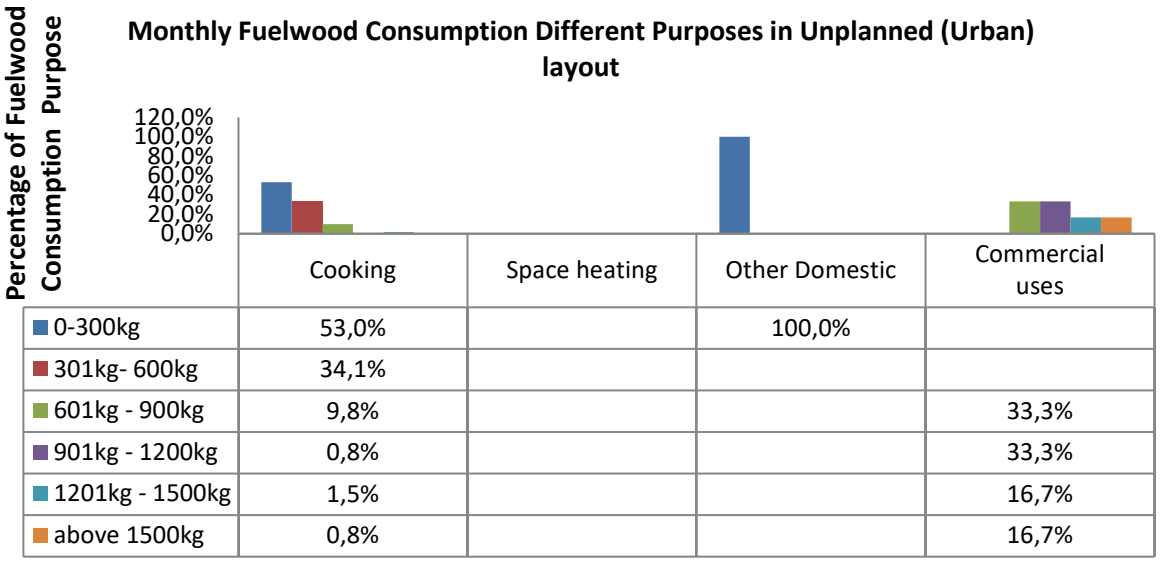


Figure 4.9.3: Monthly Fuelwood Consumption for Different Purposes in Planned (Urban) layout



	Cooking	Space heating	Other Domestic	Commercial uses
0-300kg	53,0%		100,0%	
301kg- 600kg	34,1%			
601kg - 900kg	9,8%			33,3%
901kg - 1200kg	0,8%			33,3%
1201kg - 1500kg	1,5%			16,7%
above 1500kg	0,8%			16,7%

Figure 4.9.4: Monthly Fuelwood Consumption for Different Purposes in Unplanned (Urban) layout

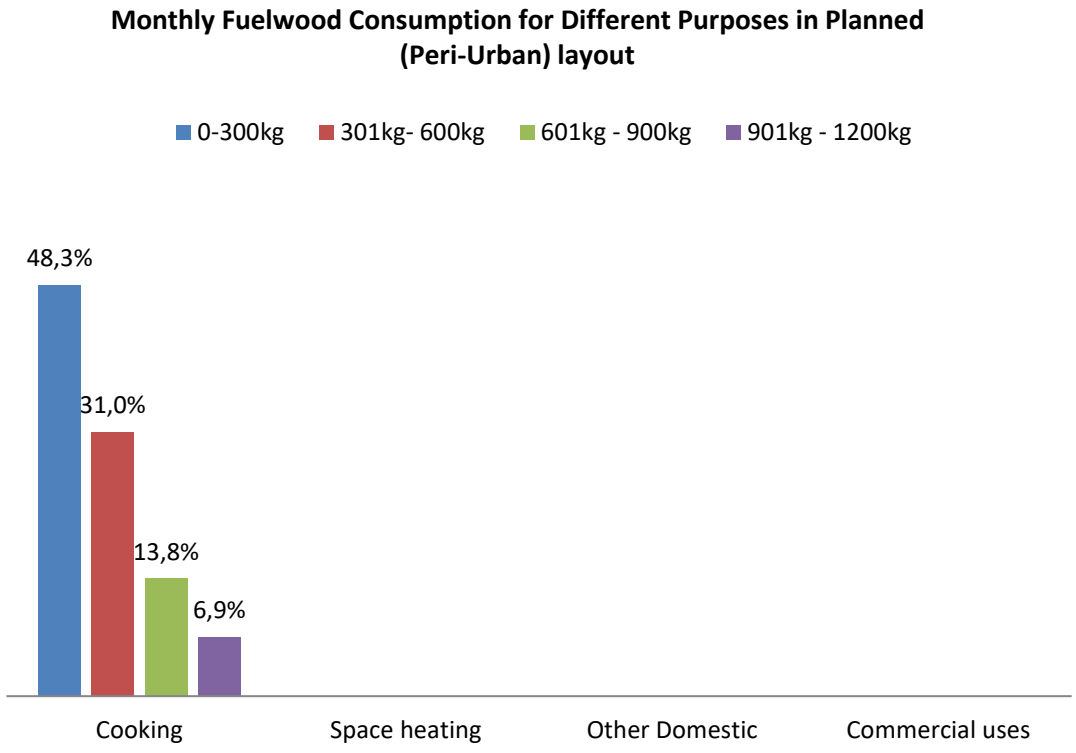


Figure 4.9.5: Monthly Fuelwood Consumption for Different Purposes in Planned (Peri-Urban) layout

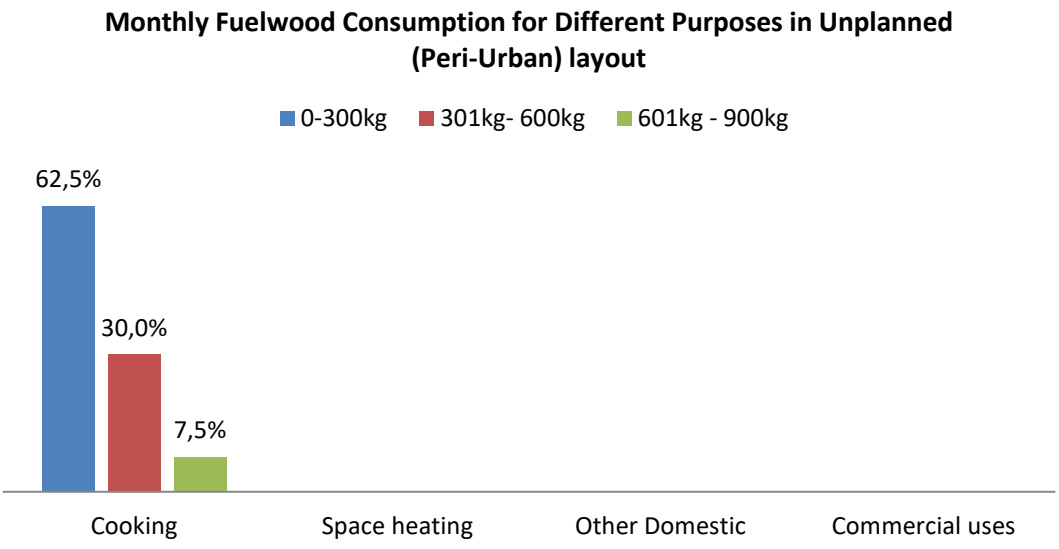
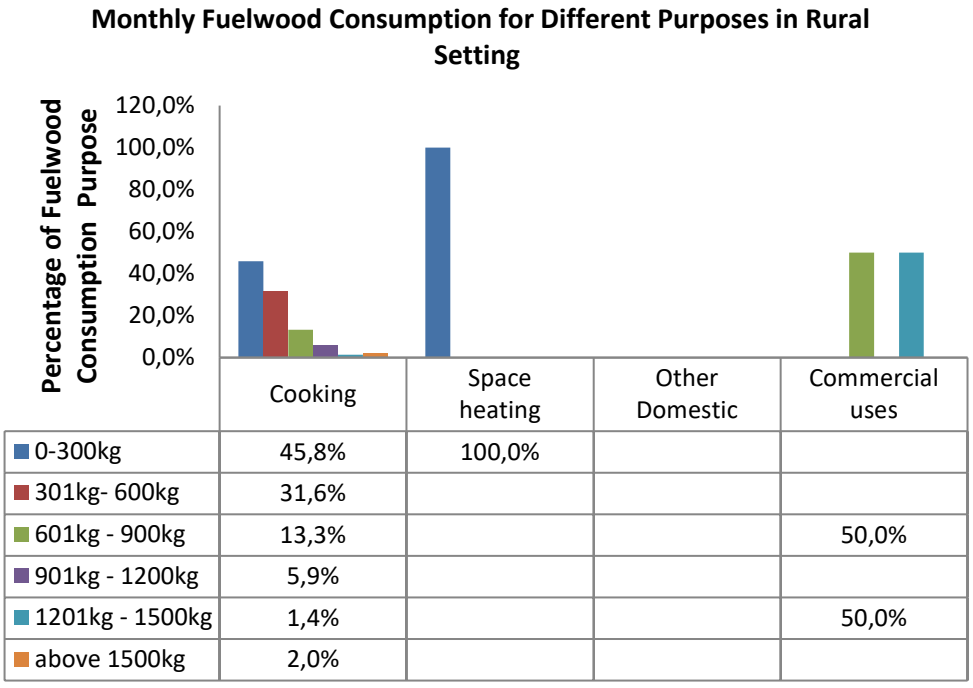


Figure 4.9.6: Monthly Fuelwood Consumption for Different Purposes in Unplanned (Peri-Urban) layout



	Cooking	Space heating	Other Domestic	Commercial uses
0-300kg	45,8%	100,0%		
301kg- 600kg	31,6%			
601kg - 900kg	13,3%			50,0%
901kg - 1200kg	5,9%			
1201kg - 1500kg	1,4%			50,0%
above 1500kg	2,0%			

Figure 4.9.7: Monthly Fuelwood Consumption for Different Purposes in Rural Setting

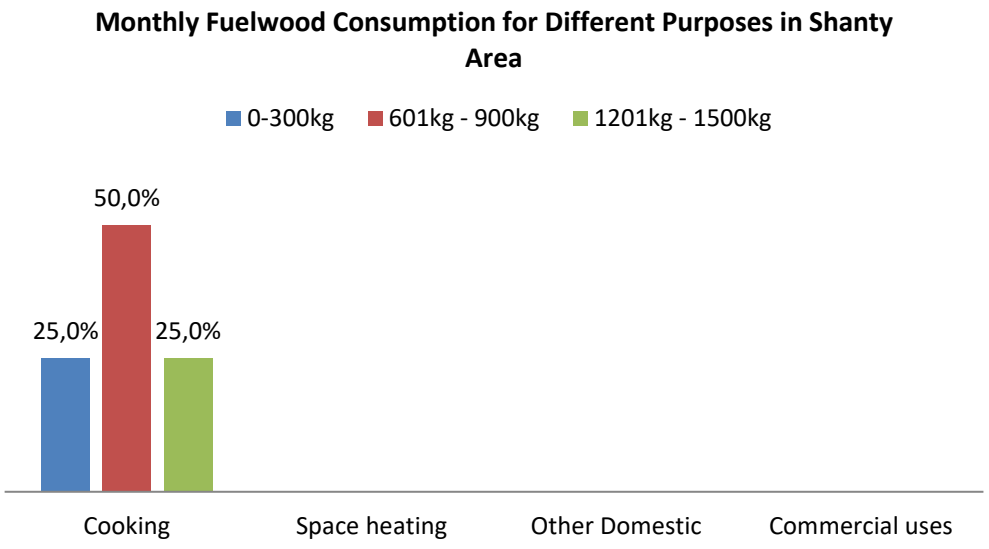


Figure 4.9.8: Monthly Fuelwood Consumption for Different Purposes in Shanty Area

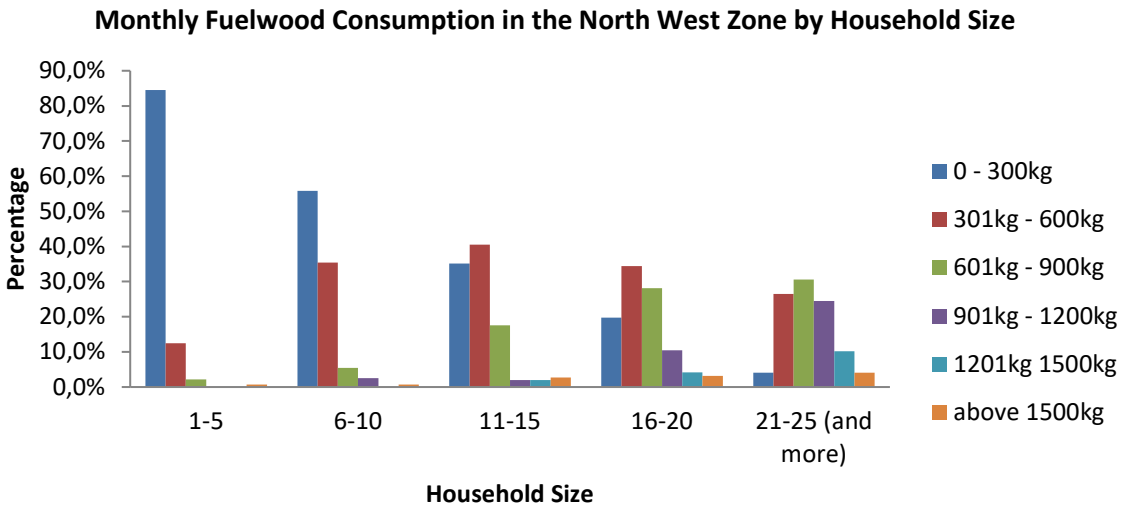


Figure 4.9.9: Monthly Fuelwood Consumption in the North West Zone by Household Size

4.9.4 Monthly Fuelwood Consumption in the North West Zone by Household Size

In this study, the household size ranged from 1 to 25 and more. As shown in Figure 4.9.9, lower fuelwood consumption was found in households with members ranging from 1 to 10 mostly using between 0 and 300kg monthly, while households with members ranging from 16 to 25 largely used 601kg and above monthly. This clearly shows that fuelwood consumption is higher in households with larger number of members than in smaller households.

4.9.5Type of Wood mostly used as Fuelwood in the North West Zone

Table 4.9.3 presents the type of wood mainly used as fuelwood in the North West Zone. Spilt Stem and Branches (Direct Convectional) are the major type of wood (87.7%) used as fuelwood by households while Wood Chips, Sawdust (INDIRECT) have the least (0.4%) usage.

In this study, households in all the States mostly used Spilt Stem and Branches (Direct Convectional) as fuelwood as depicted in Figure 4.9.12. Similarly, Spilt Stem and Branches (Direct Convectional) are the major type of wood used in all the layouts except the Rural and Unplanned Peri-Urban Layouts. Consumption in these layouts have 17.3 and 7.5% of Twigs (Thin, Terminal branches), Brushwood (Thin branch of tree or bushes), Leaves (Direct Marginal) wood used as fuelwood respectively.

Table 4.9.3: Type of Wood mostly used as Fuelwood in the North West Zone

Type of Wood	Number of Household	Percentage
Spilt Stem and Branches (DIRECT CONVECTIONAL)	901	88.7
Twigs (Thin, Terminal branches), BrushWood (Thin branch of tree or bushes), Leaves (DIRECT MARGINAL)	105	10.3
Wood Chips Sawdust, etc (INDIRECT)	4	0.4
(From old furniture, Construction material, etc) USE/RECOVERED	6	0.6
Total	**1016**	**100.0**

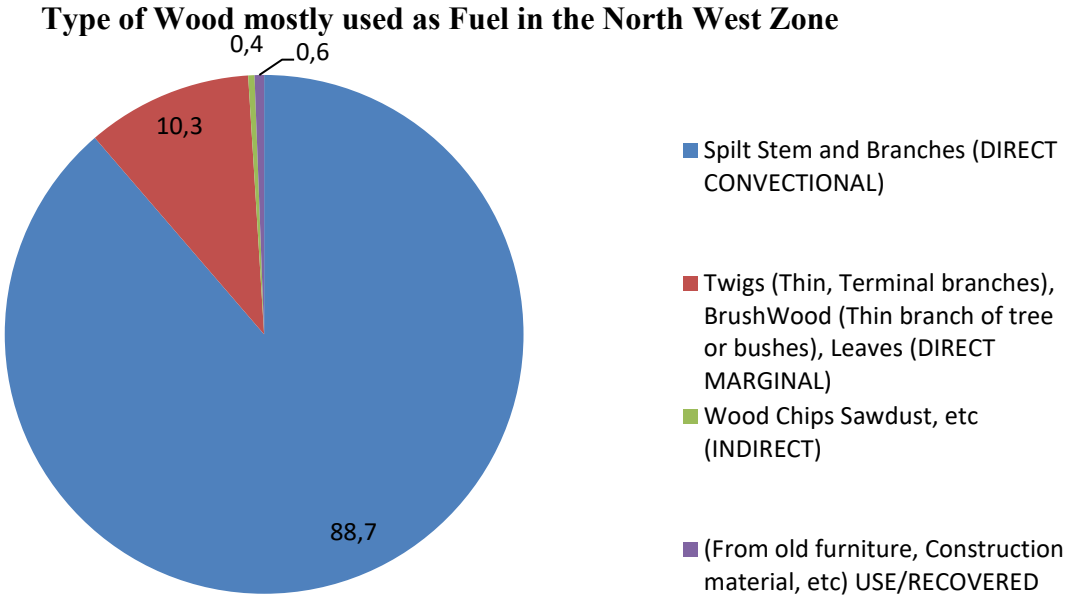


Figure 4.9.10: Type of Wood Used mainly used as Fuelwood in the North West Zone

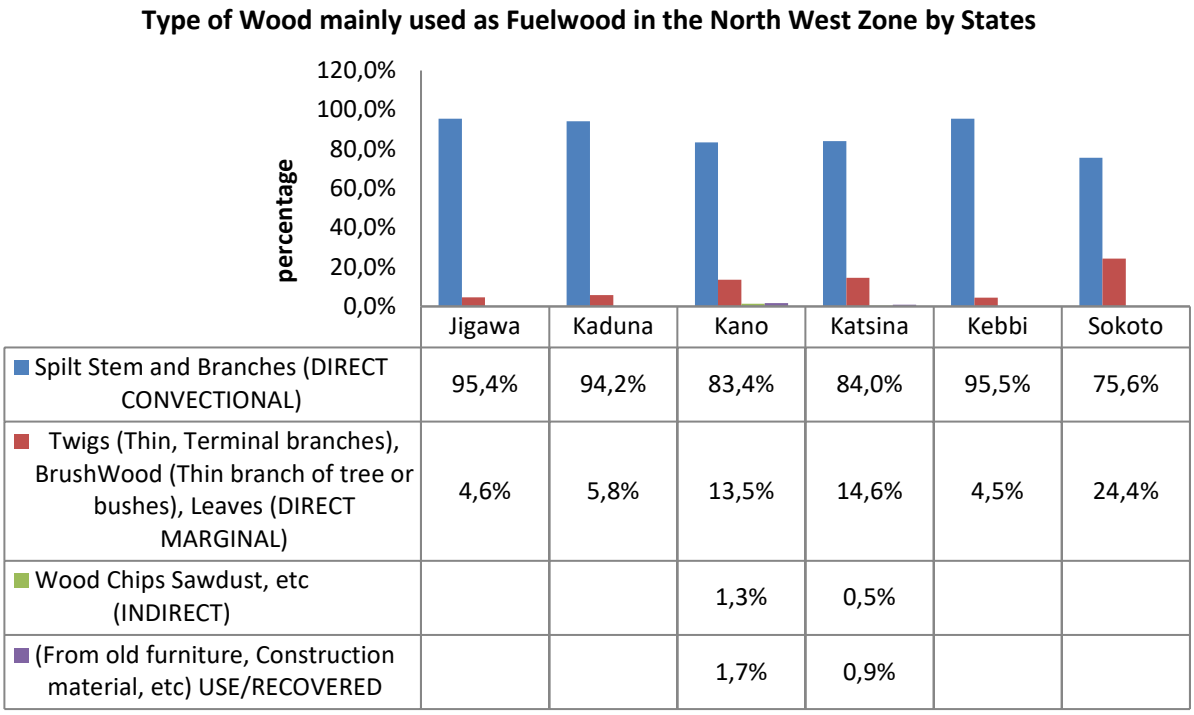


Figure 4.9.11: Type of Wood mainly used as Fuelwood in the North West Zone by States

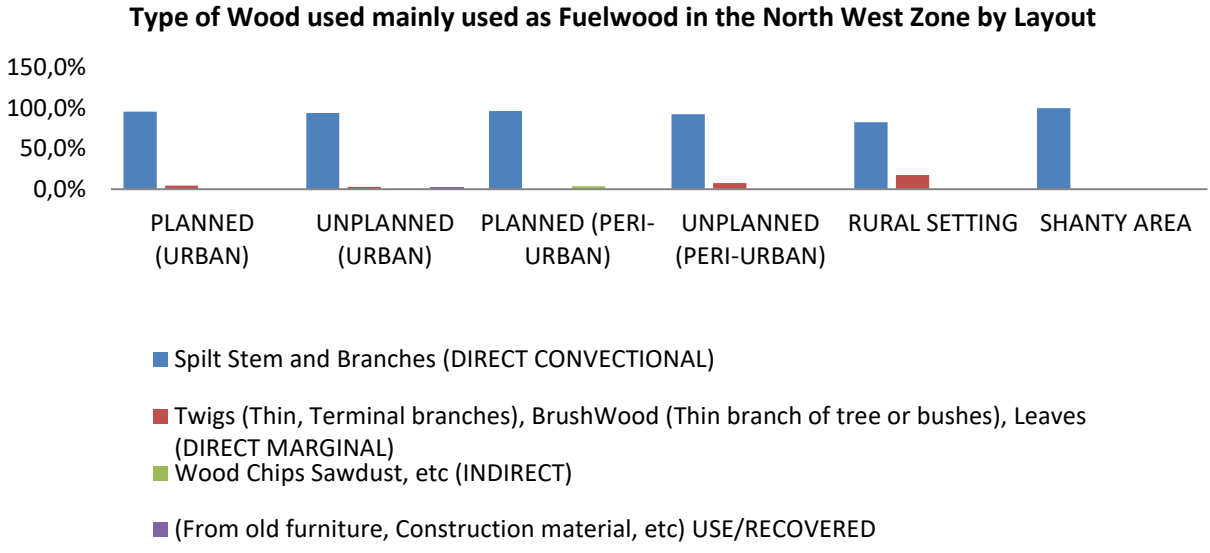


Figure 4.9.12: Type of Wood used mainly used as Fuelwood in the North West Zone by Layout

CHAPTER FIVE

5.1Charcoal Usage

In this study, charcoal was investigated for its usage for cooking and other purposes, so as to know the extent of use in the Zone. Table 5.1.1 illustrates the number of respondents to Yes and No to charcoal usage in the zone. Based on the table, 151 persons out of 795 people sampled responded to Yes while the remaining 644 persons responded to No. This is an indication that majority of the people in the zone do not use charcoal for cooking and other purposes, since only 19 % responded to Yes.

Table 5.1.1: Response on Charcoal Usage

Response	Frequency	Percent	Valid Percent	Cumulative Percent
Yes	151	19.0	19.0	19.0
No	644	81.0	81.0	100.0
Total	795	100.0	100.0	

The survey further examined the number of people using charcoal for the purpose of cooking and other activities such as space heating, other domestic, agricultural, commercial and cultural/religious uses. However, it can be deduced that charcoal was only used for cooking, other domestic and commercial uses in the zone as illustrated in Figure 5.1.1 According to the figure, 74 % of charcoal usage in the zone was for cooking while the remaining 26 % were shared between other domestic and commercial uses in the tune of 19.3 and 6.6 % respectively. This demonstrates the use of charcoal for mainly cooking in this Geopolitical Zone of Nigeria.

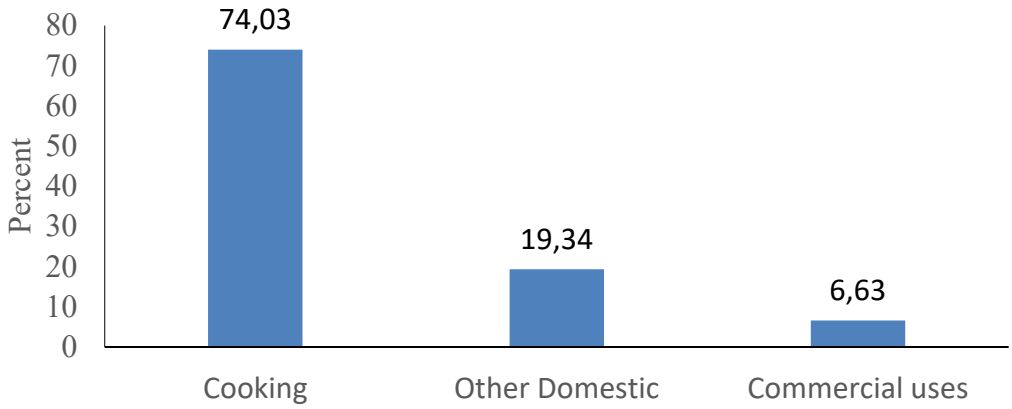


Figure 5.1.1: Purpose of Charcoal Usage

In order to access the consumption of the charcoal in the zone, both daily and monthly charcoal consumption were evaluated from the obtained data as presented in Table 5.1.2 and Figure 5.1.2. According to Table 5.1.2 and 5.1.3, the daily consumption of charcoal in the zone was found to be 425.32 kg with average consumption of 3.02 kg daily.

Table 5.1.2: Daily Consumption of Charcoal by State

State	Consumption, kg	Consumption, %	Frequency	Mean
Jigawa	7	1.646	3	2.333
Kaduna	97.5	22.924	26	3.750
Kano	180.82	42.514	66	2.740
Katsina	39	9.170	14	2.786
Kebbi	35.6	8.370	8	4.450
Sokoto	65.4	15.377	24	2.725
Total	425.32	100	141	3.016

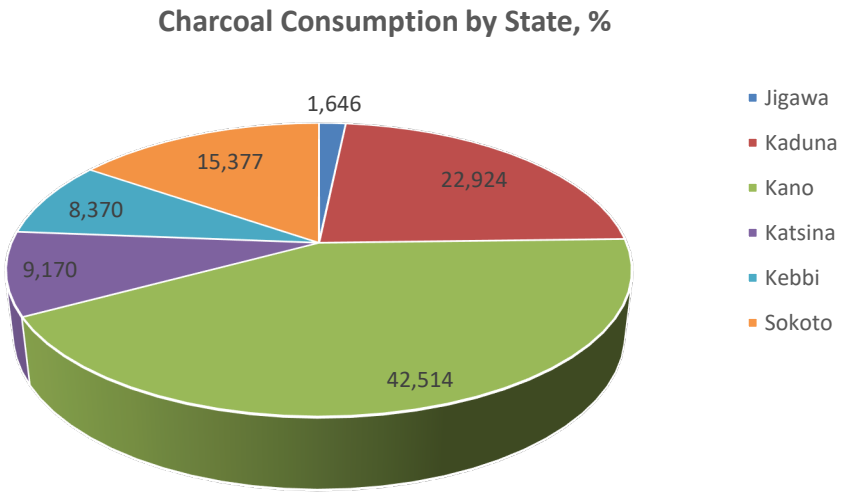


Figure 5.1.2: Daily Consumption of Charcoal by State

The highest daily usage of charcoal was recorded in Kano state, while the least was in Jigawa state with daily consumption of 180.82 and 7 kg respectively as shown in Table 5.1.2 and Figure 5.1.2 However, Kano state appearing as the state where charcoal consumption was the highest is attributed to the high population using charcoal for cooking and other purposes. As can be seen from Table 5.1.2 that Jigawa state had the lowest average daily usage of charcoal, which might be due to a very low population using charcoal for these purposes and probably, the used quantity.

On the other hand, 210.12 kg of the overall 425.32 kg of charcoal used daily in the zone was by Unplanned (Urban) layout which was slightly higher than 119.1 kg by theRural setting as shown in Table 5.1.3. This shows that 49.40 % of charcoal daily consumption in the zone was documented for the Unplanned (Urban) layout (Figure5.1.3), which was the highest, followed by the rural setting with 28 %. However, the Planned (Peri-Urban) had the lowest usage of 2.73 %. The highest percentage observed in Unplanned (Urban) layout suggests the highest usage of charcoal in the Zone. It is also obvious from the presented results that the consumption of charcoal is related to the population using charcoal for cooking, other domestic and commercial uses as well as the size of the household.

Table 5.1.3: Daily Consumption of Charcoal by Layout

Layout	Consumption, kg	Consumption, %	Frequency	Mean
Planned (Urban)	49.2	11.568	19	2.590
Unplanned (Urban)	210.12	49.403	82	2.562
Planned (Peri-Urban)	11.6	2.727	4	2.9
Unplanned (Peri-Urban)	22.3	5.243	4	5.575
Rural Setting	119.1	28.002	29	4.107
Shanty Area	13	3.057	3	4.333
Total	425.32	100	141	3.017

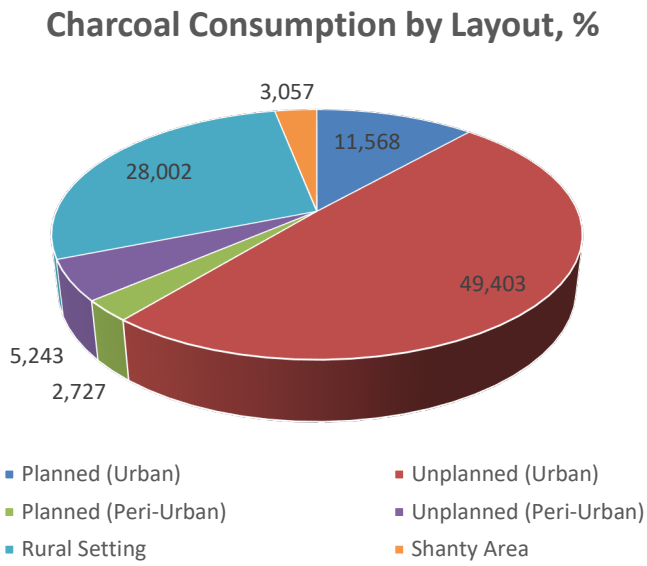
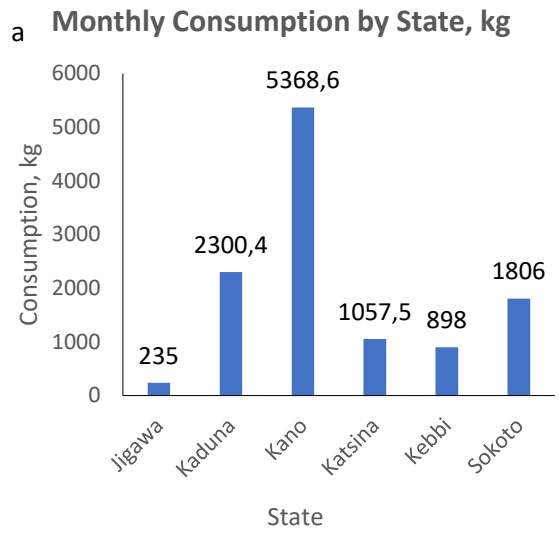


Figure 5.1.3:Daily Consumption of Charcoal by Layout

Furthermore, the monthly consumption in the zone (by state and layout) were also evaluated as illustrated in Figure 5.1.4(a and b).

a



b

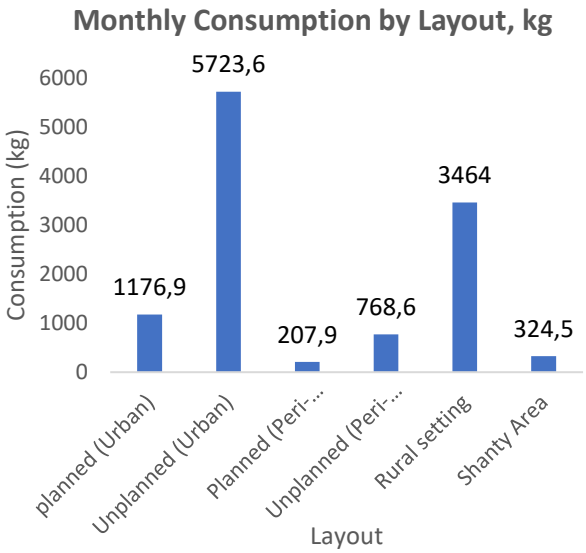


Figure 5.1.4: Monthly Consumption of Charcoal (kg) by (a) State and (b) Layout

With respect to the figures, the charcoal usage follows the same trend with daily usage for both by state and layout. The usage by state in descending order are Kano>Kaduna>Sokoto>Katsina>Kebbi>Jigawa, while by layout are Unplanned (Urban)>Rural setting>Planned (Urban)>Unplanned(Peri-Urban)>Shantyarea>Planned (Peri-Urban). The estimated monthly consumption of charcoal in the Zone was 11665.5 kg (Tables 5.1.4 and 5.1.5), translating to 64.81 kg on the average. The trend of these results suggests that charcoal usage in the zone was mostly in unplanned (Urban) and rural area.

Table 5.1.4: Monthly Consumption of Charcoal by State

States	Consumption, kg	Consumption, %	Frequency
Jigawa	235	2.10	4
Kaduna	2300.4	19.70	34
Kano	5368.6	45.98	86
Katsina	1057.5	9.06	17
Kebbi	898	7.69	8
Sokoto	1806	15.47	31
Total	11665.5	100.00	180

Table 5.1.5: Monthly Consumption of Charcoalby Layout

Layout	Consumption, kg	Consumption, %	Frequency
planned (Urban)	1176.9	10.09	19
Unplanned (Urban)	5723.6	49.06	86
Planned (Peri-urban)	207.9	1.78	4
Unplanned (Peri-urban)	768.6	6.59	5
Rural setting	3464	29.69	35
Shanty Area	324.5	2.78	33
Total	11665.5	100	180

5.2Charcoal Acquisition

The source of charcoal for cooking and other purposes including sales in the zone was investigated, to assess the mode of acquisition. Based on the gathered data, the mode of acquisition of charcoal in the zone was basically through purchase. The daily purchases in the zone by state are presented in Table 5.2.1 and Figure 5.2.1. According to the presented results, Kaduna state had the highest daily purchase of charcoal of 3429.5 kg, which translates to 68.52 % of the total charcoal purchased in the Zone. However, Kano state had a daily purchase of 632.3 kg which was higher than 499.55 kg purchased by Kebbi state. The daily charcoal purchased by Katsina and Sokoto state was 204.5 and 188.8 kg respectively. Whereas, Jigawa state had the lowest purchase of 50.5 kg daily, having 1.01 % of the overall charcoal purchased of 5005.15 kg in the Zone.

Table 5.2.1: Daily Purchase of Charcoal by State

State	Purchase, kg	Purchase, %	Frequency	Mean
Jigawa	50.5	1.009	3	16.833
Kaduna	3429.5	68.519	26	131.904
Kano	632.3	12.633	66	9.580
Katsina	204.5	4.086	14	14.607
Kebbi	499.55	9.981	9	55.506
Sokoto	188.8	3.772	24	7.867
Total	5005.15	100	142	35.248

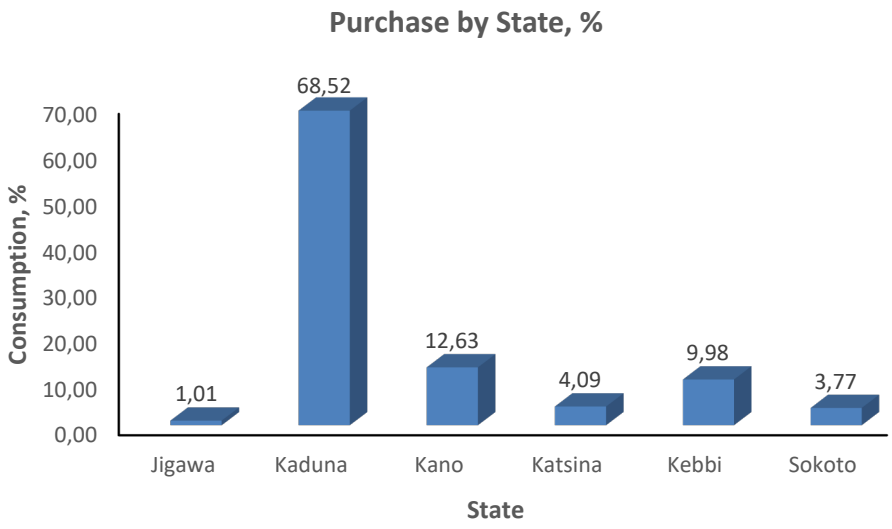


Figure 5.2.1: Daily Consumption of Charcoal (%) by State

Based on the presented results in Table 5.2.1, it is expected that Kano state will have the highest daily purchase of charcoal, considering the number of persons purchasing charcoal. However, Kaduna state having the highest daily purchase suggests that certain percentage of the charcoal purchased might be for other purpose such as sales, since, the population involved in the purchase was far smaller than Kano state.

Table 5.2.2 shows the daily purchase of charcoal in different layout of the zone. The results reveal rural setting as the highest charcoal purchaser with 3175.1 kg of the overall 5005.15 kg purchased daily in the Zone. The Unplanned (Urban), Planned (Urban), Planned (Peri-Urban), Shanty area and Unplanned (Peri-Urban) recorded 1139.5, 405.30, 128.40, 88.85 and 68.0 kg accordingly. Averagely, the Zone purchased 35.25 kg on daily basis as shown in the table.

Table 5.2.2: Daily Purchase of Charcoal by Layout

Layout	Purchase, kg	Purchase, %	Frequency	Mean
Planned (Urban)	405.30	8.10	19	21.332
Unplanned (Urban)	1139.50	22.77	82	13.896
Planned (Peri-Urban)	128.40	2.57	4	32.100
Unplanned (Peri-Urban)	68.00	1.36	4	17.000
Rural Setting	3175.10	63.44	29	109.486
Shanty Area	88.85	1.78	4	22.213
Total	5005.15	100.00	142	35.248

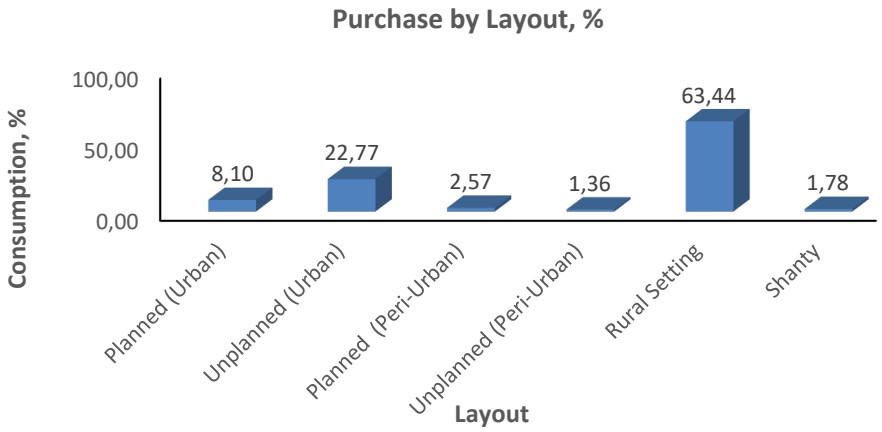


Figure 5.2.2: Daily Consumption of Charcoal (%) by Layout

The monthly purchase of charcoal by state is illustrated in Table 5.2.3 andFigure 5.2.3. The monthly purchase was estimated from the product of daily purchase and the number of days of purchase of charcoal in a month. The results further revealed that Kaduna state had the highest monthly purchase of 7788.4 kg (34.54 %) which was higher than 6372 kg (28.26 %) and 5422.5 kg (24.02 %) by Kano and Katsina state. Whilst Kebbi state recorded 927.85 kg (4.12 %) which was lower than 1785.5 kg (7.92 %) purchased by Sokoto state. The lowest purchase of 251 kg (1.11 %) was recorded in Jigawa state.

Table 5.2.3: Monthly Purchase of Charcoal by State

State	Purchase, kg	Purchase, %	Frequency	Mean
Jigawa	251	1.11	3	83.66667
Kaduna	7788.4	34.54	26	299.5538
Kano	6372	28.26	66	96.54545
Katsina	5422.5	24.05	14	387.3214
Kebbi	927.85	4.12	9	103.0944
Sokoto	1785.5	7.92	24	74.39583

Total	22547.25	100	142	158.7835

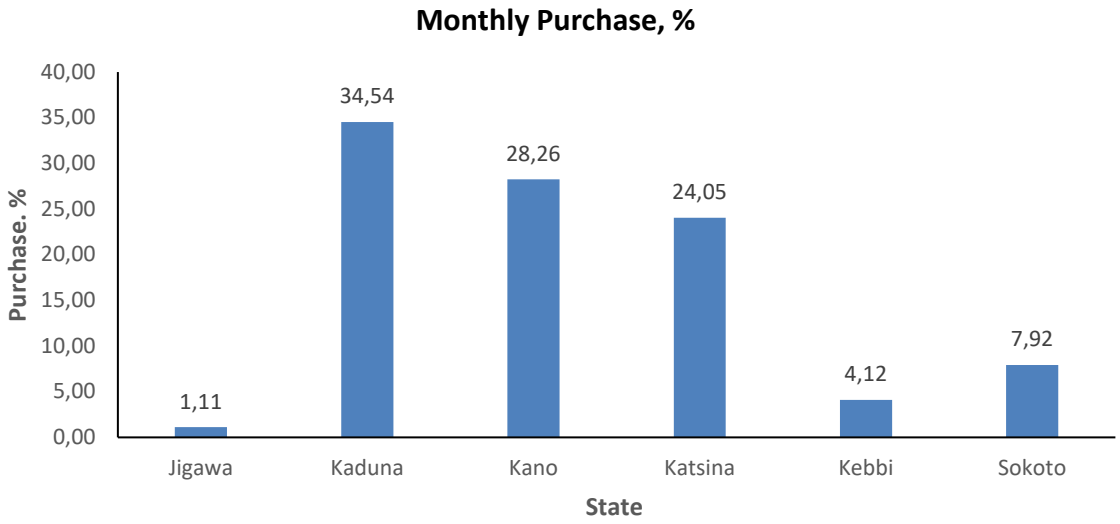


Figure 5.2.3: MonthlyPurchase of Charcoal (%) by State

Likewise, the Unplanned (urban) layout had the highest purchase of 12750.5 kg, which translates to 56.55 % of the total monthly purchased in the Zone, followed by the rural setting with 7792.5 kg (34.56 %) purchase as presented in Table 5.2.4 and Figure 5.2.4. The Planned (Urban), Unplanned (Peri-urban), Shanty area and Planned (Peri-Urban) recorded 1276.6, 273, 244, 209.9 kg accordingly. The trend of monthly purchase of charcoal in descending order are Kaduna>Kano>Katsina>Sokoto>Kebbi>Jigawa state and Unplanned (Urban)>Rural setting>Planned (Urban)>Unplanned (Peri-Urban)>Shanty area>Planned (Peri-Urban) by state and layout respectively. However, both the results of monthly purchase by state and layout do not follow the same trend with the daily purchase as observed in the results. This is attributed to the mode of calculation of the monthly purchase as earlier stated. The monthly charcoal purchased in the Zone was estimated to be 22547.25 kg with an average purchase of 158.78 kg Tables 5.2.3 and 5.2.4)

Table 5.2.4: Monthly Purchase of Charcoal by Layout

Layout	Purchase, kg	Purchase, %	Frequency	Mean
PLANNED (URBAN)	1276.6	5.66	19	67.19
UNPLANNED (URBAN)	12750.5	56.55	82	155.49
PLANNED (PERI-URBAN)	209.9	0.93	4	52.48
UNPLANNED (PERI-URBAN)	273	1.21	4	68.25
RURAL SETTING	7792.5	34.56	29	268.71
Shanty Area	244.75	1.09	4	61.19
Total	**22547.25**	**100**	**142**	**158.78**

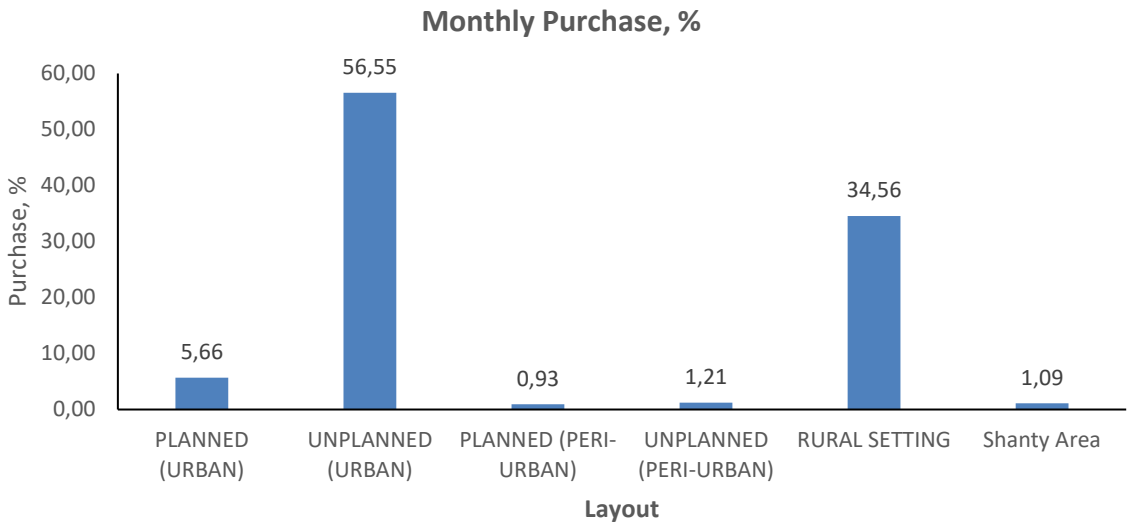


Figure 5.2.4: MonthlyPurchase of Charcoal (%) by State

5.3Charcoal Expenditure

The survey further investigated the amount expended on charcoal in the Zone on both daily and monthly basis; the results are presented in Table 5.3.1 and 5.3.2. The daily expenditure on charcoal in the Zone was estimated to be ₦73,930.00 daily as revealed in the tables. Averagely, ₦520.64 was spent on charcoal daily. According to Table 5.3.1, the highest expenditure on charcoal was in Kano state with a total of ₦34,450.00 on daily basis, followed by Kaduna state with ₦16,660.00 expended on charcoal daily. The daily expenditure on charcoal for Kebbi, Sokoto, Jigawa and katsina state were ₦10,270.00, N6,200.00, ₦3,250.00 and ₦3,100.00 respectively. Kano state appearing as the state where the highest daily expenditure was recorded, having 46.6 % of the total amount expended on charcoal in the Zone, might be due to the population (Table 5.3.1) using charcoal for cooking and other purposes. Jigawa state with just three (3) people using charcoal expended more money than Katsina state with fourteen (14) people as noticed in the table. None the less, the size of the household using charcoal in Jigawa state might be more than those in Katsina state, thereby, resulting to such observations.

Table 5.3.1: Daily Expenditure on Charcoal by State

State	Expenditure, ₦	Frequency	Mean, N
Jigawa	3250	3	1083.333
Kaduna	16660	26	640.7692
Kano	34450	66	521.9697
Katsina	3100	14	221.4286
Kebbi	10270	9	1141.111
Sokoto	6200	24	258.333
Total	73930	142	520.634

The daily expenditure on charcoal by layout in the Zone as presented in Table 5.3.2 reveals that the highest daily expenditure was in Unplanned (Urban) layout with ₦48,050.00 of the overall ₦73,930.00 expended on charcoal daily in the Zone. This might be due to the high population (57.75 %) using charcoal for cooking and other purposes in the zone, which were

in this layout as shown in the table. According to the presented results, the daily expenditure on charcoal were ₦8,870.00, ₦7,050.00, ₦4,100.00, ₦3,000.00, and ₦2,860.00 corresponding to Planned (Urban), Rural setting, Planned (Peri-Urban), Shanty area and Unplanned (Peri-Urban). The trend of daily expenditure in descending order are Unplanned (Urban)> Planned (Urban)> Rural setting> Planned (Peri-Urban)> Shanty area> Unplanned (Peri-Urban).

Table 5.3.2: Daily Expenditure on Charcoal by Layout

Layout	Expenditure, ₦	Frequency	Mean
Planned (Urban)	8870	19	466.84
Unplanned (Urban)	48050	82	585.98
Planned (Peri-Urban)	4100	4	1025
Unplanned (Peri-Urban)	2860	4	715
Rural Setting	7050	29	243.1
Shanty Area	3000	4	750
Total	73930	142	520.63

On monthly basis, the zone expended ₦544,140.00 on charcoal with an average of ₦3,831.97 as presented in Tables 5.3.3 and 5.3.4 Kano state had the highest monthly expenditure in the tune of ₦340,000 (62.48 %) which was higher than ₦71,150.00 (13.08 %) and ₦53,180.00 (9.77 %) by Sokoto and Kaduna state respectively. The monthly expenditure on charcoal for Katsina, Kebbi and Jigawa were ₦46,150.00 (8.48 %), ₦24,160.00 (4.44 %) and ₦9,500.00 (1.75 %) accordingly as illustrated in Table 5.3.3 and Figure 5.3.1a.

Table 5.3.3: Monthly Expenditure on Charcoal by State

State	Expenditure, ₦	Expenditure, %	Frequency	Mean
Jigawa	9500	1.746	3	3166.667
Kaduna	53180	9.773	26	2045.385
Kano	340000	62.484	66	5151.515
Katsina	46150	8.481	14	3296.429
Kebbi	24160	4.440	9	2684.444
Sokoto	71150	13.076	24	2964.583
Total	544140	100	142	3831.972

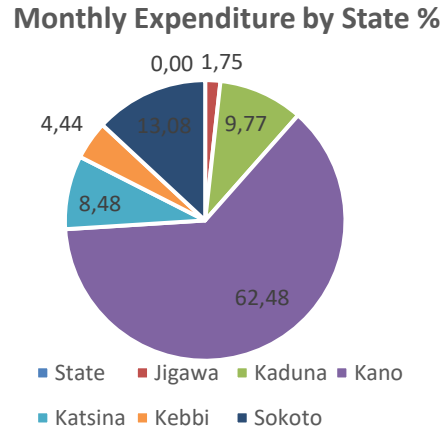
Also, It can be deduced fromTable 5.3.4 and Figure 5.3.1b that the monthly expenditure on charcoal in Unplanned (Urban) layout was ₦407,000.00, which translates to 74.80 % of the overall amount incurred on charcoal in the Zone. Additionally, the Rural setting was next to the Unplanned (Urban) with monthly expenditure of ₦55,930.00 (10.28%), which was slightly higher than ₦55,760.00 (10.25 %) incurred by the Planned (Urban) layout as illustrated in Table 5b. Other layout was the Unplanned (Peri-Urban) with monthly expenditure of ₦12,000.00 which was higher than Shanty area with ₦7,450.00 (1.34 %) and Planned (Peri-Urban) with ₦6,000.00 (1.10 %). The results demonstrate that majority of the people using charcoal for cooking and other purposes in the Zone were in Unplanned (Urban) layout. Therefore, high percentage of the expenditure incurred on charcoal was in this layout. The

trend of monthly expenditure by state and layout follow the trend in descending order via Kano>Sokoto>Kaduna>Katsina>Kebbi>Jigawa state and Unplanned (Urban)> Rural setting> Planned (Urban> Unplanned (Peri-Urban) > Shanty area> Planned (Peri-Urban) respectively. These results are not in agreement with the daily expenditure, which might be due to mode of monthly calculations as earlier stated.

Table 5.3.4: Monthly Expenditure on Charcoal by Layout

Layout	Expenditure, ₦	Expenditure, %	Frequency	Mean
Planned (Urban)	55760	10.24736	19	2934.74
Unplanned (Urban)	407000	74.79693	82	4963.41
Planned (Peri-Urban)	6000	1.102657	4	1500.00
Unplanned (Peri-Urban)	12000	2.205315	4	3000.00
Rural Setting	55930	10.2786	29	1928.62
Shanty Area	7450	1.369133	4	1862.50
Total	544140	100	142	3831.97

a



b

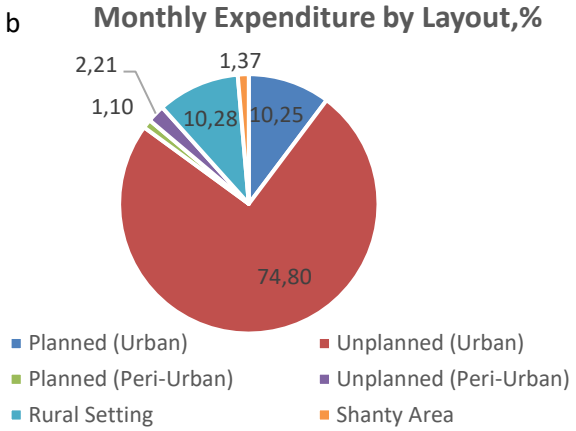


Figure 5.3.1: Monthly Expenditure (%) by (a) State and (b) Layout

CHAPTER SIX

6.1 Fuelwood and Charcoal Sales

The demand for fuelwood decreases with increase in per capital income due to the fact that is considered as an inferior/traditional energy sources; the demand for it decreases as per capital income increases paving way for other energy sources. However, many households in Nigeria still depend on fuelwood as the major source of energy either for cooking or other domestic needs. In the Northwest geopolitical zone within the scope of the study, considered Purchase (direct wood, indirect wood and improved fuelwood), Cut or Collected (natural forest, forest plantation, bush, river bank, natural vegetation, own farm, construction site) and other means such as gift, borrow, trade by barter and payment in kind as means of fuelwood acquisition.

From the study it was observed that many of the households get their fuelwood from the first two category i.e purchase and cut or collected. It is therefore important to consider the trend of fuelwood sales and income generated.

This sales-income chain is very important to this study: fuelwood survey in the North West geopolitical zone of Nigeria as this gives us a holistic insight into the quantity of fuelwood sold, and the income generated from the sales based on the sampled size. The sales-income chain is considered from different perspective; as a zone, then scaling it down to state; layout, and by household.

The total quantity of fuelwood sold within a month is measured in Kilograms.

Table 6.1.1: Total Number of Respondents to Fuelwood Sales

Response	Frequency	Percent	Cumulative Percent
Yes	33	4.2	4.2
No	762	95.8	100.0
Total	795	100.0	

Table 6.1.1 shows the total number of respondents to the fuelwood sale in the last one month in the zone (NW). The total of seven hundred and ninety five (795) respondents, the information shows that thirty three (33) persons accounting for 4.2% sells while the remaining 95.8% don't sell.

Also, it shows that the percentage of the seller in the zone is very low, indicating that acquisition is not done by direct purchase.

Table 6.1.2: Quantity of fuelwood sold

Quantity	Frequency	Percent	Cumulative Percent	Total Quantity
18.30	1	3.0	3.0	18.3
	1	3.0	6.1	21
24.00	1	3.0	9.1	24
	2	6.1	15.2	48.8
25.00	1	3.0	18.2	25
	1	3.0	21.2	67.5
91.50	1	3.0	24.2	91.5
	1	3.0	27.3	92
100.00	1	3.0	30.3	100
	1	3.0	33.3	120
127.05	1	3.0	36.4	127.05
	1	3.0	39.4	140
160.00	1	3.0	42.4	160
	1	3.0	45.5	175
190.00	1	3.0	48.5	190
	1	3.0	51.5	200
210.00	1	3.0	54.5	210
	1	3.0	57.6	220
250.00	1	3.0	60.6	250
	1	3.0	63.6	265
400.00	1	3.0	66.7	400
	1	3.0	69.7	420
440.00	1	3.0	72.7	440
	1	3.0	75.8	450
480.00	1	3.0	78.8	480
	1	3.0	81.8	600
720.00	1	3.0	84.8	720
	1	3.0	87.9	1400
1875.00	1	3.0	90.9	1875
	1	3.0	93.9	3000
5400.00	1	3.0	97.0	5400
	1	3.0	100.0	18000
Total	33	100.0		35730.15

Table 6.1.2 shows the total quantity of fuelwood sold in the zone in the last one month. The different bundle sizes of fuelwood in kilogram (kg) were stated in the table. A total of thirty-five thousand seven hundred and thirty (35730.15) kilogram was sold in the last one month. Furthermore, the study examines the quantity sold by state and by layout.

Figure 6.1.1 gave the detailed analysis of the sales by the states in the zone; Sokoto having the highest number of fuelwood sales of eighteen thousand two hundred and fifty (18250) kilogram within a month, followed by Jigawa with seven thousand two hundred and forty(7240) kilogram and Kebbi having the least of seven hundred and thirty five(735) kilogram.

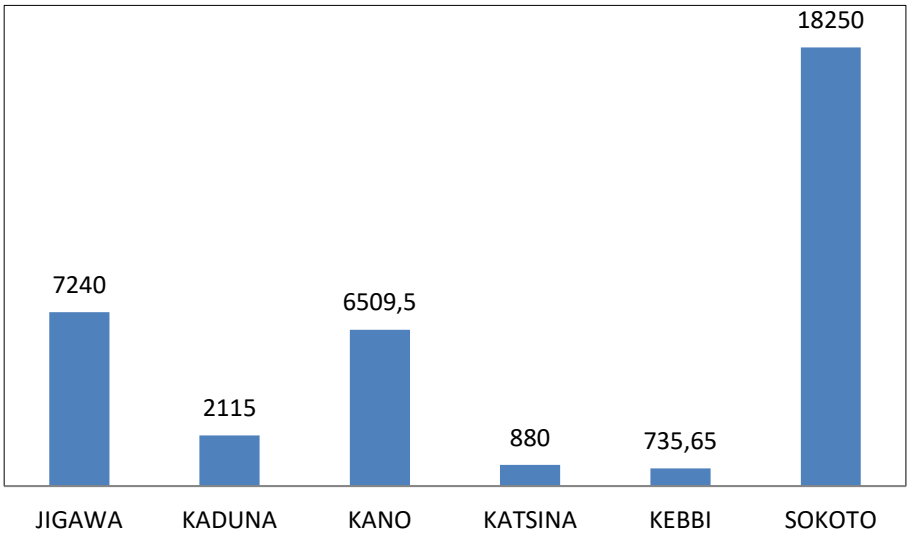


Figure 6.1.1: Fuelwood Sales by State

From Figure 6.2, It was observed that selling of fuelwood is more higher in the unplanned Urban areas of the zone. Over twenty three thousand kilogram was sold in the area, this may be attributed to the fact that household in this neighborhood requires more fuelwood for their energy use and their main source of acquisition is through direct purchase from neighborhood vendors. While on the other hand, unplanned peri-urban and planned peri-urban ranked the lowest with ninety two and nine seventy eight kilogram respectively.

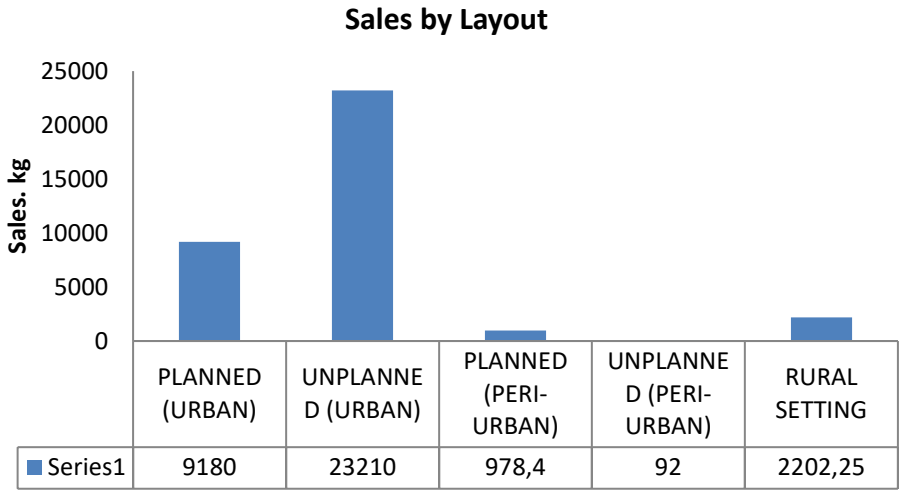


Figure 6.1.2: Fuelwood Sales by Layout

6.2 Income from Fuelwood Sales

The study investigated the income realized from the fuelwood sale in the zone, by state and layout. Income is expressed in total amount of money made from the sales in Naira (₦) within the last one month.

Table 6.2.1: Income derived from fuelwood sales

Price (₦)	Frequency	Percent	Cumulative Percent	Total (₦)
200	2	6.1	6.1	400
250	1	3.0	9.1	250
300	1	3.0	12.1	300
400	2	6.1	18.2	800
500	1	3.0	21.2	500
800	1	3.0	24.2	800
1500	1	3.0	27.3	1500
2000	1	3.0	30.3	2000
2541	1	3.0	33.3	2541
4000	1	3.0	36.4	4000
5000	1	3.0	39.4	5000
5500	1	3.0	42.4	5500
6000	2	6.1	48.5	12000
7000	1	3.0	51.5	7000
10000	2	6.1	57.6	20000
12000	1	3.0	60.6	12000
12500	1	3.0	63.6	12500
13250	1	3.0	66.7	13250
15000	2	6.1	72.7	30000
20000	1	3.0	75.8	20000
23000	1	3.0	78.8	23000
25000	1	3.0	81.8	25000
35000	1	3.0	84.8	35000
52500	1	3.0	87.9	52500
60000	1	3.0	90.9	60000
100000	1	3.0	93.9	100000
200000	1	3.0	97.0	200000
210000	1	3.0	100.0	210000
Total	33	100.0		855841

From the study it was observed that the total income derived from fuelwood sale in the zone is eight hundred and fifty five thousand eight hundred and forty one naira only, when this is compared with the total number of kg, it thus mean that average of twenty eight thousand Naira (approximately 1,200kg) is expended on a daily basis.

Figure 6.2.1 and table 6.2.2 shows the average income derived by the households in each state, Sokoto is having the highest income of an average of one hundred and five thousand monthly, followed by Kano state with forty seven thousand eight hundred and eighty naira and Kebbi state is the lowest with two thousand eight hundred and sixty six naira only.

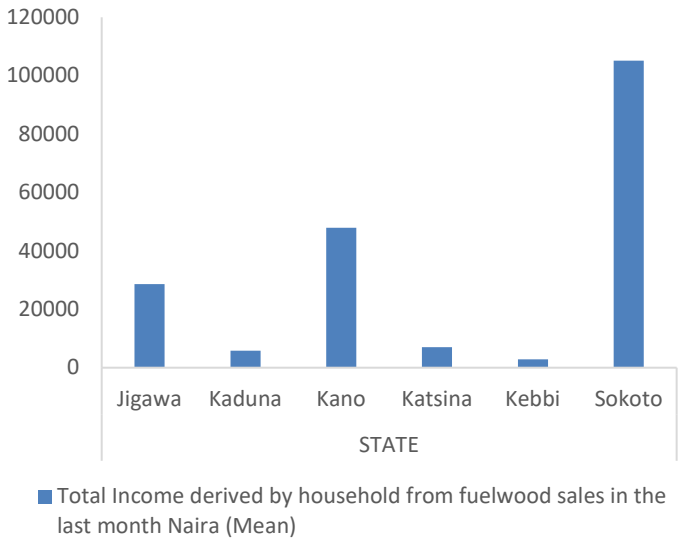


Table 6.22: Fuelwood Sales Income by State

	Total Income derived from fuelwood sales (Mean)
Jigawa	28667
Kaduna	5857
Kano	47880
Katsina	7000
Kebbi	2866
Sokoto	105125

Figure 6.2.1: Fuelwood Sales Income by State

Figure 6.2.2 shows the households in the unplanned urban areas of the zone makes more income from the sale of fuelwood, with an average of sixty two thousand naira in a month.

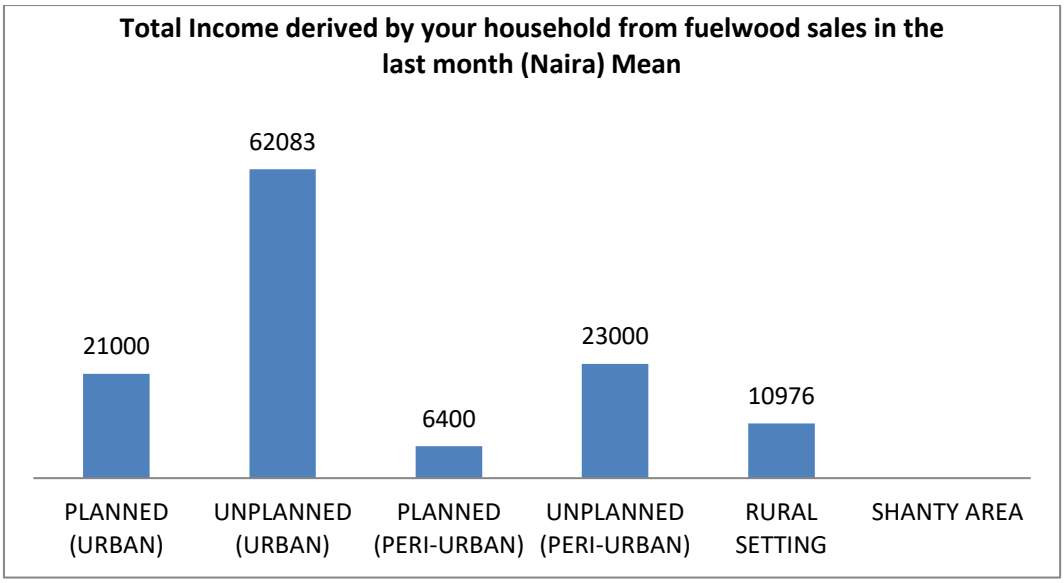


Figure 6.2.2: Fuelwood Sales Income by Layout

6.3 Charcoal Sales

The survey showed from Table 6.3.1 and Figure 6.3.1 respectively that just fourteen respondent sells charcoal acounting for 1.8% while seven hundred and eighty respondents (98.2%) said they don't sell. This infer that the demand for fuelwood is more when compared with charcoal in the zone.

Table 6.3.1: Total Number of Respondent to Charcoal Sales

Response	Frequency	Percent	Cumulative Percent
Yes	14	1.8	1.8
No	780	98.2	100.0
Total	794	100.0	

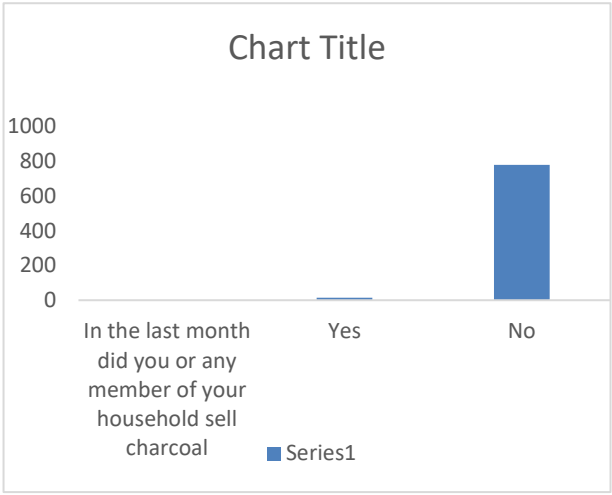


Figure 6.3.1: Total Number of Respondent to Charcoal Sales

Table 6.3.2: Total Amount of Charcoal Sold

Size (kg)	Frequency	Percent	Cumulative Percent	Total (kg)
54.00	1	7.1	7.1	54
72.00	1	7.1	14.3	72
120.00	1	7.1	21.4	120
150.00	2	14.3	35.7	300

175.00	1	7.1	42.9	175
200.00	1	7.1	50.0	200
210.00	1	7.1	57.1	210
450.00	1	7.1	64.3	450
512.00	1	7.1	71.4	512
990.00	1	7.1	78.6	990
1140.00	1	7.1	85.7	1140
9250.00	1	7.1	92.9	9250
30000.00	1	7.1	100.0	30000
Total	14	100.0		43473

Table 6.3.2 showed total amount of charcoal sold in the last one month in the zone, the result showed that forty three thousand four hundred and seventy three kg of charcoal was sold.

Figure 6.3.2 revealed that the highest sales was recorded in the rural area with a total of thirty one thousand eight hundred kilogram, the unplanned urban setting had a total of eleven thousand two hundred and ninety four kilogram, planned urban and planned peri-urban had one hundred and fifty and fifty four kilogram respectively. This showed that rural dwellers in the zone use more charcoal in the north west geopolitical of Nigeria.

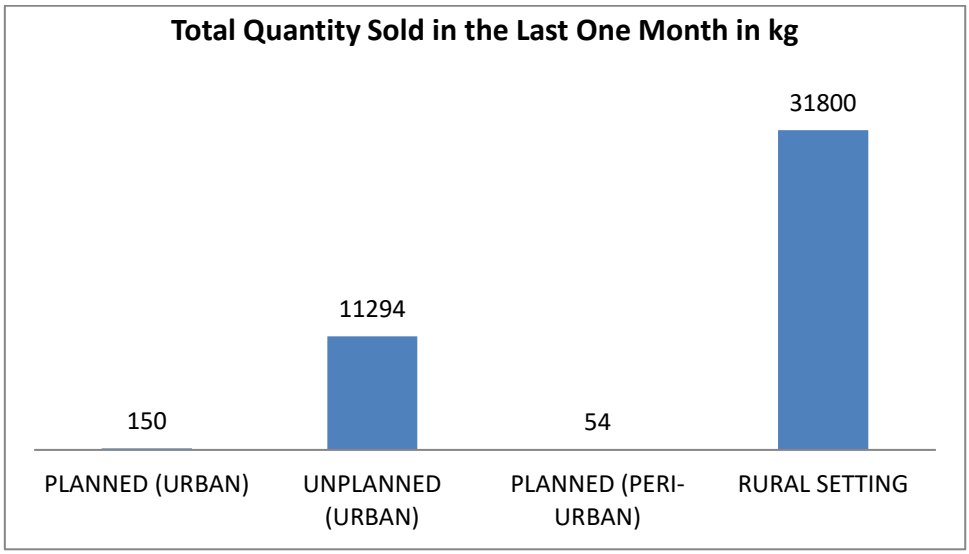


Figure 6.3.2: Quantity of Charcoal Sold

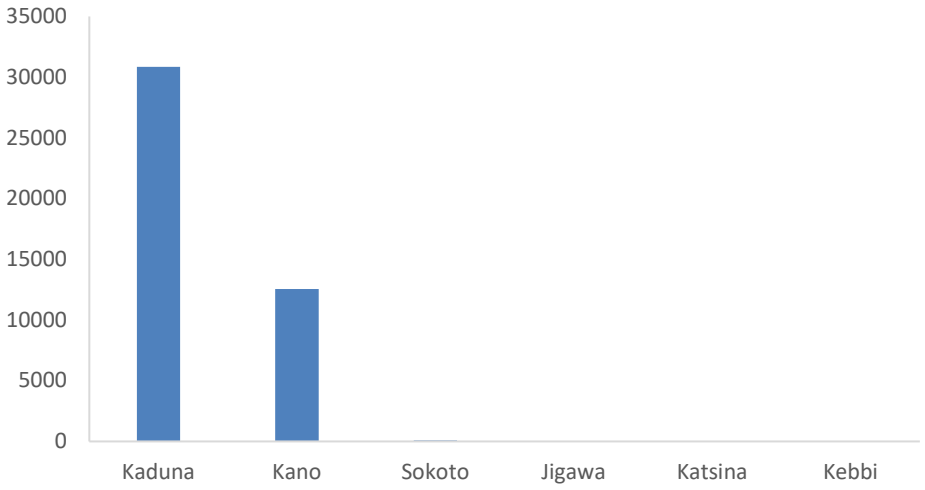


Figure 6.3.3: Amount of Charcoal Sold by State

Figure 6.3.3 shows the amount of charcoal sold by each state in the zone, the charcoal sales was investigated and it was observed that the highest quantity of charcoal sale was recorded in Kaduna state with more than thirty thousand kilogram in one month. This indicate that households in the rural settings of Kaduna state prefer to use charcoal for their energy reqirements. This can be attributed to the fact that charcoal is cheaper and available in the state. One kilogram of charcoal is sold for fifty naira (₦50) while one kg of firewood goes for one hundred naira (₦100).

6.4Income from Charcoal Sales

Table 6.4.1 showed that a sum of seven hundred and forty-five thousand five hundred and sixty thousand naira was realized from charcoal sale in the zone.

Kaduna state has the highest income from charcoal sales in the zone with four hundred and seven thousand one hundred naira only, this was followed by Kano having three hundred and thirty-five thousand and sixty naira and Sokoto state is having three thousand four hundred naira as shown in table 6.4.2 and figure 6.4.1 respectively.

Table 6.4.1: Amount of Charcoal Sold

Amount by Sizes	Frequency	Percent	Cumulative Percent	Total Amount (₦)
210	1	7.1	7.1	210
2000	1	7.1	14.3	2000
2500	1	7.1	21.4	2500
2600	1	7.1	28.6	2600
3400	1	7.1	35.7	3400
6000	1	7.1	42.9	6000
10000	1	7.1	50.0	10000
15000	1	7.1	57.1	15000
33600	1	7.1	64.3	33600
40000	1	7.1	71.4	40000
70000	1	7.1	78.6	70000
71250	1	7.1	85.7	71250
99000	1	7.1	92.9	99000
390000	1	7.1	100.0	390000
Total	14	100.0		745560

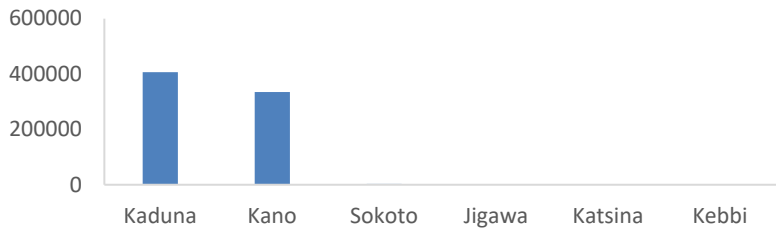


Figure 6.4.1: Charcoal Sales Income by State

Table 6.4.2: Charcoal Sales Income by State

Kaduna	**407100**
Kano	335060
Sokoto	3400
Jigawa	0
Katsina	0
Kebbi	0

Figure 6.4.2 reveals that the demand for charcoal is higher in the urban areas across the zone with four hundred and ninety four thousand three hundred and ten naira and unplanned urban area has one hundred and ninety four thousand two hundred and fifty naira only. Figure 6.4.3 showed that Urban households buy more of charcoal in the zone.

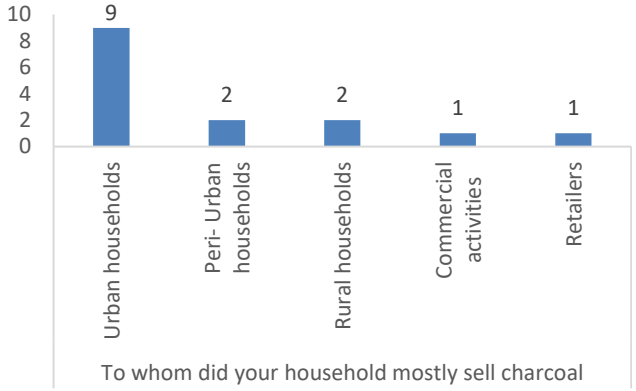


Figure 6.4.2: Major Customers of Charcoal

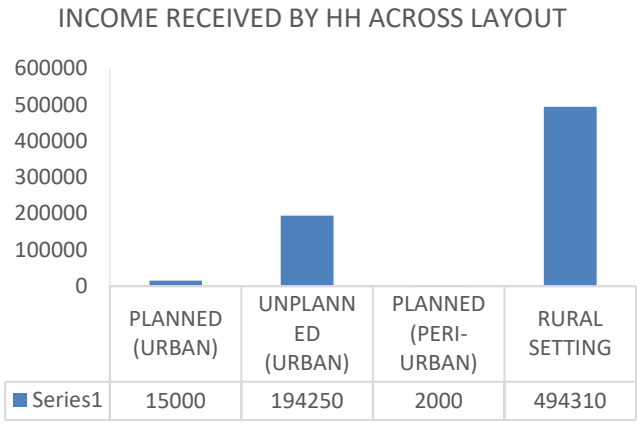


Figure 6.4.3: Income Recieved

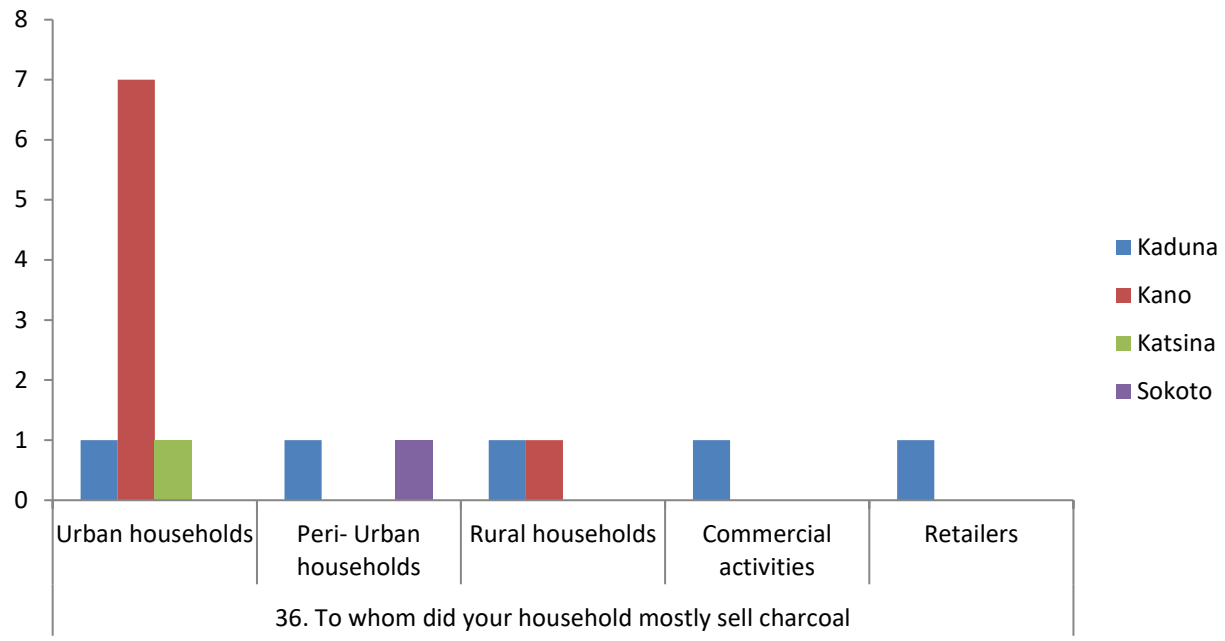


Figure 6.4.4: Charcoal Sales within Layout and by Activities

Figure 6.4.4 compares the sale of charcoal within the state, type of layout, commercial activities and retailers that buy charcoal mostly. It shows that charcoal is mostly used by urban households in Kano state. Charcoal sale is more lucrative in Kaduna state, the sale cuts across domestic and commercial use in both urban and rural area. In Katsina, charcoal is mostly sold among the urban households while Sokoto sells more among the peri-urban households.

CHAPTER SEVEN

7.1Conversion Technology for Cooking

A study on the conversion technology mainly used in cooking was also incorporated in the survey conducted in North West Zone of Nigeria. The states examined are Jigawa, Kaduna, Kano, Katsina and Sokoto States and their conversion technologies are sub-categorized into eleven namely, Electric stove/Cooker; Solar thermal stove/Cooker; Gas stove/Cooker; Liquid fuel (Kerosene) stove; Manufactured solid fuel stove; Locally fabricated Char Stove; Sawdust Stove;Three-stone fire (Open Fire); One directional open fire and Others.

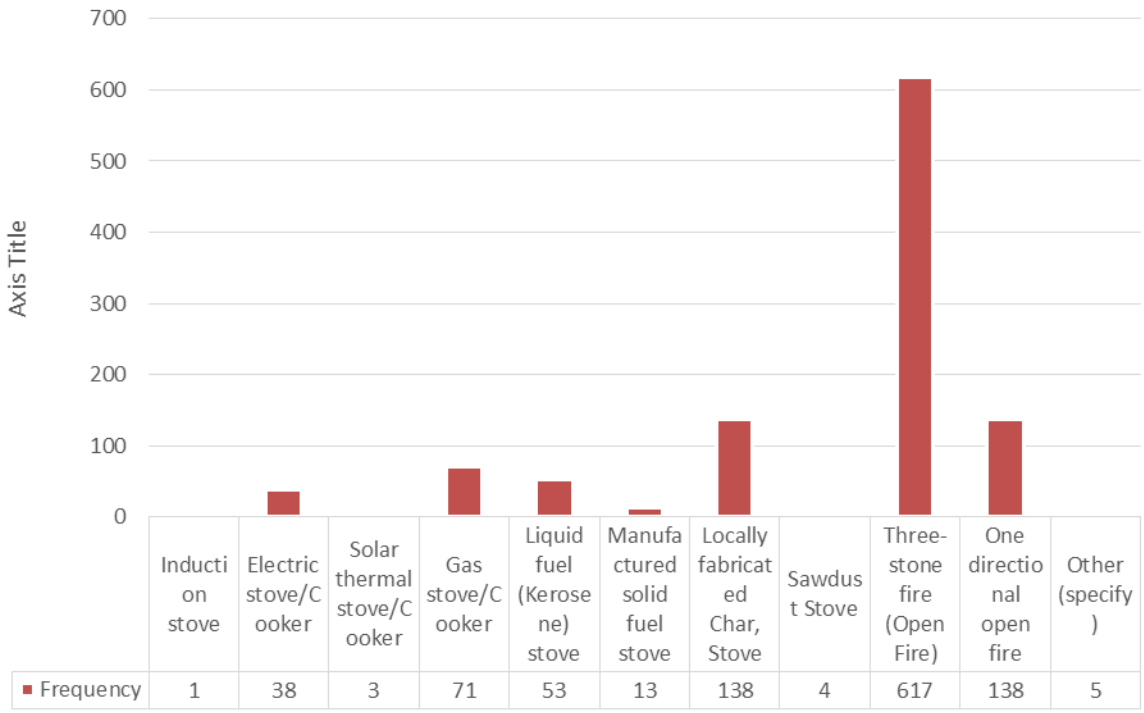


Figure 7.1.1: Frequency Distribution of Energy Conversion Technologies in Cooking

From the survey, Figure 7.1.1 shows a large portion of the people in this zone use three zone (open fire) as conversion technology for cooking. This recorded 57 % of the overall technologies, making it the most commonly used. The locally fabricated charcoal stove and one directional open fire are both tied to 13% in the second position of the most used technologies as presented in Figure 7.1.1

Other technologies are evidently reported, although with very few respondents in these categories; Gas stove/ Cooker (7%), Liquid Fuel Kerosene (5%), Electric Stove (4%) and Manufactured Solid Fuel with only 1 percent.

In order to examine the usage per state, the conversion technology was further analyzed and the result is presented in Table 7.1.1 from where it could be seen that out of 151 respondents in Jigawa State, 137 responded to yes for the three-stone fire stove which represented 90.7% of the total population sampled. Due to the high population in Kano State, it had 146 of 306 sampled for three-stone fire stove. This is slightly higher in frequency than Jigawa state but translates to 48% of total respondents using three-stone fire stove. However, Kaduna State had the highest distribution with almost all the available technology in use.

Table 7.1.1: Conversion Technology by States

Conversion Technologies	Jigawa	Kaduna	Kano	Katsina	Kebbi	Sokoto	Total
Induction stove	0	0	1	0	0	0	1
Electric stove/Cooker	0	3	12	17	5	1	38
Solar thermal stove/Cooker	0	0	1	1	0	1	3
Gas stove/Cooker	1	14	26	23	6	1	71
Liquid fuel (Kerosene) stove	1	8	20	17	5	2	53
Manufactured solid fuel stove	5	0	2	4	1	1	13
Locally fabricated Char, Stove	4	29	64	15	7	19	138
Sawdust Stove	0	1	3	0	0	0	4
Three-stone fire (Open Fire)	137	57	146	114	113	50	617
One directional open fire	3	3	24	42	49	17	138
Other (specify)	0	0	5	0	0	0	5
Total	151	115	304	233	186	92	1081

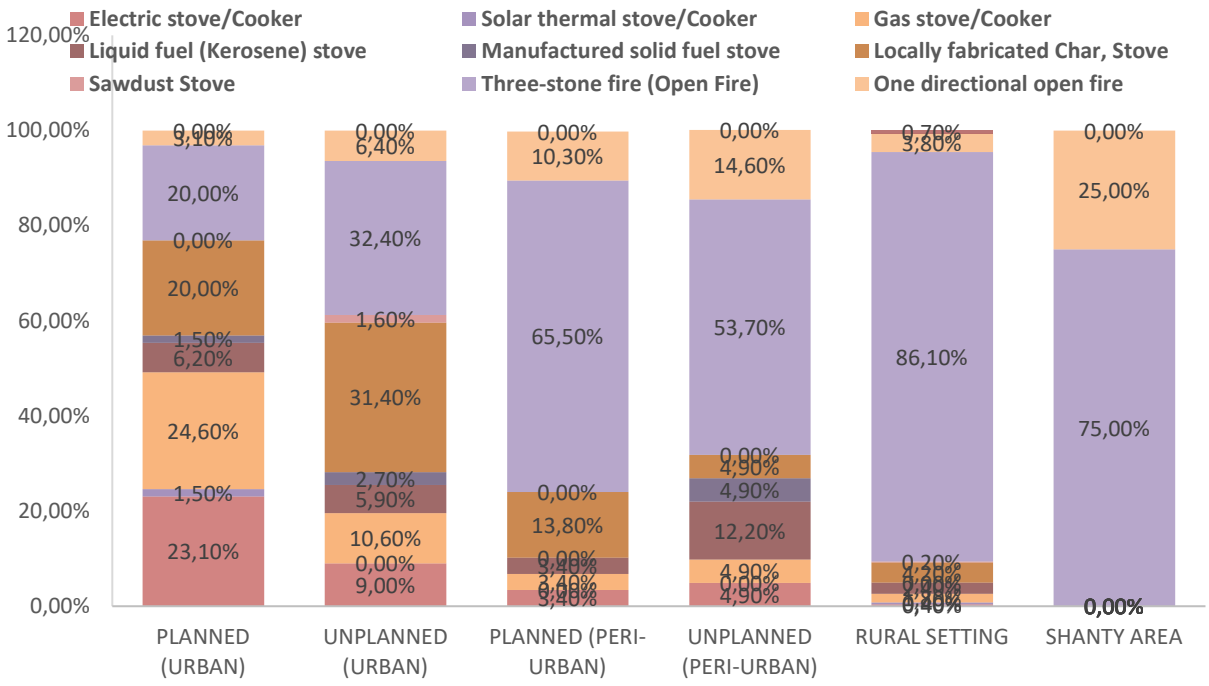


Figure 7.1.2: Frequency Distribution of Energy Conversion Technologies in Cooking by layouts

In the same vein, the type of conversion technology in use is analyzed based on the area layout they live. Figure 7.2.2 reveals that shanty area uses predominantly only three-stone fire stove (Open Fire) and one directional open fire. Rural setting, although with some incidences of other technology occurring, has the highest percentage of three-stone fire stove (86.10%). Planned (urban) area layout recorded the highest distribution across all technology with Electric stove/Cooker, Gas stove/Cooker, Locally fabricated Char Stove and three-stone fire stove (Open Fire) all with over 20% each.

Table 7.1.2 Frequency Distribution of Energy Source

Energy Source	Frequency
Electricity National Grid	40
Electricity, Generator	1
LPG (Cylinder)	71
Piped gas	4
Kerosene	51
Charcoal	145
Coal	1
Firewood	722
Crop Residues/Grass/Straw/Shrubs	41
Animal Dungs	1
Sawdust	1

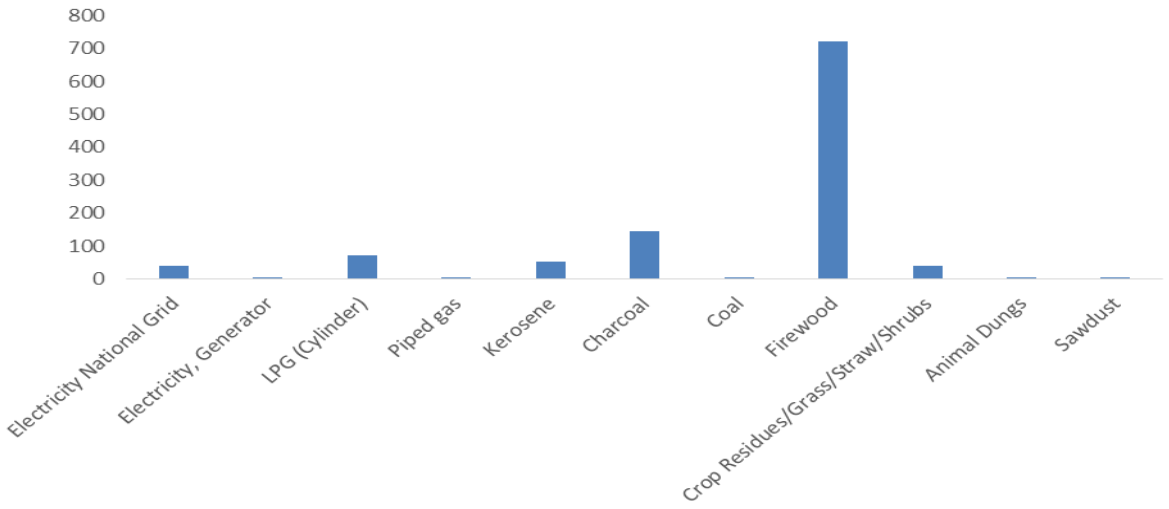


Figure 7.1.3: Frequency Distribution of Energy Source

Table 7.1.2 and Figure 7.1.3 illustrates the frequency distribution of the energy source used for cooking in the North-West Zone of the country. It is evident that fire wood is the most used source of energy in the region with about two–third. Charcoal, with 13% remains the second highest while LPG-Cylinder (6.6%) follows. Charcoal and Firewood alone makes a total of 80% usage which signifies that they are the most available and preferred. Cooking is done almost exclusively with fuelwood (either directly or after conversion into charcoal).

Table 7.1.3 Percentage of Energy Source for Cooking in States

Energy Source	Jigawa, %	Kaduna, %	Kano, %	Katsina, %	Kebbi, %	Sokoto, %
Electricity National Grid	0.00	2.60	4.30	7.70	2.70	1.10
Electricity, Generator	0.00	0.00	0.00	0.00	0.50	0.00
LPG (Cylinder)	0.70	12.30	10.20	7.70	3.20	1.10
Piped gas	0.00	0.00	0.00	1.70	0.00	0.00
Kerosene	0.70	7.00	6.60	6.90	2.70	1.10
Charcoal	2.70	25.40	22.80	7.30	2.70	22.80
Coal	0.00	0.00	0.00	0.00	0.50	0.00
Firewood	90.0	52.60	46.20	68.70	87.60	69.60
Crop Residues/Grass/Straw/Shrubs	5.30	0.00	9.60	0.00	0.00	4.30
Animal Dungs	0.70	0.00	0.00	0.00	0.00	0.00
Sawdust	0.00	0.00	0.30	0.00	0.00	0.00

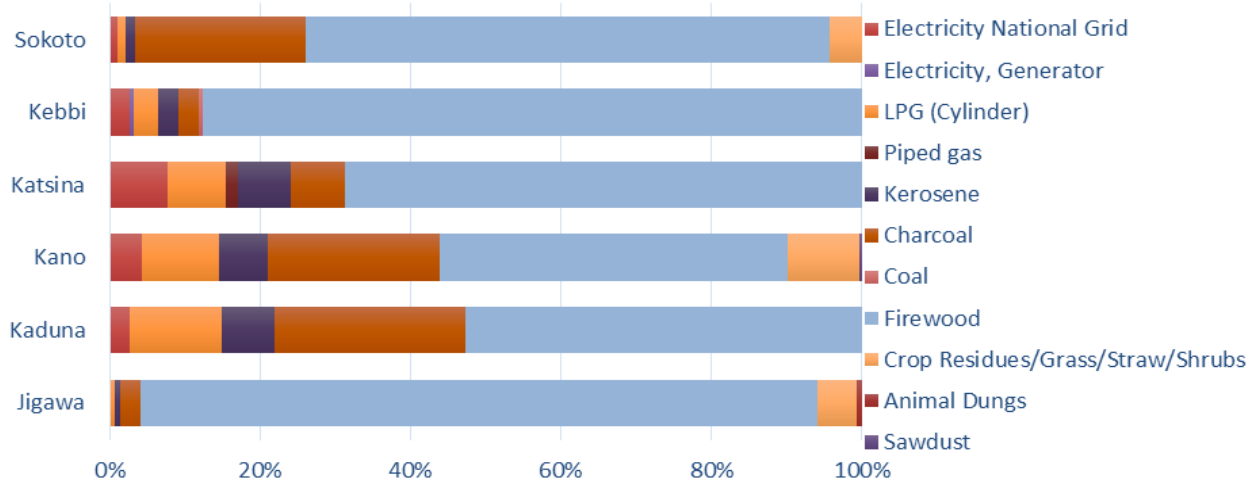


Figure 7.1.4: Energy Source for Cooking in States

Figure 7.1.4 presented the comparison of the energy usage with respect to the various States in the region, Jigawa State is the State with the highest number of people using firewood. Out of the 150 respondents, 135 households (90%) use firewood for cooking. Kebbi and Sokoto follow with 87.60 and 69.60% respectively. Kaduna and Kano which have a little bit above 10% of their total consumption in LPG Cylinder remain the states with the highest users of LPG. JIgawa, however have as low as 0.70% of people who said they use gas.

Another most used source of energy is charcoal, which recorded over 20 percent of people in Kaduna, Kano and Sokoto states using it. The use Electricity in cooking in this region is not a really common phenomenon, as the entire States poll less than 10 percent in usage. Other sources of energy studied were seen as low or not in use at all in some occasions.

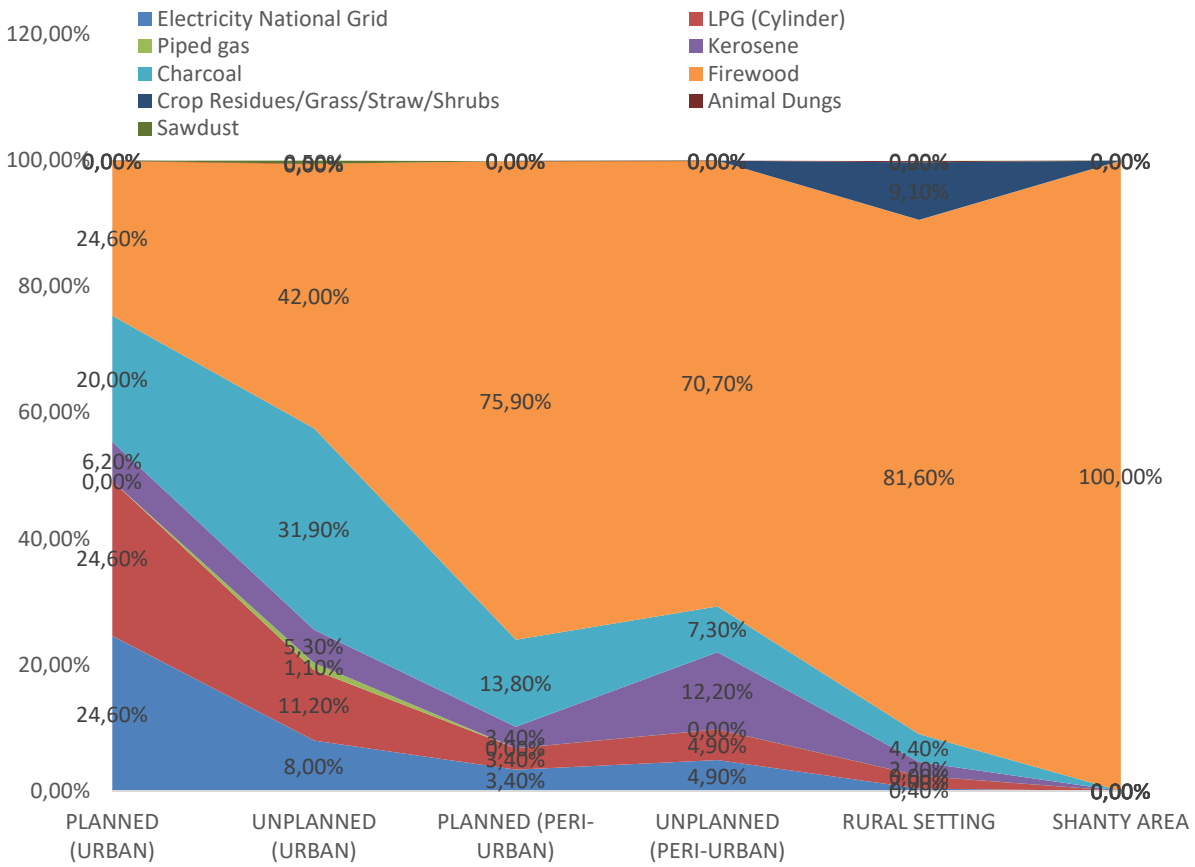


Figure 7.1.5: Energy Source for Cooking in Layouts

A further examination of the data with distribution based on the various area layouts they reside was sampled as shown in Figure 7.1.5, from the table and chart below, it shows that Planned Urban area has the least percentage of the people using fuelwood with 24.6% and surprisingly one of the highest consumers of charcoal (20%). The three most dominant energy sources in this area are LPG, Electricity and Firewood. The Unplanned Urban area on the other hand, has about half of its energy use as firewood, with charcoal polling in the second with 31%. The Planned urban, unplanned urban, rural settings and Shanty area all have over 70% of their energy usage mainly on fuelwood.

Table 7.1.3 Percentage of Energy Source for Cooking

Energy Source	PLANNED (URBAN), %	UNPLANNED (URBAN), %	PLANNED (PERI-URBAN), %	UNPLANNED (PERI-URBAN), %	RURAL SETTING, %	SHANTY AREA, %
Electricity National Grid	24.6	8.0	3.4	4.9	0.4	0.0
LPG (Cylinder)	24.6	11.2	3.4	4.9	2.0	0.0
Piped gas	0.00	1.1	0.0	0.0	0.0	0.0
Kerosene	6.20	5.3	3.4	12.2	2.2	0.0
Charcoal	20.0	31.9	13.8	7.3	4.4	0.0
Firewood	24.60	42.0	75.9	70.7	81.6	100.0
Crop Residues/Grass/Straw/Shrubs	0.00	0.0	0.0	0.0	9.1	0.0
Animal Dungs	0.00	0.0	0.0	0.0	0.2	0.0
Sawdust	0.00	0.5	0.0	0.0	0.0	0.0
Total	100.0	100.0	100.0	100.0	100.0	100.0

7.2Negative Consequences of Fuelwood Collection/Cut/Use

A total of 281 households out of the 799 surveyed in the zone reported having experienced one form of negative consequences of Fuelwood collection or the other. The collection was observed to be carried out by almost all categories of household members, which include fathers, mothers, and children of both gender as well as other live-in relatives and domestic aides.

While thirty (30) households or 10.7 % reported missed school days for their school-age children due fuelwood collection activities, another 6 % complained of other schooling problems. Similarly, 74.4 % recorded injuries and other health issues resulting from fuelwood collection; 6.8 % have encountered assault, kidnapping and other violent activities while 5.3 % of the surveyed household had also suffered other forms of negative consequences of fuelwood cutting and collection.

The survey also revealed that majority (86.7%) of the negative consequences of fuelwood collection was experienced by people living in rural settings. This is obviously due to the fact that it is mostly the rural people who cut and collect fuelwood from nearby forests.

Among the states surveyed as outlined in Figure7.2.1, Jigawa lead with a total of 40 % of the surveyed households with missed school days problem. It was followed by Kebbi (36.7%); Sokoto (13.3%); while Kano, Kaduna and Katsina has 3.3 % each. This sequence is maintained for fuelwood collection related injuries in the states as shown in Figure 7.2.2

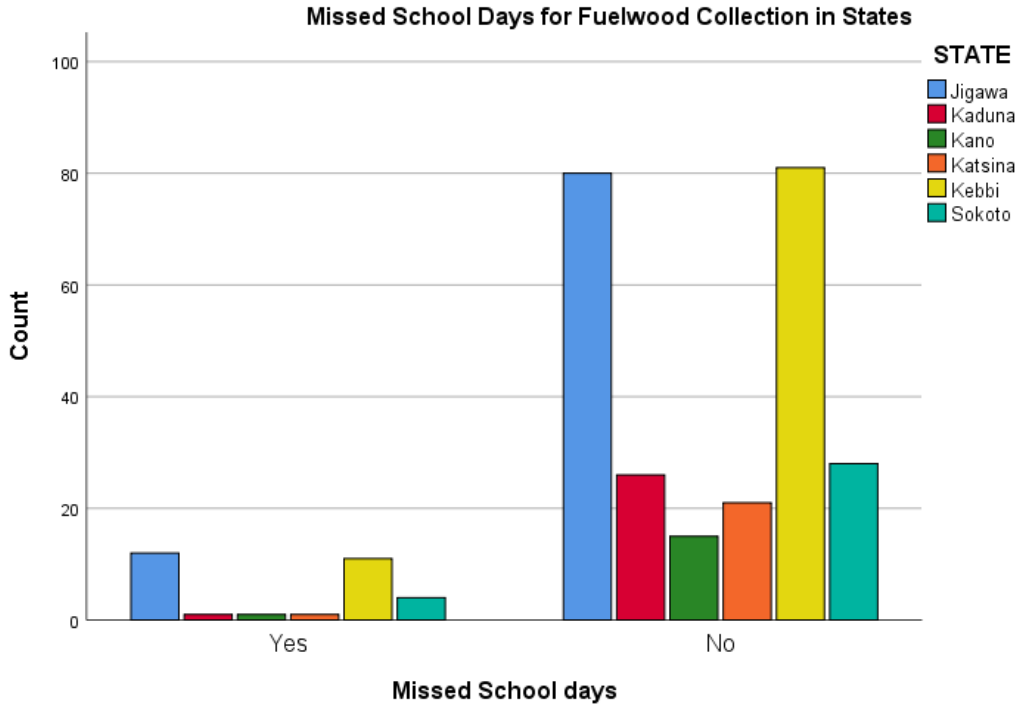


Figure 7.2.1: Missed School Days for Fuelwood Collection in States

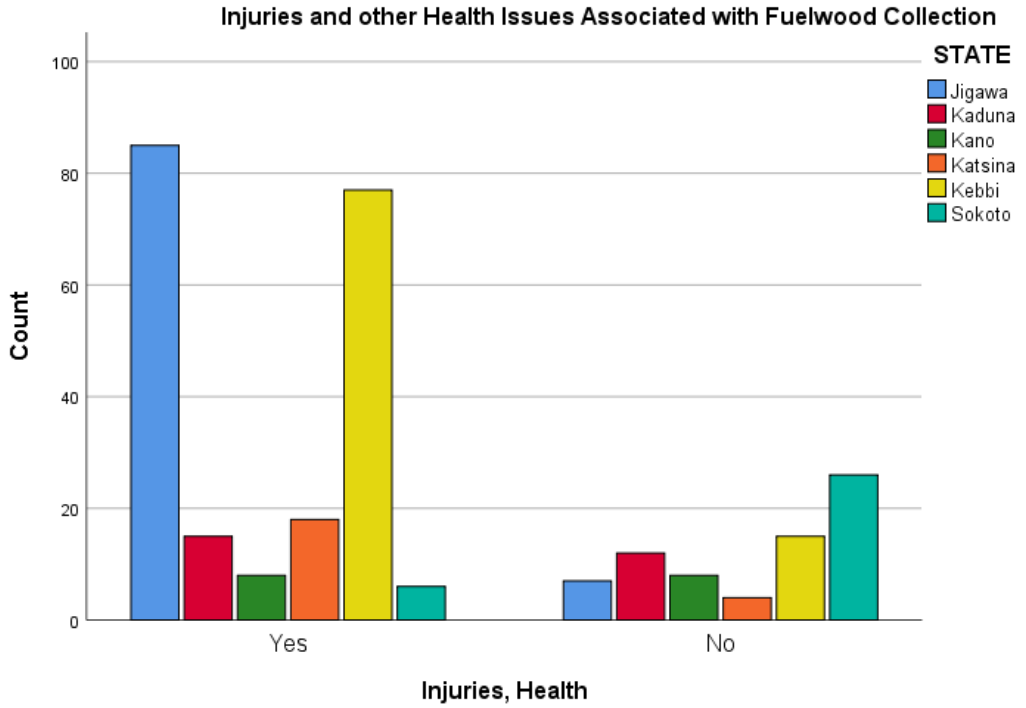


Figure 7.2.2: Injuries and other Health Challenges associated with Fuelwood Collection

For assault, kidnapping and other violence affecting fuelwood collection, Jigawa State is still leading with 15.2 % reporting having experienced one form of violence or another. It was closely followed by Kano State (12.5%). Kaduna has 3.7%; Sokoto 3.1% and Kebbi 1.1%. It was only in Katsina State that nobody reported violence.

7.2 Carbon Dioxide (CO_2) Emission

The computed fuelwood-based CO_2 emission of the NW zone was found to be **112,297 tCO_2**per day. Kano state leads with 21,018.86tCO_2 followed by Katsina, Kaduna, Jigawa and Sokoto states while Kebbi has the least CO_2 emission in the zone at 8,742.34 tCO_2.

Table 7.2.1: States Fuelwood Per Capita Consumption and CO_2 Emission

S/N	STATES	POPULATION (2017)	FUELWOOD CONSUMPTION PER CAPITA (kg/day)	DAILY FUELWOOD CONSUMPTION (tonnes)	CO_2 EMISSION (tCO_2)
1.	Jigawa	5,828,163	1.197	6,980.24	11,475.51
2.	Kaduna	8,252,366	0.977	8,068.28	13,264.25
3.	Kano	13,076,892	0.977	12,785.20	21,018.86
4.	Katsina	7,831,319	1.136	8,900.83	14,632.96
5.	Kebbi	4,440,050	1.197	5,317.73	8,742.34
6.	Sokoto	4,998,090	1.124	5,619.60	9,238.62

CHAPTER EIGHT

8.0 OBSERVATIONS AND RECOMMENDATIONS

8.1 Observations

1. **Questionnaire validation:**

   The survey has confirmed the validity and suitability of the questionnaire developed by the FAO for the purpose of fuelwood consumption survey. Although some sections were modified to suit local peculiarities, major aspects of the questionnaire remained untouched and were used to capture the required data. It could therefore be concluded that the questionnaire is validated and recommended for further use in future fuelwood surveys.

2. **Fuelwood Acquisition:** It was observed that fuelwood consumed for all purposes in the North West Zone is mostly purchased (64.2%) by households with an average monthly fuelwood expenditure of ₦6, 684. With majority of the respondents reporting a monthly income of N18, 000 or less, this amount certainly is a cause of concern for most residents. This is especially more for urban dwellers that do not have the option of collection other than purchase. Most of the fuelwood collected or purchased is from direct wood (wood from forests, plantations, agricultural tree crops). This obviously has direct impact on the scarce forests in the region resulting in desert encroachment. It may also justify the inclusion of almost all the states in the zone into the ongoing National Great Green Wall programme of the government, aimed at planting of wall of trees at certain areas to replace the lost forests.

   The survey also revealed that 35.8% of households cut/collected fuelwood from nearby bush and forests. All interviewed households in Shanty area cut/collected fuelwood while 53.4% and 61% of households in Rural and Unplanned Peri-urban respectively cut/collected fuelwood. The survey also revealed that majority (86.7%) of the negative consequences of fuelwood collection was experienced by people living in rural settings. This is obviously due to the fact that it is mostly the rural people who cut and collect fuelwood from nearby forests.

3. **Fuelwood Consumption:** The result obtained from the study revealed that most households (90.7%) in the North West Zone used fuelwood for cooking, space heating, other domestic uses, agricultural, commercial, and cultural/religious purposes while only 9.3% of households reported not using fuelwood. This implies that fuelwood tends to be the dominant fuel type used by households in the Zone especially in the rural areas. The report also shows that fuelwood is predominantly used for cooking at 69 %, while other uses such as space heating, agricultural, commercial and cultural/religious uses accounted for rest.

   From the survey, the average monthly quantity of fuelwood consumed by a household in the Zone is 388kg.

   Households that have 1 to 10 people used between 0 and 300kg monthly, while households with members ranging from 16 to 25 people used 601kg and above

monthly. This clearly shows that fuelwood consumption is higher in households with larger number of members than in smaller households.

Using an estimated population of 48,942,307 people (NBS, 2017) in the North West zone and the survey-established average household size of 10.58 heads, the fuelwood and charcoal consumption per capita is computed at 1.185kg/day and 0.27kg/day respectively (Daisuke *et.al*., 2015). This is slightly below the national fuelwood consumption per capita of 1.264Kg/day (IMCCDD, 2000).Similarly, an approximate total of 58,018.83tonnes of fuelwood and 13,551.20 tonnes of charcoal are estimated to be consumed daily in the zone.

4. **Energy Conversion Technology and Negative Consequences:** For energy conversion technology in cooking, the survey revealed that the three-stone fire stove (Open Fire) is the most commonly used conversion technology in the zone. This system according to IPCC, 1996 has only 40 % energy efficiency resulting in the excessive smoke emission that has both health and environmental implications. Consequently, 74.4 % of the respondents reported being affected by injuries and other health issues resulting from fuelwood collection and usage. The associated carbon dioxide emission was also computed at **112,297 tCO_2**per day in the zone.
5. **Charcoal Acquisition and Consumption:** Mode of acquisition of charcoal in the zone was found to be basically through purchase. The estimated monthly consumption of charcoal in the Zone was 11,665.5 kg, translating to 64.81 kg on the average per household. The trend of these results suggests that charcoal usage in the zone was mostly in unplanned (Urban) and rural area. On monthly basis, the zone expended ₦544,140.00 on charcoal with an average of ₦3,831.97 per household.

8.2 Recommendations

- Government should employ holistic approach towards utilization of traditional biomass energy by ensuring that programmesand projects by different MDAs and stakeholders are synergized in order to promote cleaner energy consumption.
- There should also be consistent awareness programmes for the promotion of modern cooking technologies to encourage adoption among residents.
- The uncommon words/terms are recommended to be translated into the dominant language of the survey area and because it assisted the enumerators on the field in satisfactorily rendering of questions with uncommon words into the local language.
- Preferably, the classroom training for enumerators should take 3 or 4 days depending on the enumerators-trainees' responsiveness during the training.
- Each enumerator should individually carry out all the measurement activities during the hands-on practical demonstration.
- Enumerators should always call on the local authority or community leader first on arrival in a community and source local guides for easy facilitation, security and safety.

CHAPTER NINE

9.1Conclusion

The household woodfuel supplementary module (WSM) of the food and Agriculture Organization (FAO) was tested in a survey conducted in the North-western zone. The module was found convenient and suitable for the household survey. The survey revealed a fuelwood and charcoal per capital consumption of 1.185and 0.27kg/day/capita respectively; while the associated carbon dioxide (CO_2) emission was estimated as 112,297tCO_2/day within the North-western zone of Nigeria.

REFERENCES

1. Adedayo, A.G., (2005) "Gender roles in forest resources utilization and its impact on rural environment in Kwara State, Nigeria" In: Environmental sustainability and conservation in Nigeria.
2. Adedayo, A.G., F.A. Sale and O. Koleh, 2008 "Rural household wood energy utilization pattern and its impact on deforestation in Akoko South-West L.G.A., Ogun State, Nigeria" Proceedings of the 1st National Conference of the Forests and Forest Produce Society, April 16-18, 2008, Nigeria, pp: 15-164;
3. Adelekan, I.O. & Jerome, A.T. (2006) "Dynamics of household energy consumption in a traditional African city, Ibadan" *Environmentalist, 26:* 99–110
4. Adeoti, O., Idowu, D. O. O., & Falegan, T. (2001) "Could fuelwood use contribute to household poverty in Nigeria"? *Biomass & Bioenergy, 21*(3): 205-210.
5. Cherp, A., Jewell, J. & Goldthau, A. (2011) "Governing global energy: systems, transitions, complexity" *Global Policy, 2(* 1): 75 – 88.
6. Cline-Cole, R. A., Falola, J. A., Main, H. A. C., Mortimore, M. J., Nichol, J. E. & O'Reilly, F. D. (1987) "Wood fuel in Kano, final report of the rural energy research project" Bayero University, Kano, Nigeria Report submitted to the United Nations university Development studies division. http://www.odi.org.uk/fpeg/publications/greyliterarture/fuelwood/Clinecole/index.html - accessed 06/11/2019
7. Couture, S., Garcia, S. & Reynaud A. (2012) "Household energy choices and fuelwood consumption: An econometric approach using French data" *Energy Economics, 34* :1972–1981
8. Daisuke Sawauchi, daisuke Kunii and Yasutaka Yamamoto (2015) "Carbon Dioxide Emissions and Energy Self Sufficiency of Woody Biomass Utilization for Residential Heating: Acase Study of Nishiwaga, Japan" *Journal of Environmental Protection* 6: 321-327
9. Eroke, L. (2012) "20.3 Million Nigerians currently Unemployed, Statistics reveal" *Thisday Newspaper*, 8/10/2012 edition.
10. Florini, A. & Sovacool, B.K. (2009) "Who governs energy? The challenges facing global energy governance" *Energy Policy, 37(12):* 5239 – 5248.
11. Food & Agriculture Organization of the United Nations (FAO), (2011) "State of the World's Forests" Rome, FAO https://www.fao.org accessed 11/08/2019
12. Food & Agriculture Organization of the United Nations (FAO), (2011) "State of the World's Forests" Rome, FAO https://www.fao.org accessed 11/08/2019
13. Hyman, E. L. (1993) "Forestry policies and programs for fuelwood supply in Northern Nigeria" *Land Use Policy 10*(1): 26-43.
14. Hyman, E. L. (1994) "Fuel substitution and efficient woodstoves - are they the answers to the fuelwood supply problem in Northern Nigeria". *Environmental Management, 18* (1): 23-32.

15. Intergovernmental Panel on Climate Change (IPCC 1996) **"**How to calculate carbon emissions from a fuel wood cooking stove". https://www.ipcc-nggip.iges.or.jpaccessed 11/09/2019.

16. Inter-Ministerial Committee on Combating Desertification and Deforestation (IMCCDD 2000) "Federal Ministry of Environment of Nigeria: A report on National Action Programme to Combat Desertification in Nigeria**"** *table 6.1 page 53.*

17. Jatau, D.F., E.E. Dishan and H. Bonkary, 2006 "Domestic energy consumption pattern in Zinder State, Niger republic' Proceedings of the 31st Annual Conference of the Forestry Association of Nigeria, Markudi, November 20-23, 2006, Nigeria, pp: 351-358;
18. Kebede, E., Kagochi, J. & Jolly, C.M. (2010) "Energy consumption and economic development in Sub-Sahara Africa" *Energy Economics, 32* : 532–537
19. Kowsari, R. & Zerriffi, H. (2011) "Three dimensional energy profile: A conceptual framework for assessing household energy use" *Energy Policy, 39 :*7505–7517.
20. Maconachie, R., Tanko, A. & Zakariya, M. (2009) "Descending the energy ladder? Oil price shocks and domestic fuel choices in Kano, Nigeria" Land Use Policy, 26 (4): 1090-1099.
21. Maduka, J.O., 2011. Popularizing the use of Liquefied Petroleum Gas (LPG) as a substitute for fuel wood among women in Nigeria. Proceedings of the 3rd International Conference of the African Renewable Energy Alliance on Renewable Energy and Gender, June 29-July 1, 2011, Abuja, Nigeria;
22. National Bureau of Statistics (NBS, 2017) "2017 Demographic Statistics Bulletin" Published in May, 2018.
23. National Population Commission (NpoC) 2006 "National Census Figures" https://www.npoc.gov.ng accessed 11/09/201
24. Ogunkunle, A. T. J., & Oladele, F. A. (2004) "Ethno-botanical study of fuelwood and timber-wood consumption and replenishment in Ogbomoso, Oyo State, Nigeria" *Environmental Monitoring and Assessment, 91* (1-3): 223-236.
25. Sambo, A.S.(2008) "Renewable Energy Options for the Environment and Sustainable Development in Nigeria" Paper Presented at The National Workshop an Energy Investment and Private Sector and Participation at The Petroleum Training Institute, Warri.
26. Scott, A. (2012) "The energy trilemma for developing countries" ODI development progress blog http://www.developmentprogress.org/blog/2012/08/03/energy-trilemma-developing-countries - accessed 11/09/2019.
27. Sovacool, B.K. (2011) "Security of energy services and uses within urban households" *Current Opinion in Environmental Sustainability, 3:*218 – 224

APPENDICES

Appendix 1: Report of Training on CSPro and SPSS for Data Analysis

Introduction

The training was held on 16th – 19th September 2019 with three (3) staff of National Bureau of Statistics (NBS) as resource persons, while 13 staff of the Commission participated as trainees. It was organized in order to develop the capacity of the project team members on CSPro and SPSS tools for effective analysis of survey data. The questionnaire used to capture responses during the survey was converted into the digital format using CSPro for data entry and collation. The entered data was cleaned and concatenated during the training and handed over to the team at the end of the training.

Training Course Content

The training was highly intensive and practical. Each trainee's computer was provided with both CSPro and SPSS software. The following areas were thoroughly covered during the four (4) days training:

- Introduction to CSPro
- Introduction to SPSS
- Installation of CSPro and SPSS
- Data Coding
- Questions and Answers Session
- Data Dictionary/Creation
- Data Entry Forms/Creating & Designing
- Queries/Logic
- Creating Tables
- Concatenation/Data Exporting
- Introduction to Data Analysis/Descriptive Statistics
- Data Entry/Export Data Cleaning
- Graphs & Tables
- Data Manipulation
- Training Wrap up/Survey Design

Attendance

Resource persons

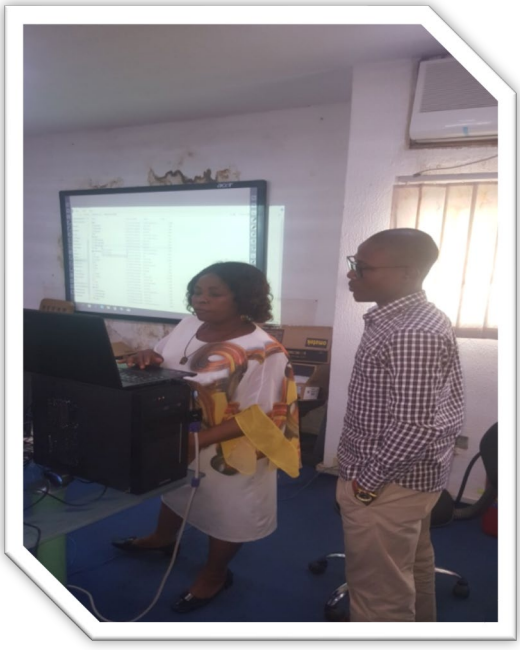
S/N	Name	Organization
1.	Regina Fidelis SamNBS	
2.	Wash Pam	NBS
3.	Abioye Joshua	NBS

Trainees

S/N	Staff Trainees List		
	Name	**Designation**	**Department**
1.	Mr. Jafar Bawa	ACSO	EIS
2.	Mrs. Farida A. Umar	ACSO	EIS
3.	Engr. Ndacheko I. Usman	ACSO	EMTMD
4.	Garba Modu Sale	ACSO	EMTMD
5.	Ahmad Tijjani	PSO	EMTMD
6.	Abbas I. Musa	PSO	EMTMD
7.	Inusa B. Muhammad	PSO	EMTMD
8.	Adisa G. Bukola	SSO	EMTMD
9.	Idowu Olokungbemi	SSO	EMTMD
10.	Mrs. Amina I. Ibrahim	SSO	EMTMD
11.	Mrs. Zahira Aminu	SSO	EIS
12.	Mrs. Sherifat A. Ibrahim	SSO	EMTMD
13.	Engr. Sanusi S. Sani	SSO	EMTMD

Data Analysis Guidelines

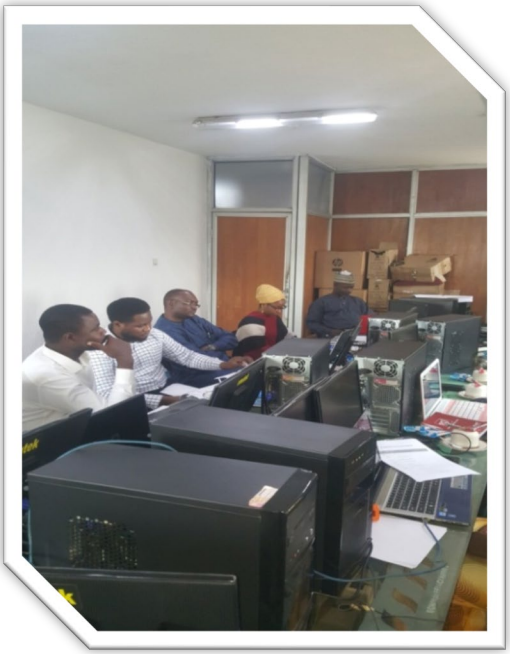
Draft data analysis guidelines were developed for both fuelwood and charcoal sections of the questionnaire to guide the project team in the data analysis.



Resource Persons

Training Session in progress

A presentation during the training



A cross-section of the trainees

Director, EMTMD Department Dr Mrs. Roseline Kela addressing the trainees on behalf of the DG

Group Photograph at the end of the training

Appendix 2: Photos captured during the field survey

A locally manufactured charcoal Stove

Cut trees and the sparse forest background

Three-Stone fuelwood stove used by most HHs

Another three-stone open fire stove in use

Fuelwood cut and stored for domestic use

Bunch of purchased fuelwood

Indoor metal open fire fuelwood stove

Bunches of fuelwood for sale

A separate room used as kitchen

Indoor kitchen

storage for domestic use

Fuelwood Tree trunk parts showing a whole tree cut for sale

Collected twigs and fallen branches

Collected twigs and crop residue

Dried and stored fuelwood for rainy days

Locally constructed cart used for transportation of cut fuelwood after collection

Logs of fuelwood stored in an urban for cooking

Charcoal use in an urban household

Heap of fuelwood for sale

Awhole tree cut down for fuelwood

Partially cut tree for fuelwood

Big trunks for split and sale

Weighing a bunch of fuelwood used to cook 1-mealfor a family of four (4)meal of a big family

Weighing a log of fuelwood used to cook1-day

Children conveying cut/collected fuelwood home

Splitting big logs in to smaller pieces for sale

Hygrometer used to determine water content

Bunch of fuelwood primed for weighing

Charcoal for sale

A typical Charcoal depot

Appendix3: Questionnaire used during the field survey

FIELDS/N:……..

PILOT TESTING OF RESIDENTIAL WOODFUEL SUPPLEMENTARY MODULE (WSM) IN NIGERIA

QUESTIONNAIRE

Energy Commission of Nigeria (ECN) with the support of the International Renewable Energy Agency (IRENA) is conducting a Pilot Testing of Residential Woodfuel Supplementary Module (WSM) developed by the Food and Agriculture Organization (FAO) of the United Nations in the North West Geopolitical Zone (Jigawa, Kaduna, Kano, Katsina, Kebbi and Sokoto States) of Nigeria in April, 2019. The WSM is designed to collect information on household sector woodfuel (firewood and charcoal) consumption and acquisition, and the related socio-economic and health implications. In addition, the survey will also cover awareness and impact of the Nigerian Great Green Wall Programme in the survey area.

The aim of the pilot survey is to test the WSM through gathering of internationally comparable data that can be used to refine its questions and come up with the final version of the module that can be included in any household survey questionnaire by different country.

Note: The survey is purely for research purpose; any information generated shall be treated with confidentiality.

State: ……; Senatorial District:……..……;

LGA:……

Town/Village: ……..…….……; Enumeration Area: …….…….

Street/Quarter:…….……;Coordinates(GPS): ……; ..……..…..

Local Authority (Design.): ……..; Contact: ……..……

Local Guide (Name):…… Edu. Level:……..;

Tel.:…….…...

Time of Commencement:……(*HH.MM*); Time of Finishing:…….……..……(*HH.MM*)

RESPONSE STATUS(*Tick appropriate option clearly, please!*)			
1. Interview completed		2. Partially completed	
Enumerator:……; Design.:……Sign.: …….Date: ……/……/…… Supervisor:……..……; Design.:……Sign.: …….Date: ……/……/……			

COLLATION S/N: NW/……..

PS1A. HOUSEHOLD BUILDING INFORMATION

1. WHAT IS THE TYPE OF HOUSEHOLD BUILDING? [Use code] |___|
CODES FOR HOUSEHOLD BUILDING TYPE: DUPLEX=**1**, BUNGALOW=**2**, HIGH-RISE=**3**, TERRACE=**4**, TRADITIONAL/COMPOUND HOUSE=**5**, SHANTY HOUSE=**6**. **NOTE TO ENUMERATOR:SHANTY HOUSEHOLD –** A SMALL HOUSE USUALLY MADE FROM PIECES OF WOOD, METAL, GRASS, OR CARDBOARD, IN WHICH POOR PEOPLE LIVE, ESPECIALLY ON THE EDGE OF A CITY/TOWN.
2. WHAT IS THE LAYOUT OF THE AREA? [Use code] |___|
CODES FOR LAYOUT: PLANNED (URBAN)=**1;** UNPLANNED (URBAN)=**2**; PLANNED (PERI-URBAN)=**3**; UNPLANNED (PERI-URBAN) = **4**; RURAL SETTING = **5**; SHANTY AREA=**6**.
3. WHAT IS THE POPULATION DENSITY OF THE AREA? [Use code] |___|
CODES FOR POPULATION DENSITY: LOW DENSITY=**1**; MEDIUM DENSITY=**2**; HIGH DENSITY=**3**. **NOTES TO ENUMERATOR:LOW DENSITY** – VILLAGE AND REMOTE AREA; **MEDIUM DENSITY** –TOWN/CITY; **HIGH DENSITY** –SUBURB, PERI-URBAN. *THIS IS JUST FOR A GUIDE*

PS1B. RESPONDENT INFORMATION

4a. RESPONSIBILITY OF **RESPONDENT-1** IN THE HOUSEHOLD WOODFUELCHAIN? [Use code] |___|
4b.RESPONSIBILITY OF **RESPONDENT-2** IN THE HOUSEHOLD WOODFUEL CHAIN? [Use code]|___|
CODES FOR RESPONDENT RESPONSIBILITY: MAIN COOK =**1**;PURCHASE =**2**, COLLECTION OF FIREWOOD =**5**, PRODUCTION OF CHARCOAL =**4**. **NOTE TO ENUMERATOR:**IF TWO PERSONS (RESPONDENTS) ARE RESPONSIBLE FOR DIFFERENT OR THE SAME ASPECTS OF THE WOODFUEL CHAIN; THE TWO SHOULD BE INTERVIEWED ON THE RELEVANT AREAS. **THE ENUMERATOR SHOULD FIRST ESTABLISH THE HOUSEHOLD BEFORE COMMENCING INTERVIEW**.

PS1C. SOCIO-ECONOMIC INFORMATION OF HOUSEHOLD HEAD

6. WHAT IS THE GENDER OF THE HOUSEHOLD HEAD**?** [Use code] |___|
CODES FOR GENDER: MALE =**1**; FEMALE= **2**.
7. WHAT IS THE LANGUAGE OF THE OF THE HOUSEHOLD HEAD**?** [Use code] |_____|
WRITE IN THE SPACE PROVIDED ABOVE PLEASE.
8. WHAT IS THE AGE OF THE HOUSEHOLD HEAD? [Use code] |___|
CODES FOR AGE: 25 AND BELOW =**1**; 26 TO 40 = **2**; 41 TO 60 = **3**; ABOVE 60 YEARS=**4**.
9. WHAT IS THE MARITAL STATUS OF HOUSEHOLD HEAD? [Use code] |___|
CODES FOR MARITAL STATUS: SINGLE =**1**; MARRIED=**2**; SEPARATED=**3**; DIVORCED=**4**; WIDOWED=**5**; OTHERS=**6**_____ (SPECIFY PLEASE).
10. HOW MANY PEOPLE LIVE IN THE HOUSEHOLD ?[Use code] |___|
CODES FOR HOUSEHOLD SIZE: 1 – 5=**1**; 6 – 10=**2**; 11 – 15=**3**;16 – 20=**4**; 21 – 25 (AND MORE) =**5**.
11. WHAT IS THE LEVEL OF EDUCATION OF THE HOUSEHOLD HEAD? [Use code] |___|
CODES FOR EDUCATIONAL LEVEL: INFORMAL (ADULT/MASS EDUCATION, ISLAMIYYAH) =**1**; PRIMARY=**2**; SECONDARY=**3**; TERTIARY=**4**;POST-TERTIARY=**5**;NO EDUCATION=**6**.
12. WHAT IS THE OCCUPATION OF THE HOUSEHOLD HEAD? [Use code] |___|
CODES FOR OCCUPATION: PUBLIC SERVANT = **1**; PRIVATE SECTOR EMPLOYEE = **2**; BUSINESSMAN = **3**; ARTISAN/CRAFTSMAN = **4**; TRADER = **5**; FARMER = **6**; OTHER _____ (PLEASE SPECIFY) = **7**. **NOTES TO ENUMERATOR:PRIVATE SECTOR EMPLOYEE** INCLUDES STAFF OF INTERNATIONAL ORGANISATIONS/DEVELOPMENT PARTNERS AND DIPLOMATIC MISSIONS; **BUSINESSMAN** – BUSINESS REGISTERED WITH CORPORATE AFFAIRS COMMISSION'S (CAC); **TRADER** – PETTY TRADERS WITHOUT CAC REGISTRATION.
13. WHAT IS THE HOUSEHOLD HEAD AVERAGE MONTHLY INCOME, IN NAIRA (₦)? [Use code] |___|
CODES FOR MONTHLY INCOME: ≤ 18000=**1**; 18,001 – 48,000 =**2;** 48,001 – 79,000=**3**; 79,001 – 98,000 = **4**; 98,001 – 190,000 = **5**; 190,001 AND ABOVE=**6**.

S1A. FUELWOOD USE

1. IN THE **LAST MONTH**, DID YOU OR ANY MEMBER OF YOUR HOUSEHOLD **USE FUELWOOD** FOR ANY DOMESTIC, AGRICULTURAL, COMMERCIAL, CULTURAL OR RELIGIOUS USE? Yes ☐No ☐→**Q. 3**

1.a For which of the following purposes Wasfuelwood used?	**1.b** In how **Many days?**	**1.c** Type of wood mostly used	**1.d** U**sual daily amount***		
			No. of bundles	Kg per bundle	Total (kg)
COOKING …… ☐Yes☐No	|__|	|__|			
SPACE HEATING ……....☐Yes☐No	|__|	|__|			
OTHER DOMESTIC USES ……..…☐Yes☐No	|__|	|__|			
AGRICULTURAL USES ……..…☐Yes☐No	|__|	|__|			
COMMERCIAL USES……..…☐Yes☐No	|__|	|__|			
CULTURAL/RELIGIOUS USES … ☐Yes☐No	|__|	|__|			

HOW TO WEIGH WOOD: The First Time Wood Is Weighed, Form A **Bundle** (Or Fill A Sack For Pellets, Briquettes) And Weigh It With The Provided **Scale**. For The Following Quantities, Express Them In Number of Bundles Like The One Just Weighed (I.E.: Wood Should Be Weighed Only Once).

TYPE OF WOOD: 1 = Split Stems And Branches **(DIRECT-CONVENTIONAL)**; **2 =** Twigs (thin, terminal branches), Brushwood (thin branches of tree or bushes), Leaves **(DIRECT-MARGINAL)**;**3 =**Wood Chips, Sawdust, Etc. (**INDIRECT**); **4 =** (From Old Furniture, Construction Material, Etc.) **USED/RECOVERED**; **5 =** Pellets, Briquettes… **(IMPROVED)**.

OTHER DOMESTIC USES: Lighting, Boiling Water For Bathing, Laundering, Ironing, Smoking Against Insect.

AGRICULTURAL USES: Roasting Coffee; Parboiling of Rice or Yam; Curing Tobacco; Pasteurizing Milk; Preparing Feed For Animals; Heating Greenhouses, Poultry-Houses Or Swine-Houses; Drying Tea, Herbs, Tapioca.

COMMERCIAL USES: Baking Bread; Smoking Fish; Brewing Alcoholic Beverages; Street Food Vending; Lodges And Restaurants; Artisanal Workshops; Micro-Industries.

CULTURAL AND RELIGIOUS USES: Cremations, Other Religious Rituals; Incense Burning; Other Cultural Traditions.

*__ENUMERATOR –__ The Respondent May Give Only Total Quantity of Fuelwood Used For All the Activities, Hence, The Enumerator Has to Try And Disaggregate the Total Quantity into Various Uses;

2. WHAT IS THE MAIN**PLANT SPECIES** USED FOR FUEL? (Use local name of plants) … _____

2.a [ENUMERATOR: take the hygrometer provided to you and measure the water content of wood] … _____%

S1B. FUELWOOD ACQUISITION

3. IN THE LAST MONTH, DID YOU OR ANY MEMBER OF YOUR HOUSEHOLD **PURCHASE** FUELWOOD, EXCLUDING WOOD TO PRODUCE CHARCOAL? (TICK AS APPROPRIATE, PLEASE)

Yes – Wood from forests, plantations, agricultural tree crops(**Direct wood**) ☐→**Q. 4**

Yes – Wood chips, sawdust, other industrial by-products (**Indirect wood**) ☐→**Q. 4**

Yes – Pellets, briquettes, other improved fuelwood(**Improved fuelwood**) ☐→**Q. 4**

No☐→**Q. 7**

4. IN HOW MANY **DAYS?**	**5.** WHAT WAS THE **USUAL AMOUNT** OF WOOD**PURCHASED**BYTHE HOUSEHOLD PER DAY?			**6.** WHAT WAS THE **USUAL EXPENDITURE**ON FUELWOOD PER DAY, IN NAIRA?
|__|days	No. of bundles	Kg per bundle	Total (kg)	₦|__|__|__|__|__|

In case wood was not weighed before, form a bundle (or fill a sack for pellets, briquettes), weigh it with the scale and ask for the number of bundles/sacks purchased. Report the final quantity in kg. If it had already been weighed, report quantities in terms of number of bundles/sacks like the one weighed before.

7. IN THE **LAST MONTH**, DID YOU OR ANY MEMBER OF YOUR HOUSEHOLD **CUT** OR **COLLECT**FUELWOOD?Yes ☐→**Q. 8**
No ☐→**Q. 14**

8. IN HOW MANY **DAYS** PER WEEK?	**9.** WHAT WAS THE **USUAL DAILY AMOUNT** OF WOOD**CUT OR COLLECTEDIN TOTAL** BY ALL THE HOUSEHOLD MEMBERS?		
|___|days	No. of bundles	Kg per bundle	Total (kg)

10. WHERE WAS WOOD MAINLY CUT OR COLLECTED? (Select only one option)

NATURAL FOREST ……..……☐
FOREST PLANTATION ……☐
BUSH, RIVER BANKS, OTHER WILD SYSTEMS WITH NATURAL VEGETATION ……☐
OWN FARM ……...…….☐
OTHER AGRICULTURAL LAND ……...……☐
URBAN/VILLAGE AREA, ROADSIDE …..……..☐
CONSTRUCTION SITES, DUMPS ……..……. ☐
OTHER (_____)……. ☐

11. WHICH **TYPE OF WOOD** WAS MAINLY CUT OR COLLECTED? (Select only one option)

COLLECTED DEADWOOD…….☐
CUT TWIGS, BRUSHWOOD…….……☐
CUT BRANCHES, STEMS, TREES.……☐
USED/RECOVERED WOOD ……...…☐

12. HOW LONG DOES IT TAKE TO**:**

12.a GO FROM YOUR HOUSE TO THE EDGE OF THE MAIN COLLECTING AREA AND BACK?|__||__|hr|__||__|min.

12.b WHAT IS THE MAIN **TRANSPORTATION MODE**? (Write in the space provided)_____

12.c **HOW LONG DOES IT TAKES TO COLLECT** FUELWOOD?|__||__|hr|__||__|min.

13. WHICH HOUSEHOLD **MEMBERS** WERE **INVOLVED** IN FUELWOOD COLLECTION? (Enter their relationship status to the household head into roster)

13.a DID FUELWOOD COLLECTION HAVE ANY OF THE FOLLOWING NEGATIVE CONSEQUENCES ON ANY HOUSEHOLD MEMBER ON THE ROSTER?

	AGE (Enter codes)	EDU. LEVEL	MISSED SCHOOL DAYS	SCHOOLING PROBLEMS	INJURIES, ASSAULTS, HEALTH	OTHER VIOLENCE	_____ KIDNAPPING
	ROSTER (Q.13)						
1.	_____	|__||__|	☐	☐	☐	☐	☐
2.	_____	|__||__|	☐	☐	☐	☐	☐
3.	_____	|__||__|	☐	☐	☐	☐	☐
4.	_____	|__||__|	☐	☐	☐	☐	☐
5.	_____	|__||__|	☐	☐	☐	☐	☐

CODES FOR AGE: 11 YEARS AND BELOW =**1**; 12 TO 17 = **2**; 18 TO 30 = **3**;31 YEARS AND ABOVE =**4**.
CODES FOR EDU. LEVEL: INFORMAL (ADULT/MASS EDUCATION, ISLAMIYYAH) =**1**; PRIMARY=**2**; SECONDARY=**3**; TERTIARY=**4**;POST-TERTIARY=**5**;NO EDUCATION=**6**.

14. IN THE **LAST MONTH**, DID YOU OR ANY MEMBER OF YOUR HOUSEHOLD **ACQUIRE** FUELWOOD, EXCLUDING WOOD TO PRODUCE CHARCOAL IN ANY OF THE FOLLOWING WAYS? Yes ☐No ☐→**Q. 15**

14.a If **Yes, in which way?** (Multiple answers allowed)

PAYMENT IN-KIND … ☐|__|
BARTER……..…..☐|__|
GIFT ……..….. ☐|__|
BORROW....…….. ☐|__|
OTHER ……..….. ☐|__|

14.b In how many **days**?

14.c What was the **usual daily** amount?

No. of bundles	Kg per bundle	Total (kg)

S1C. FUELWOOD SALES

15. IN THE **LAST MONTH**, DID YOU OR ANY MEMBER OF YOUR HOUSEHOLD **SELL** FUELWOOD?

Yes ☐No ☐→**Q. 19**

16. WHAT WAS THE **TOTAL QUANTITY** SOLD?

No. of bundles	Kg per bundle	Total (kg)

In case fuelwood was not weighed before, form a bundle , weigh it with the scale and ask for the number of bundles sold. Report the final quantity in kg. If it had already been weighed, report quantities in terms of number of bundles like the one weighed before.

17. WHAT WAS THE **TOTAL INCOME** DERIVED BY YOUR HOUSEHOLD FROM FUELWOOD SALES IN THE LAST MONTH, IN [NAIRA, ~~₦~~]?

|__||__|.|__|

18. TO WHOM DID YOUR HOUSEHOLD MOSTLY SELL FUELWOOD?

URBAN HOUSEHOLDS ……...…☐
PERI URBAN HOUSEHOLDS ...……..…. .☐
RURAL HOUSEHOLDS …….…… .☐
INDUSTRIAL PLANTS ……..…….☐
COMMERCIAL ACTIVITIES ……..…..…☐
CHARCOAL PRODUCERS ……..……..…..☐
TRANSPORTERS, WHOLE SELLERS …….☐
RETAILERS ……..…..☐
OTHER (_____) ……...…☐

NOTE TO ENUMERATOR: Large scale commercial fuelwood located either within or outside the household is to be considered.

S2A. CHARCOAL USE

19. IN THE **LAST MONTH**, DID YOU OR ANY MEMBER OF YOUR HOUSEHOLD **USE** CHARCOAL FOR ANY DOMESTIC, AGRICULTURAL, COMMERCIAL, CULTURAL OR RELIGIOUS USE? Yes ☐No ☐→**Q. 20**

19.a For which of the following **purposes** was charcoal used? (Multiple answers allowed)	**19.b** In how many **Days per week**?	**19.c** What was the **usualdaily** amount? No. of sacks	Kg per sack	Total (kg)
COOKING …… ☐|__|				
SPACE HEATING ……☐|__|				
OTHER DOMESTIC USES ……☐|__|				
AGRICULTURAL USES ……☐|__|				
COMMERCIAL USES……☐|__|				
CULTURAL/RELIGIOUS USES … ☐|__|				

HOW TO WEIGH CHARCOAL: The first time charcoal is weighed, fill a **sack** and weigh it with the provided **scale**. For the following quantities, express them in number of sacks like the one just weighed (i.e.: charcoal should be weighed only once).

- **OTHER DOMESTIC USES**: Lighting, boiling water for bathing, laundering, ironing, smoking against insect.
- **AGRICULTURAL USES**: Roasting coffee; parboiling of rice or yam; curing tobacco; pasteurizing milk; preparing feed for animals; heating greenhouses, poultry-houses or swine-houses; drying tea, herbs, tapioca.
- **COMMERCIAL USES**: baking bread; smoking fish; brewing alcoholic beverages; street food vending; lodges and restaurants; artisanal workshops; micro-industries.
- **CULTURAL & RELIGIOUS USES**: cremations; other religious rituals; incense burning; other cultural traditions

S2B. CHARCOAL ACQUISITION

20. IN THE LAST MONTH, DID YOU OR ANY MEMBER OF YOUR HOUSEHOLD**PURCHASE** CHARCOAL?

Yes ☐→**Q. 21** No ☐→**Q. 24**

21. IN HOW MANY **DAYS?**	**22.** WHAT WAS THE **USUAL AMOUNT** OF CHARCOAL **PURCHASED PER DAY** BYTHE HOUSEHOLD? No. of sacks	Kg per sack	Total (kg)	**23.** WHAT WAS THE USUAL **EXPENDITURE** ON CHARCOAL PER DAY, IN [LOCAL CURRENCY]?
|____| days				|__|__|__|__|

In case charcoal was not weighed before, fill a sack, weigh it with the scale and ask for the number of sacks purchased per day. Report the final quantity in kg. If it had already been weighed, report quantities in terms of number of sacks like the one weighed before.

24. IN THE **LAST MONTH,** DID YOU OR ANY MEMBER OF YOURHOUSEHOLD **PRODUCE** CHARCOAL?

Yes ☐→**Q. 25** No ☐→**Q. 32**

25. HOW MANY **DAYS** DID YOUR HOUSEHOLD SPEND PRODUCING CHARCOAL**IN THE LAST MONTH**?

[This includes: going from home to the main charcoal production area and back; acquiring and transporting wood; preparing the kiln; burning wood and discharging charcoal].

\|__\|__\|days

26. WHAT WAS THE **TOTAL QUANTITY** PRODUCED?

No. of sacks	Kg per sack	Total (kg)

In case charcoal was not weighed before, fill a sack, weigh it with the scale and ask the number of sacks produced; report final quantity in kg. If it had already been weighed, report the quantity in number of sacks like the one weighed before.

NOTE TO ENUMERATOR: THE MEASURE (SACK) HERE MAY BE DIFFERENT FROM THE MEASURE (SACK) UNDER Q19C AND Q22

27. WAS THE WOOD USED TO PRODUCE CHARCOAL:

- CUT BY A HOUSEHOLD MEMBER (→**Q. 28**)……..,,,…☐
- PURCHASED OR OTHERWISE ACQUIRED (→**Q. 30**) ……..… ☐
- BOTH (→**Q. 28**) ……...…… ☐

28. WHERE IS THE WOOD USED TO PRODUCE CHARCOAL MAINLY CUT?

- NATURAL FORESTS……☐
- FOREST PLANTATIONS……...……☐
- OTHER (_____)……. ☐

29. WHAT IS THE MAIN**PLANTSPECIES** USED FOR PRODUCING CHARCOAL? (Use local name of plants) ……
…… _____

30. WHICH HOUSEHOLD **MEMBERS** WERE **INVOLVED** IN CHARCOALPRODUCTION? (Enter their relationship status to the household head into roster)

30.aDID CHARCOALPRODUCTION HAVE ANY OF THE FOLLOWING NEGATIVE CONSEQUENCES ON ANY HOUSEHOLD MEMBER ON THE ROSTER?

ROSTER (Q. 30)	AGE (Enter codes)	EDU. LEVEL	MISSEDSCHOOLING DAYS	SCHOOL PROBLEMS	INJURIES, ASSAULTS, HEALTH	OTHER VIOLENCE	_____ KIDNAPPING
1. _____	__	__	__	☐	☐	☐	☐ ☐
2. _____	__	__	__	☐	☐	☐	☐ ☐
3. _____	__	__	__	☐	☐	☐	☐ ☐
4. _____	__	__	__	☐	☐	☐	☐ ☐
5. _____	__	__	__	☐	☐	☐	☐ ☐

CODES FOR AGE: 11 YEARS AND BELOW =**1**; 12 TO 17 = **2**; 18 TO 30 = **3**;31 YEARS AND ABOVE =**4**.
CODES FOR EDU. LEVEL: INFORMAL (ADULT/MASS EDUCATION, ISLAMIYYAH) =**1**; PRIMARY=**2**; SECONDARY=**3**; TERTIARY=**4**;POST-TERTIARY=**5**;NO EDUCATION=**6**.

31. WHAT TYPE OF **KILN** WAS USED TO PRODUCE CHARCOAL?

EARTH PIT …… ☐BRICK KILN……☐
EARTH MOUND ……..……☐PORTABLE STEEL KILN ……..……☐
CASAMANCE ……,……☐STEEL KILN ……..……...……☐
OTHER TRADITIONAL KILN (_____) ……...☐OTHERIMPROVED STEEL KILN (_____)… ☐

32. IN THE **LAST MONTH**, DID YOU OR ANY MEMBER OF YOUR HOUSEHOLD**ACQUIRE**CHARCOAL IN ANY OF THE FOLLOWING WAYS? Yes ☐No ☐→**Q. 33**

32.a If **Yes, in which way?** ((Multiple answers allowed)

32.b In how many **days**?

32.c What was the **usual daily** amount?

	No. of sacks	Kg per sack	Total (kg)
PAYMENT IN-KIND … ☐|__|			
BARTER……..…..☐|__|			
GIFT ……..….. ☐|__|			
BORROW....……..….. ☐|__|			
OTHER …….. ☐|__|			

S2C. CHARCOAL SALES

33. IN THE **LAST MONTH**, DID YOU OR ANY MEMBER OF YOUR HOUSEHOLD SELL CHARCOAL?Yes ☐→ _**Q. 34**

No ☐→**Q. 37**

34. WHAT WAS THE **TOTAL QUANTITY** SOLD**?**

No. of sacks	Kg per sack	Total (kg)

In case charcoal was not weighed before, fill a sack, weigh it with the scale and ask the number of sacks sold; report final quantity in kg. If it had already been weighed, report the quantity in number of sacks like the one weighed before.

35. WHAT WAS THE **TOTAL INCOME** DERIVED BY YOUR HOUSEHOLD FROM CHARCOAL SALES, IN THE LAST MONTH IN [LOCAL CURRENCY]?

__\|__\|__\|__\|__\|

36. TO WHOM DID YOUR HOUSEHOLD MOSTLY SELL CHARCOAL?

- URBAN HOUSEHOLDS …… ☐
- PERI-URBAN HOUSEHOLDS …...… ☐
- RURAL HOUSEHOLDS ……..… ☐
- INDUSTRIAL PLANTS ……..…☐
- COMMERCIAL ACTIVITIES ……..… ☐
- TRANSPORTERS, WHOLE SELLERS … ☐
- RETAILERS …….. ☐
- OTHER (_____) …..…☐

S3. HOUSEHOLD FUEL COMBUSTION

37. WHAT DOES YOUR HOUSEHOLD USE FOR **COOKING**? [Select all that apply; **Multiple Energy Sources is Possible**]

CONVERSION TECHNOLOGY (Use codes)	**37.a** ENERGY SOURCE (Use codes)	**37.b** LOCATION	**37.c** PRESENCE OF CHIMNEY, HOOD, WINDOW, FAN (37.B)
1. INDUCTION STOVE	☐	|__||__|	|__| ☐
2. ELECTRIC STOVE/COOKER	☐	|__||__|	|__| ☐
3. SOLAR THERMAL STOVE/COOKER	☐	|__||__|	|__| ☐
4. GAS STOVE/COOKER	☐	|__||__|	|__| ☐
5. LIQUID FUEL (KEROSENE) STOVE	☐	|__||__|	|__| ☐
6. MANUFACTURED SOLID FUEL STOVE *(IMPROVED STOVE FOR CHARCOAL OR BRIQUETTE)*	☐	|__||__|	|__| ☐
7. LOCALLY FABRICATED CHAR. STOVE... *(CHARCOAL STOVE/COAL POT ALSO FOR BRIQUETTE)*	☐	|__||__|	|__| ☐
8. SAWDUST STOVE	☐	|__||__|	|__| ☐
9. THREE-STONE FIRE (OPEN FIRE)	☐	|__||__|	|__| ☐
10. ONE DIRECTIONAL OPEN FIRE	☐	|__||__|	|__| ☐
11. OTHER (SPECIFY) _____	☐	|__||__|	|__| ☐
12. NO STOVE/NO COOKING	☐	|__||__|	|__| ☐

38. RANK THE SELECTED CONVERSION TECHNOLOGIES IN ORDER OF FREQUENCY OF USE? [Use code]

[RANK -1 MOST FREQUENTLY USED]

RANK	1	2	3	4
CODE				

CODES FOR ENERGY SOURCE: 1 = ELECTRICITY, NATIONAL GRID; 2 = ELECTRICITY, GENERATOR; 3 = SOLAR PV SYSTEM; 4 = LPG (CYLINDER); 5 = PIPED GAS; 6 = BIOGAS; 7 = (BIO)ETHANOL; 8 = KEROSENE; 9 = CHARCOAL; 10 = COAL; 11 = FIREWOOD; 12 = CROP RESIDUES/GRASS/ STRAW/SHRUBS; 13 = ANIMAL DUNG/WASTE; 14 = PELLETS, WOODCHIPS; 15 = SAWDUST; 16 = GARBAGE/PLASTIC; 17 = OTHER.

LOCATION: 1 = OPEN SPACE; 2 = OUTDOOR; 3 = INDOOR, IN A SEPARATE BUILDING; 4 = INDOOR, IN THE LIVING AREA; 5 = INDOOR, IN A DEDICATED ROOM (KITCHEN).

39. WHAT DOES YOUR HOUSEHOLD USE TO **HEAT HOME** WHEN NEEDED? [Select all that apply]

CONVERSION TECHNOLOGY (TICK AS APPROPRIATE!)	**39A**. ENERGY SOURCE (Use codes)	**39b**. LOCATION (Use codes)	**39c**. PRESENCE OF CHIMNEY, HOOD, WINDOW, FAN (39.B)
1. NO SPACE HEATING	☐	|__||__|	|__| ☐
2. CENTRAL HEATING	☐	|__||__|	|__| ☐
3. SOLAR HEATING	☐	|__||__|	|__| ☐
4. SPACE HEATER, MANUFACTURED	☐	|__||__|	|__| ☐
5. SPACE HEATER, TRADITIONAL	☐	|__||__|	|__| ☐
6. COOKSTOVE, MANUFACTURED	☐	|__||__|	|__| ☐
7. COOKSTOVE, LOCALLY FABRICATED.	☐	|__||__|	|__| ☐
8. THREE-STONE OPEN FIRE	☐	|__||__|	|__| ☐
9. OTHER (SPECIFY) _____	☐	|__||__|	|__| ☐

40. WHICH OF THE SELECTED APPLIANCES IS USED FOR THE MOST TIME? [Use codes]

[RANK -1 MOST FREQUENTLY USED]

RANK	1	2	3	4
CODE				

CODES FOR ENERGY SOURCES: USE THE CODES UNDER Q37 ABOVE.

41. HOW MANY SQUARE METERS OF FLOOR AREA ARE USUALLY HEATED? |__||__|.|__|m^2

ENUMERATOR NOTE 1: USE THE PROVIDED MEASURING TAPE TO **MEASURE THE FLOOR AREA.**
ENUMERATOR NOTE 2: ACCESS TO THE LIVING AREA(S) IN MANY PARTS OF NIGERIA IS A VERY SENSITIVE RELIGIOUS/CULTURAL ISSUE; THE ENUMERATOR MAY/SHOULD THEREFORE NOT ASK FOR ACCESS TO TAKE ACTUAL MEASUREMENT BUT INSTEAD TO JUST REQUEST FOR ILLUSTRATION WITHIN THE YARD FOR ESTIMATE MEASUREMENT.

42. WHAT DOES THIS HOUSEHOLD USE MOST OF THE TIME AS A LIGHT SOURCE? [Select all that apply]

	42a ENERGY SOURCE (Use codes).	**42.b** LOCATION (Use codes)	**42.c** PRESENCE OF CHIMNEY, HOOD, WINDOW, FAN
1.ELECTRICITY	☐	|__|__|	☐
2.SOLAR POWERED LANTERN OR FLASHLIGHT	☐	|__|__|	☐
3.BATTERY POWERED LANTERN OR FLASHLIGHT	☐	|__|__|	☐
4. RECHARGEABLE LANTERN OR FLASHLIGHT*	☐	|__|__|	☐
5. SOLAR HOME SYSTEM	☐	|__|__|	☐
6. KEROSENE/BUSH LANTERN	☐	|__|__|	☐
7. OTHER LAMPS**	☐	|__|__|	☐
8. CANDLE	☐	|__|__|	☐
9. OTHER (SPECIFY) _____	☐	|__|__|	☐

CODES FOR ENERGY SOURCE: 1 = ELECTRICITY, NATIONAL GRID; 2 = ELECTRICITY, GENERATOR; 3 = ELECTRICITY, GAS (LPG/BIOGAS); 4 = SOLAR PV SYSTEM (ANY); 5 = DRY CELL BATTERY; 6= ALCOHOL/ETHANOL; 7 = KEROSENE/PARAFFIN; 8 = OTHER (SPECIFY PLEASE)_____.
***** THIS INCLUDES HANDSET LED FLASHLIGHT **AND** ** WICK LAMPS
LOCATION CODES: 1 INDOOR; 2 = OUTDOOR.

43. IN THE LAST **MONTH**, DID ANY MEMBER OF YOUR HOUSEHOLDON THE ROSTER EXPERIENCE ANY OF THE FOLLOWING **HEALTH PROBLEMS** WHILE **AT HOME**? (Enter their relationship status to the HH head into roster)

ROSTER	**AGE** [Use codes]	**EDUCATION LEVEL** [Use codes]	**HEADACHES, NAUSEA**	**SKIN / EYE IRRITATIONS**	**DIFFICULTY BREATHING, ASTHMA**	**BURNS INJURIES**	**OTHERS** _____	**43a. ACTIVITY(IES) PERFORMED WHEN PROBLEM(S) AROSE [**Use codes]
1. _____	|__|	|__|	☐	☐	☐	☐	☐…	|__|
2. _____	|__|	|__|	☐	☐	☐	☐	☐…	|__|
3. _____	|__|	|__|	☐	☐	☐	☐	☐…	|__|
4. _____	|__|	|__|	☐	☐	☐	☐	☐…	|__|
5. _____	|__|	|__|	☐	☐	☐	☐	☐…	|__|

CODES FOR AGE: 11 YEARS AND BELOW = **1**; 12 TO 17 = **2**; 18 TO 30 = **3**; 31 YEARS AND ABOVE = **4**.

CODES FOR EDUCATION LEVEL: INFORMAL (ADULT/MASS EDUCATION, ISLAMIYYAH) = **1**; PRIMARY = **2**; SECONDARY = **3**; TERTIARY = **4**; POST-TERTIARY = **5**; NO EDUCATION = **6**.

CODES FOR ACTIVITY PERFORMED: 1 = COOKING; **2** = SPACE HEATING; **3** = LIGHTING; **4** = OTHER DOMESTIC TASKS; **5** = DON'T KNOW/DON'T REMEMBER; **6** = OTHER (SPECIFY).

S4. WOOD SECURITY

44.IN THE **LAST 12 MONTHS**, HAS YOUR HOUSEHOLD EXPERIENCED FUELWOOD OR CHARCOAL **SHORTAGES**?

Yes☐→**Q. 45** No☐→**PS2A**

45.IN WHICH **MONTH(S)**?[select all that apply]

JANUARY … ☐MAY …… ☐SEPTEMBER …..☐
FEBRUARY … ☐ JUNE …..…☐OCTOBER ..…. ☐
MARCH …… ☐ JULY …..… ☐NOVEMBER … ☐
APRIL …… ☐ AUGUST … ☐DECEMBER …..☐

46.WHICH OF THE FOLLOWING **ACTIVITIES** WERE AFFECTED BY SUCH SHORTAGES? [select all that apply]

COOKING ……...…☐AGRICULTURAL USES..☐
SPACE HEATING …….☐COMMERCIAL USES …☐
OTHER DOMESTIC TASKS ☐OTHER USES ……...…☐

PS2A: GREAT GREEN WALL PROGRAMME

1. HAVE YOU HEARD OFTHE GREAT GREEN WALL PROGRAMME (**GGW**) OR THE NATIONAL AGENCY FOR THE GREAT GREEN WALL (**NAGGW**)?

Yes ☐No ☐→**End of Interview!**

- **GREAT GREEN WALL PROGRAMME (GGW)** WAS ESTABLISHED IN JUNE 2014 TO HALT AND REVERSE LAND DEGRADATION, PREVENT DEPLETION OF BIOLOGICAL DIVERSITY AND ENSURE THAT BY 2025, ECOSYSTEMS ARE RESILIENT TO CLIMATE CHANGE AND CONTINUE TO PROVIDE ESSENTIAL SERVICES.
- **THE NATIONAL AGENCY FOR THE GREAT GREEN WALL (NAGGW)**?Established In 2014 To Create A Green Wall For Sustainable Development In The Eleven Seriously Affected Desert Frontline States (Kebbi, Sokoto, Zamfara, Katsina, Jigawa, Kano, Yobe, Borno, Bauchi, Adamawa, Gombe) In Nigeria Stretching Across About 1500km Length By 15km Width That Will Be Free Of Famine, Images Of Malnourished Children And Starving Livestock.

2. IF YES, WHAT DO YOU KNOW ABOUT THE AIMS AND OBJECTIVES OF THE **GGW/NAGGW**? (TICK AS APPROPRIATE)

- ADDRESSING LAND DEGRADATION……..…☐
- COMBATING DESERTIFICATION……...……..…☐
- BOOSTING FOOD SECURITY…….……..…☐
- OTHER (_____)……...……☐

3.HAVE YOU COME ACROSS ANY OF THE GGW OR NAGGW ACTIVITIES IN YOUR AREA?

Yes ☐No ☐→5

4. IF YES, WHICH OF THE ACTIVITIES ARE LOCATED IN YOUR AREA?

- COMMUNITY TREE NURSERY ……..……☐
- SHELTER BELT ……....……☐
- SOLAR BOREHOLE ……..…☐
- ANIMAL WATERING POND…….……..☐
- SENSITIZATION/ENLIGHTENMENT...…….……..☐
- DISTRIBUTION OF IMPROVED WOODSTOVES AND OTHER
- EFFICIENT COOKSTOVES...…….……...☐
- OTHER (_____) ……..… …☐

5. IS THE SHELTER BELT CLOSE TO YOUR COMMUNITY?Yes ☐No ☐

5a IF YES, WHAT IS THE DISTANCE? |__|

CODES FOR DISTANCE RANGE: 1 TO 2 KM= **1**; 3 TO 4KM= **2**; 5 TO 6KM= **3;** 6KM AND ABOVE =**4**

6. IN EXTREME FUELWOOD SCARCITY HOW READILY ARE YOU TO PROTECT THE BELT BY NOT FELLING TREES FOR FUELWOOD? |__|

CODES FOR READINESS: HIGH= **1**; MEDIUM= **2** , LOW= **3**

7. HOW WOULD YOU RATE THE IMPACT OF THE GGW PROGRAMME / NAGGW ACTIVITIES GENERALLY? |__|

CODES FOR RATINGS: HIGH= **1**; MEDIUM= **2** , LOW= **3**

END OF INTERVIEW
THANK YOU!

HAUSA TRANSLATION OF SOME UNCOMMON WORDS IN THE QUESTIONNAIRE

S/N	English	Hausa	Remarks
1.	Wood chips, pellets	Dudduga	
2.	Twigs, brushwood	Kirare	
3.	Natural forests	Daji	
4.	plantations	Gandun Sarki	
5.	River banks	Bakin kogi	
6.	Charcoal	Gawayi	
7.	Space heating	Jin dumi	
8.	Earth pit	Rami	
9.	Earth mound	Rufin kasa	
10.	Casamance	Rufin kasa mai wurin fitar da hayaki	
11.	Cooking	Girki	
12.	Stove	Risho	
13.	Three stone fire	Murhu	
14.	Payment in kind	Musanye	
15.	Gift	Kyauta	
16.	Trade by barter	Kakara	
17.	Borrow	Aro/rance	
18.	Great Green Wall	Babbar katangar bishiyoyi	
19.	Land degradation	Zaizayar kasa	
20.	Desertification	Kwararowar hamada	
21.	Chimney	Wurin fitar hayaki	
22.	Community tree nursery	Lambun kanan shukoki	
23.	Shelter belt	Tarin bishiyoyi	
24.	Solar borehole	Rijiyar burtsatse mai amfani da hasken rana	
25.	Animal watering pond	Wajen shan ruwan dabbobi	
26.	Sensitization/Enlightment	Fadkarwa/ wayar da kan al'umma	
27.	Improved Woodstoves/cookstoves	Murhun itace masu inganci	
28.	Combating desertification	Yaki da kwararowar hamada	
29.	Addressing land degradation	Yaki da zaizayar kasa	

30. Boosting food security Samun isashshen abinci

Appendix 4: LIST OF ENUMERATORS AND SUPERVISORS

S/N	ENUMERATION AREA	ENUMERATOR	DESIGN.	DEPT
1.	Jigawa North (Hadejia Axis)	Mukhtar Ahmed	HTO	EMTMD
2.	Jigawa Central	Sanusi Sani	SSO	EMTMD
3.	Jigawa South (Dutse)	Garba Modu Saleh	ACSO	EMTMD
4.	Kaduna North (Zaria Axis)	Maryam A. Bulama	SSO	EMTMD
5.	Kaduna Central	Gloria E. Jonah	SSO	RE
6.	Kano (Wudil Axis)	Ibrahim Idakwo Abdulkadir	SSO	RE
7.	Kano (Nasarawa Axis)	Adisa Bukola George	SSO	EMTMD
8.	Kano (Kura Axis)	Aminu Aliyu Tukur	SSO	EPA
9.	Kano (Gwarzo Axis)	Ahmad Tijjani	PSO	EMTMD
10.	Kano (Rogo Axis)	Abbas Musa	PSO	EMTMD
11.	Kano (KMC)	Sherifat A. Ibrahim	PSO	EMTMD
12.	Katsina (Funtua Axis)	Inusa B. Muhammad	PSO	EMTMD
13.	Katsina (City)	Olasusi A. Kayode	SSO	NST
14.	Katsina North I	Aisha S. Ingawa	ACSO	EPA
15.	Katsina North II	Zainab A. Datti	SSO	EMTMD
16.	Katsina (Malumfashi Axis)	Ndaceko I. Usman	PSO	EMTMD
17.	Kebbi North (Birnin Kebbi)	Aladire Yekini Yahaya	ACTO	EMTMD
18.	Kebbi Central (Jega Axis)	Bako Chonoko Ibrahim	SSO	EIS
19.	Kebbi South (Zuru Axis)	Ignatius James Yamma	NYSC	EMTMD
20.	Sokoto Central (Sokoto)	Amina Ibrahim Ibikunle	SSO	EMTMD
21.	Sokoto South (Shagari Axis)	Farida Umar	PSO	EIS
22	Kaduna, Kano, Jigawa	Samuel A-Aku (**Supervisor**)	CSO	EMTMD
23	Katsina, Sokoto, Kebbi	Asogwa C. Jude (**Supervisor**)	DD	EMTMD
24	All States	Sulu B. F. I. (**Supervisor**)	DD	EMTMD