

**LONG AND SHORT RUN IMPACT OF ENERGY CONSUMPTION ON HOUSEHOLD CONSUMPTION EXPENDITURE IN NIGERIA****Abah, D., \*\* Oko, W. E. and \*Acheme, F**\*Department of Agricultural Economics,  
Federal University of Agriculture, Makurdi, PMB 2373, Makurdi, Nigeria.\*\*Department of Agricultural Economics,  
Federal University of Technology, OwerriCorrespondence: [daniel.abah@uam.edu.ng](mailto:daniel.abah@uam.edu.ng), [dangod23@yahoo.com](mailto:dangod23@yahoo.com)

Tel.: 08038823544

**Abstract**

*The study aimed at assessing the impact of energy consumption on household consumption expenditure in Nigeria. Time series data from 1981 to 2020 were collected from the Food and Agriculture Organization (FAO) for analysis. Descriptive statistics, the Augmented Dickey Fuller (ADF) test for unit root, Johansen Co-integration test, and Vector Error Correction Model (VECM) were employed in the analysis. The results of the ADF test indicated that all variables were integrated of order one and became stationary after first differencing. The Johansen Co-integration test showed that the computed Trace statistics and Maximum Eigen value exceeded the critical values at 0.05 level, indicating the presence of co-integration among the variables. This suggests a long-run relationship between energy consumption and household consumption expenditure. The VECM analysis revealed statistically significant coefficients for fuel wood, charcoal, and electricity consumption at 1%, 1%, and 5% levels respectively. This indicates the existence of a long-run effect of energy consumption on household consumption expenditure. In the short run, the coefficients for fuel wood and electricity consumption were also statistically significant at 1% level. The study recommended the promotion of welfare policies, implementing initiatives that can effectively increase income levels and subsidizing the prices of modern energy sources like electricity tariff as avenue to encourage savings among farmers as solutions.*

**Keywords:** Household, Energy, Consumption, Expenditure, Impact**Introduction**

Energy plays a crucial role in household life as it is essential for modern living. The type and usage pattern of energy in households significantly impact their overall welfare. According to Danlami and Islam (2020), the total well-being of a household is closely tied to its energy consumption. Oyedepo (2012) further emphasizes that energy enables the fulfillment of basic needs such as cooking food, maintaining a comfortable living temperature, providing lighting, powering appliances, accessing piped water, facilitating healthcare services, supporting education, communication, and transportation. In essence, energy is a fundamental commodity that supports various aspects of household functioning and contributes to overall quality of life.

According to the Energy Commission of Nigeria (ECN), the primary energy-consuming activities in Nigerian households are cooking, lighting, and the use of electrical appliances.

Cooking alone accounts for a significant 80% of household energy consumption while the remaining 2% is attributed to lighting and the use of basic electrical appliances like televisions and pressing irons (ECN, 2021). These figures highlight the substantial reliance on energy for cooking purposes in Nigerian households, as well as the importance of lighting and basic electrical appliances in overall energy consumption patterns.

In Nigeria, the primary energy resources utilized for domestic and commercial purposes include fuel wood, charcoal, kerosene, cooking gas, and electricity (Famuyide *et al.*, 2011; Okon, *et al.*, 2022). These energy sources are widely employed for various household activities. Additionally, there are less common sources such as sawdust, agricultural crop residues like corn stalks and cassava sticks, and in some cases, even cow dung. The utilization of these energy resources, either directly or indirectly, has a significant impact on household consumption expenditure. The

choice of energy source and its associated costs can influence the overall expenditure patterns and budget allocation of households.

Household consumption expenditure encompasses the total amount of spending made by resident households to fulfill their everyday needs. This includes expenditures on essential items such as food, clothing, housing, energy, transportation, durable goods, healthcare costs, leisure activities, and various services. It is an important variable for economic analysis as it typically represents a significant portion of a country's Gross Domestic Product (GDP).

According to the Nigerian GDP report published by the National Bureau of Statistics (NBS), household consumption expenditure in Nigeria experienced positive growth in recent years. In the fourth quarter of 2020, household consumption expenditure rose by 16.59% to reach N13.92 trillion compared to the corresponding quarter of 2019 when it stood at N11.94 trillion. This represents a substantial increase of 20.76% compared to the preceding quarter. Real household consumption expenditure in Q3 and Q4 of 2020 grew by 6.1% and 16.59% year-on-year respectively. Furthermore, the annual growth rate in real household consumption expenditure for 2020 was 0.81%, marking a positive trend compared to the decline of 1.06% recorded in 2019. In total, the final consumption expenditure of households in Nigeria amounted to N42.81 trillion in 2020 (NBS, 2021). These figures highlight the importance of household consumption expenditure in driving economic activity and reflect the overall consumption patterns and trends within the Nigerian economy.

The energy crisis in Nigeria has had a significant impact on various sectors, including households, industries, and commercial activities, over the past two decades. The lack of reliable and sufficient power supply has resulted in frequent power outages, which have paralyzed economic activities and contributed to the incidence of poverty in the country. The Council for Renewable Energy of Nigeria (CREN, 2009) estimated that these power outages caused an annual loss of 126 billion naira (US\$ 984.38 million) in 2009.

The consequences of the energy crisis go beyond the economic losses. The reliance on alternative energy sources, such as fuel wood and "backyard generators," has led to increased carbon emissions, posing health hazards to individuals exposed to the resulting pollution. Additionally, the energy crisis has contributed to unemployment and a higher cost of living, leading to a deterioration in living conditions for many households. These challenges in the energy sector have had direct and indirect effects on household spending patterns across the country. The high cost of energy and the need for alternative sources have affected the allocation of resources within households, influencing their consumption expenditure. Understanding the complex relationship between energy consumption and household spending is crucial, particularly in developing countries like Nigeria.

The current research aims at providing valuable insights into this relationship, shedding light on how energy consumption patterns within households affect their consumption expenditures. By examining the dynamics of energy expenditure and its impact on household spending, the study seeks to contribute to the understanding of energy-related challenges in developing countries like Nigeria and inform policy decisions aimed at improving the living conditions and welfare of households.

## **Research Methodology**

### **The Study Area**

The study was carried out in Nigeria. Nigeria, located in West Africa, is a country with a diverse geographical and demographic landscape. With a land area of 923,768 square kilometers, it is known for its coastal region along the Gulf of Guinea and stretches inland to encompass tropical rainforests, savannahs, and mangrove swamps. The country has a significant population, ranking as one of the eight most populous countries in the world. According to the National Population Commission (NPC) in 2006, Nigeria had a population of around 140 million people. However, with a high population growth rate of 2.6%, the estimated population has increased significantly. As of 2021, it is estimated to be around 210.87 million people (source: [www.statista.com](http://www.statista.com)). This population growth presents both opportunities and challenges for the country.

Nigeria's location within the tropics and its diverse agro-ecological climate have made agriculture a vital sector in the country's economy. The climate varies across the country, ranging from equatorial in the south to tropical in the central region and savannah in the north. The vegetation also varies accordingly, with grassland savannah in the north and forests in the south.

**Data Collection and Analytical Techniques**

The study employed annual time series data, utilizing data obtained from the Food and Agriculture Organization (FAO) database. The data covered the period from 1981 to 2020. Various statistical techniques such as descriptive statistics, Johansen co-integration, Augmented Dickey Fuller (ADF) test and Vector Error Correction Model (VECM) were applied to analyze the data and draw meaningful insights.

**Model Specification**

**Vector Error Correction Model (VECM)**

The researchers employed the vector error correction model to analyze the causal impact between non-stationary I(1) variables that showed evidence of a long-run relationship. The vector error correction model is a valuable tool for assessing short-term adjustments that converge towards long-run equilibrium in each time period. In cases where the variables are co-integrated, a VECM is estimated because it focuses on the long-run relationship without considering short-run dynamics. The key

advantage of this approach is that it allows for the evaluation of both long run and short run influences of the variables within the model, considering the mechanism that maintains equilibrium.

$$\Delta \ln HCE_t = \varphi_2 + \sum_{i=1}^p \alpha_{2i} \Delta \ln FWD_{t-i} + \sum_{i=1}^p \beta_{2i} \Delta \ln CHC_{t-i} + \sum_{i=1}^p \gamma_{2i} \Delta \ln ELE_{t-i} + \sigma_2 ECT_{t-i} + \xi_{2t} \dots \dots \dots (1)$$

where:  $\varphi$  and  $\sigma$  are  $m \times 1$  vector of parameters;  $\alpha, \beta, \delta, \mu$  and  $\gamma$  are  $m \times 1$  and  $m \times p$  vectors of parameters respectively;  $p$  is the optimal lag order that minimizes Information criteria;  $n$  is the number of endogenous variables under investigation (energy consumption and household consumption expenditure);  $\xi_{jt}$  is an  $m \times 1$  vector of random variables assumed to be normally distributed white noise process.

**Results and Discussion**

**Preliminary Analysis**

The findings of the initial analysis, which include summary statistics, unit root test, co-integration test, and lag length selection criteria, are outlined below. These results provide a comprehensive understanding of the variables by employing appropriate econometric techniques relevant to the study

**Table 1: Summary of Statistics of Variables**

	Fuel wood	Charcoal	Electricity	HCE
Mean	57929815	3053874	107.1847	2.35E+13
Median	59523102	3100278	98.97802	1.78E+13
Maximum	66883138	4636741	156.7972	4.39E+13
Minimum	44266220	1469004	50.90104	8.33E+12
Std. Dev.	6623239	940005.6	28.76985	1.32E+13
Skewness	-0.474324	-0.076297	0.129925	0.372402
Kurtosis	1.985700	1.751784	1.727416	1.500848
Jargue-Bera	3.214565	2.635545	2.811652	4.670319
Probability	0.200432	0.267731	0.245164	0.096795
Sum	2.32E+09	1.22E+08	4287.390	9.38E+14
Sum Sq. Dev.	1.71E+15	3.45E+13	32280.48	6.75E+27
Observation	40	40	40	40

Source: Data Analysis, 2022

**Unit roots test**

Table 2 presents the results of the Augmented Dickey Fuller (ADF) test, a crucial preliminary test used to examine the stationarity of variables and determine their order of integration. The findings indicate that all the variables under investigation, namely fuel wood, charcoal,

electricity, and household consumption expenditure, were integrated of order one. Furthermore, the variables became stationary when first differenced. These results suggest that the variables follow a random walk pattern (unit roots) or that their future values do not converge from their past values.

**Table 2. Results of Augmented Dickey-Fuller (ADF) Test**

Variable	Level				First Difference				
	ADF	1%	5%	10%	ADF	1%	5%	10%	Inference
<b>Fuelwood</b>	-2.3731	-3.6156	-2.9411	-2.6091	-4.2871***	-3.6156	-2.9411	-2.6091	I(1)
<b>Charcoal</b>	-0.13179	-3.6105	-2.9390	-2.6080	-5.8305***	-3.6156	-2.9411	-2.6091	I(1)
<b>Electricity</b>	-1.79938	-3.6105	-2.9390	-2.6080	-8.2180***	-3.6156	-2.9411	-2.6091	I(1)
<b>HCE</b>	0.2952	-3.6156	-2.9411	-2.6091	-8.9190***	-3.6156	-2.9411	-2.6091	I(1)

Source: Data Analysis, 2022, HCE = Household Consumption Expenditure \*\*\* Significant at 1%

**Results of Co-Integration Test**

Engle and Granger (1987) stated that regressing non-stationary series on another non-stationary series can lead to spurious regression. However, if the linear combination of the series is stationary, it indicates that the variables are co-integrated, and the regression relationship is no longer spurious. Co-integration implies the existence of a long-run association between variables. Given that the variables in this study are non-stationary, it is crucial to test for co-integration.

The analysis conducted using both Trace and Maximum Eigen statistics indicates the

presence of one co-integrating equation among the variables. This suggests that there is a single long-run linear relationship or co-integrating equation among these variables. The results presented in Table 3 demonstrate that the computed trace statistics (75.94753) exceed the critical value at the 0.05 significance level (69.81889). Similarly, the Maximum Eigen value (39.25469) is also greater than the critical value (33.87687) at the 0.05 significance level. Therefore, we can conclude that co-integration exists among the variables, indicating the presence of a long-run relationship between energy consumption and household consumption expenditure.

**Table 3: Johansen Co-Integration Test for Unrestricted Co-integration Rank Test**

Trace				
Hypothesised No. of CE(S)	Eigenvalue	Trace Statistics	0.05 Critical Value	Prob**
None*	0.644069	75.94753	69.81889	0.0149
At Most 1	0.431598	36.69284	47.85613	0.3622
At Most 2	0.206954	15.22562	29.79707	0.7653
At Most 3	0.149521	6.414427	15.49471	0.6465
At Most 4	0.006822	0.260116	3.841466	0.6100
Maximum Eigenvalue				
Hypothesised No. of CE(S)	Eigen value	Max-Eigen Statistics	0.05 Critical Value	Prob**
None*	0.644069	39.25469	33.87687	0.0104
At Most 1	0.431598	21.46722	27.58434	0.2490
At Most 2	0.206954	8.811197	21.13162	0.8474
At Most 3	0.149521	6.154311	14.26460	0.5935
At Most 4	0.006822	0.260116	3.841466	0.6100

Trace test indicates 1 co-integrating eqn(s) at the 0.05 level

Source: Data Analysis, 2022.

### Long and short run Effects of Energy Consumption on Household Consumption Expenditure

Based on the presence of one co-integrating equation, indicating a long-run relationship among the variables, the Vector Error Correction Model (VECM) was estimated to examine the short-run and long-run effects of energy consumption on household consumption expenditure in Nigeria.

In the long run, the results from the VECM (Table 5) revealed that fuel wood consumption had a positive and statistically significant coefficient (40.443) at the 1% level. This suggests that a unit increase in fuel wood consumption would lead to a 40.443 unit increase in household consumption expenditure. This positive relationship indicates that, households that use more fuel wood for various purposes (such as cooking, heating, etc.) tend to have higher overall spending. The potential reasons for this positive relationship could include the fact that fuel wood consumption might be associated with larger household size (more people to support), a higher need for energy (related to economic activities or climate), or absence of other energy sources. On the other hand, charcoal consumption showed a negative and statistically significant coefficient (-16.384) at the 1% level. This implies that a unit increase in charcoal consumption would result in a decrease of 16.384 units in household consumption expenditure, all else being equal. This negative relationship between charcoal consumption and household spending suggests that, higher charcoal usage is associated with lower overall household consumption expenditure. This can be attributed to the fact that households with lower overall income levels or in more economically constrained situations might rely more heavily on charcoal due to its potentially lower cost compared to other energy sources. Alternatively, it might be related to the environmental context, where charcoal could be more accessible but less efficient or effective than other energy sources. Additionally, electricity consumption had a positive and statistically significant coefficient (1.557) at the 5% level. This indicates that a unit increase in electricity consumption would lead to a 1.557 unit increase in household

consumption expenditure. This positive relationship suggests that, higher electricity consumption is associated with higher overall household consumption expenditure. This finding aligns with the general understanding that access to electricity often leads to improved quality of life, increased economic activities, and enhanced living standards. Households with greater access to electricity are likely to use it for various purposes, including lighting, heating, cooling, and powering appliances, which can contribute to a more comfortable and productive lifestyle. These findings support the existence of a long-run effect of energy consumption on household consumption expenditure, which aligns with the observations of Wang *et al.* (2011) and Oyedepo (2012) regarding the significant role of the household sector in energy usage, particularly in Nigeria.

The short-run results indicated that the coefficient of fuel wood consumption (2.670) was positive and significant at the 1% level. This implies that an increase in fuel wood consumption would lead to a 2.670 unit increase in household consumption expenditure in the second lag period. Similarly, electricity consumption had a positive and statistically significant coefficient (0.258) at the 1% level, indicating that an increase in electricity consumption would result in a 0.258 unit increase in household consumption expenditure in the first lagged period. The research result implies that households with greater electricity consumption tend to be more economically active, potentially having a higher income to afford electricity usage, and may have a lifestyle that requires more energy-intensive activities or appliances. These results which corroborates the findings of Shuaibu, Shafiu, and Ibrahim (2020) who observed a positive relationship between energy consumption and household consumption.

Moreover, the short-run results revealed that the Error Correction Term [ECT (-1)] was statistically significant and negative (-0.205), suggesting a slow speed of adjustment. This means that approximately 20.5% of the deviation from the long-run equilibrium is corrected within a year. Additionally, the coefficient of determination ( $R^2$ ) was found to be 58%, indicating that the independent variables explained 58% of the variations in the

dependent variable. This  $R^2$  suggests a reasonable goodness of fit for the model.

**Table 6. The Vector Error Correction Model of Long and Short-run Effects of Energy Consumption on Household Consumption Expenditure in Nigeria**

Long run		Estimates			
<b>Regressors</b>	<b>CointEq1</b>				
HCE (-1)	1				
Fuelwood (-1)	40.443 (3.974***)				
Charcoal (-1)	-16.384(-4.108***)				
Electricity (-1)	1.557 (2.462**)				
Constant	-516.718				
Short run		Estimates			
ECM	HCE	Fuelwood	Charcoal	Electricity	
CointEq1	-0.205 (-2.068**)	-0.011 (-1.661)	-0.011(-1.183)	-0.147 (-2.048**)	
$\Delta$ HCE (-1)	-0.151 (-0.839)	0.005 (0.448)	0.019 (1.192)	0.379 (2.905***)	
$\Delta$ HCE (-2)	0.122 (0.604)	0.007 (0.540)	-0.016 (-0.875)	0.302 (2.060**)	
$\Delta$ Fuelwood (-1)	6.401 (1.177)	0.547 (1.566)	0.532 (1.058)	3.739 (0.948)	
$\Delta$ Fuelwood (-2)	2.670 (3.472***)	0.034 (0.094)	-0.203 (-0.388)	5.886 (1.435)	
$\Delta$ Charcoal (-1)	-4.022 (-1.049)	-0.144 (-0.585)	0.109 (0.310)	-4.957 (-1.782)	
$\Delta$ Charcoal (-2)	-2.506 (-0.704)	-0.003 (-0.015)	0.190 (0.578)	-1.731 (-0.671)	
$\Delta$ Electricity (-1)	0.258 (3.084***)	0.033 (2.159**)	0.058 (2.623**)	-0.329 (-1.911*)	
$\Delta$ Electricity (-2)	-0.041 (-0.199)	0.007 (0.540)	-0.002 (-0.098)	0.033 (0.223)	
Constant	0.145 (1.702)	0.006 (1.189)	0.015 (1.882)	0.085 (1.382)	
$R^2$	0.58	0.352	0.443	0.497	
Adj. $R^2$	0.54	0.136	0.357	0.329	
F Statistics	3.165	1.632	2.387	2.961	
Sum sq. resids	0.446	0.002	0.004	0.235	
S.E. equation	0.129	0.008	0.012	0.093	
Mean dependent	0.045	0.009	0.028	0.015	
S.D. dependent	0.131	0.009	0.014	0.114	
Likelihood	339.4519	AIC -15.97037	SC -14.05469		

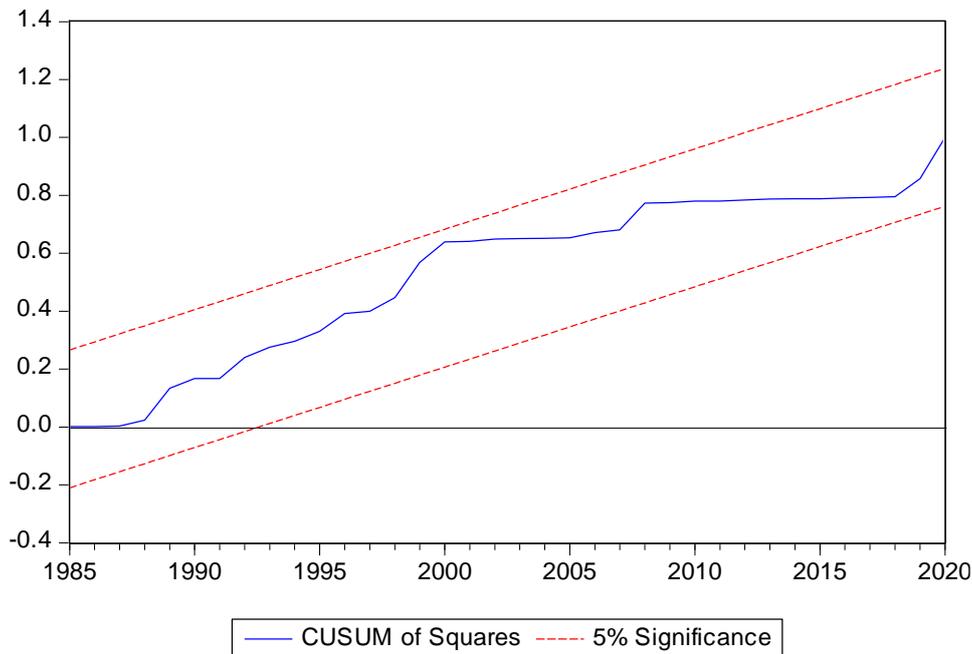
Figures in parentheses are t-values, \*\*significant at 5%, \*\*\*significant at 1%

Source: Data Analysis, 2022

### Stability Diagnostics Test

Figure 1 shows the results of a CUSUM of squares test conducted to assess the stability of the model. The model is statistically stable and

can be used for policy direction because the gridline is perfectly between the 95% confidence interval. Therefore, the model is stable and can be used for economic inference.



**Figure 1. CUSUM of squares test**

Source: Data Analysis, 2022

### Conclusion

The study assessed the impact of energy consumption on household consumption expenditure. The study revealed that household consumption expenditure is significantly influenced by fuel wood consumption, charcoal consumption and electricity consumption in both in the long and short long period which indicated the existence of long run effect of these energy consumption on household consumption expenditure.

### Recommendations

The study therefore recommends that:

- i. Promoting welfare policies aimed at enhancing living standards and per capita income should be a priority across all levels of government. It is crucial to give special attention to the welfare of farmers in rural and semi-urban areas, as this will

have a significant impact on their long-term household consumption expenditure.

- ii. For effective discouragement of deforestation and desertification, efforts should be made to enhance household purchasing power by implementing initiatives that can effectively increase income levels. These schemes should aim to encourage the use of easily accessible and durable energy sources, thereby promoting sustainable energy consumption practices.
- iii. Since there is a positive relationship between energy consumption and household consumption expenditure, government should subsidize the prices of modern energy sources like electricity tariff which will help farming households in saving sufficient finance which will be invested in agricultural production.

### References

Central Intelligence Agency (CIA) (2009); The World Fact Book; available online at <https://www.cia.gov/library/publications/the-world-factbook/goes/ni.html>

Council for Renewable Energy, Nigeria (CREN), (2009); Nigeria Electricity Crunch, retrieved on 21/10/2021; available at [www.renewablenigeria.org](http://www.renewablenigeria.org)

Daily fuel consumption jumps to 72 million litres, subsidy hits N541.66bn. punch news. 23/09/2021. Retrieved from: <https://www.punchng.com>

Danlami, A.H., and Islam, R., (2020); Explorative Analysis of Household Energy Consumption in Bauchi State, Nigeria. Energy efficiency and sustainable lighting, Chapter 4: 764-

780. Retrieved from:  
<https://www.intechopen.com/chapters/69542>
- Energy Commission of Nigeria (2021): The Nigeria Energy Market Report, 2021.
- Engel, R, F, and Granger, C.W., (1987); Cointegration and Error Correction; Representation, Estimation and Testing; *Econometrica*, 55(2):251-276
- Famuyide, O. O., Anamayi, S.E., Usman, J.M., (2011); energy resources' pricing policy and its implications on forestry and environmental policy implementation in Nigeria; *continental journal of sustainable development*, 2(1): 1-7
- National Bureau of Statistics (2021); Nigerian Gross Domestic Product report (Expenditure and Income Approach), retrieved from:  
<https://www.google.com/amp/s/nairametrics.com>
- Okon, U. E., Solomon, U. U. and David, I. S. (2022). Evaluation of Households cooking energy choice decisions in Akwa Ibom State of Nigeria. *Journal of Agripreneurship and Sustainable Development*; 5 (1):259- 269
- Oyedepo, O., (2012); energy and sustainable development in Nigeria: the way forward, *Energy Sustain Soc.* 2(1):15-28. Retrieved on 26/9/2021; from:  
<https://doi.org/10.1186/2192-0567-2-15>
- Shuaibu M., Shafiu I. A., and Ibrahim M., (2020); Do Energy Consumption, Interest Rate and Import affect Household Consumption in Nigeria: What the Empirical Evidence says? *Lapai Journal of Economics*; 4(2):45-88.
- Wang, Z., Zhang, B., Yin, J., Zhang, Y., (2011); determinants and policy implication of household electricity saving behaviour: Evidence from Beijing China; *Energy Policy* 39(1); 3550-3557.
- [www.statista.com/statistics/382264/total-population-of-nigeria/](http://www.statista.com/statistics/382264/total-population-of-nigeria/) accessed 13<sup>th</sup> September, 2022