



Petroleum fuel use and its effect on farm household consumption expenditure: Evidence from Nigeria

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Abstract

Persistent petroleum fuel crisis in Nigeria is hurting consumption and welfare of households. The burden of the crisis is more precarious in the rural area since the rural households purchase the fuel at prices far above the official pump price. Therefore, the study examined socioeconomic determinants and effects of petroleum fuel use on per capita consumption expenditure among the farm households in Nigeria based on the 2020-2019 General Household Survey data obtained from the National Bureau of Statistics. The study used descriptive statistics, random and fixed effect regression model. Three factors significantly influenced per capita consumption expenditure among the farm households. These are cost of petroleum fuel consumed, productivity per hectare attained and household size. The results of the study should serve as an invaluable guide to the Nigerian government and policy makers to ensure farm households have adequate access to petroleum fuels. Suggested policy measures included targeted petroleum fuel subsidy, rejuvenation of domestic petroleum refineries and improved access of farm households to credit facilities to enable adequate use of fuels for farm mechanisation in their production and processing activities.

Keywords: petroleum fuel, farm household, consumption, and expenditure

Introduction

Nigeria is one of the major oil-exporting countries, and is richly endowed with petroleum resources which provide many households with modern energy sources such as kerosene, gasoline and diesel for their use. The country's fast growing petroleum fuel consumption at an average of 3 per cent per annual rate over the past twenty years has made her a net fuel importer (Nkang, 2018) ^[16]. In the last twenty-five years, fuel consumption has increased faster than production which has led to importation to cover the excess demand. The petroleum industry in Nigeria has brought unprecedented changes to the Nigerian economy, particularly in the past five decades when it replaced agriculture as the cornerstone of the Nigerian economy. The oil industry has risen to the commanding heights of the Nigerian economy, accounting for the bulk of federal government revenue and foreign exchange earnings since early 1970s (Oni, 2009) ^[22].

However, according to National Bureau of Statistics (NBS 2022), 63 percent of Nigerian population, about 133 million, are multi-dimensionally poor. Over 50 per cent of the population who are multidimensionally poor cook with dung, wood or charcoal, rather than cleaner energy. Multidimensional poverty is higher in rural areas, where 72per cent of people are poor, compared to 42per cent of people in urban areas. About 70per cent of Nigeria's population live in rural areas, yet these areas are home to 80 per cent of poor people. Nigeria ranks very low among nations with poor living standards in the world. Despite being among the ten largest exporters of crude petroleum in the world, a large proportion of the country's population live in poverty.

In Nigeria like other African countries, petroleum fuel is attracting attention in socioeconomic and environmental issue for government and policymakers (Foluso *et al* 2020)

^[10]. In spite of enormous efforts to improve energy supply in Nigeria, power supply has remained a serious obstacle to production and income generation. The United Nations Sustainable Development Goal is linked to quality energy use by a household to achieve improved livelihood and living standard. However, two out of every three households in Africa are underprovided with access to appropriate, effective and dependable energy source needed for socioeconomic activities. In Nigeria, rising prices of petroleum fuels and their erratic supply have compelled many households to depend on energy sources such as charcoal, firewood, dung, candles and kerosene.

Farming households in the rural sector have relied on the use of petroleum fuels to power their farm machinery, household gadgets, generators, vehicles and motorcycles as means of transportation. Notwithstanding the widespread use, petroleum fuel is unaffordable and makes business operation expensive, increases production cost, and prices of outputs (Tuttle and Beatty, 2017) ^[25]. Price of petroleum fuel such as kerosene, petrol and gas are much higher in the rural areas than the urban centres (Foluso *et al* 2020) ^[10]. Consequently, rising cost of petroleum fuel as alternative source of energy in the rural areas aggravates poverty among the rural farm households given that substantial household expenditure goes to the purchase of petroleum fuels. Rising cost of the fuels in both the rural and urban often reduce household access and affordability of other food and non-food consumption. The burden of rising cost of fuel is more precarious in the rural area since the rural households purchase the fuel at prices far above the official pump price.

Generally, household's welfare can be greatly affected by increase in cost of petroleum fuels. Households with low income especially in the rural areas that engage primarily in farm production has been found to be more vulnerable to

poor consumption expenditure due to fuel price hike in Nigeria (Oluwatayo and Alagbe 2015) ^[20, 21]. As demand for energy products are inelastic, that is increase in price does not proportionally imply a reduction in the quantity of petroleum fuels purchased. Households tend to reallocate their income from other household expenditure in order to maintain a constant level of petroleum fuel's consumption in the short run (Beatty *et al* 2021). This unexpected effect is mostly seen in low-income households in developing countries where a greater population depends on agriculture for survival

With the high incidence of poverty in Nigeria, it is important to know factors influencing consumption of petroleum fuel among the farm households and the effects of petroleum fuel consumption on the household's per capita expenditure in the country (Tuttle and Beatty, 2017 ^[25]). Studies on the effects of petroleum use on per capita consumption expenditure among the rural households in Nigeria are scanty. This partly underscores the motivation for this study. This study therefore aims to lay empirical evidence on the socioeconomic factors influencing the consumption of petroleum fuel and the effects of fuel use on the per capita consumption expenditure among the farm households in Nigeria. The study attempts to answer the following research questions. What socioeconomic factors influenced petroleum fuel consumption among the farm households? What is the marginal effects of petroleum fuel use on per capita consumption expenditure among the farm households? The rest of the paper is organised as follows. Section 2 contains literature review while section three focuses on the research methodology and data. Section four presents the results and discussion while section 5 concludes.

Literature Review

Scholars have come up with different theories of consumption of energy resources. Two major theories that offer a sound understanding of fuel consumption in literature are energy ladder and fuel stacking. The two theories help to characterise personal decisions and behaviours as well as public welfare on fuel use. Energy ladder is one of the early theories which posits that an increase in income gives rise to change from unclean energy consumption to clean energy use. For instance, Foluso Osunkwo *et al* (2020) ^[10], Toole (2015); pointed out that energy ladder is built on the foundation of the ranked relationship between the choice of decent energy use with an increase in economic status. This presupposes that the increase in income of a household usually leads to the choice of superior goods to inferior ones. This is in agreement with the concept of economic rationality and utility maximization. High income is seen as positively related to the level of consumption of fuels. Literature such as Prabhakar *et al* 2021, Christophe Muller and Huijie Yan 2018 have criticized the energy ladder theory on the grounds that it cannot adequately describe the dynamics of households' fuel use. Instead, they noted that fuel stacking is common in both urban and rural areas of developing countries. Fuel stacking is the concept of multiple fuel use or use of a combination of fuels.

Fuel stacking suggests a household will only partly switch to a different fuel or that they will accumulate and continue to use multiple fuels. In effect, households will rely on traditional fuels for certain activities in addition to adopting

modern fuels. Fuel stacking occurs due to three major factors; high cost of modern energy sources; cultural preferences, including familiarity with existing fuel; and to avoid total dependence on one fuel that may be a manifestation of price and supply vulnerability (Foluso *et al* 2020) ^[10].

Therefore, in rural areas there is a practice of using a portfolio of fuels. Underlying the concept of fuel stacking are various decision-making processes that lead a household to both switch and use multiple fuels. In recent time, more refined agricultural household model was proposed to explain fuel use among the farm households. Agricultural household theory specified that in the absence of market failure, a rural household may be seen as behaving firstly as a profit maximizing producer and then as a utility maximizing consumer given the profit realized in the first stage. Instead, under market failure, the allocation decisions for production and consumption are made jointly in a non-separable fashion. In this case, the diverse rural household's decisions relating to petroleum fuel supply and consumption are made simultaneously (Christophe Muller and Huijie Yan, 2016). In this framework, rural households are modelled as maximizing utility subject to leisure and budget constraints, and an agricultural production function. In a non-separable agricultural household theory, fuel use decision may thus be seen as guided by the household-specific and community characteristics associated with all constraints and preferences (Ogunsola and Tipoy, 2022) ^[18]. Habanabakize (2021) ^[13] employed quarterly time series data from 2002 to 2020 to analyze the responsiveness of household consumption expenditure to the petrol price, disposable income and exchange rate volatility in South Africa. This was a macro-level analysis that ignored the empirical analysis at the farm household's level. The study employed Augmented Dickey-Fuller (ADF) test, autoregressive distributed lag (ARDL) model and bounds testing process to establish the relationship between household expenditure and petrol price. Results shows that although positive, changes in petrol price had no significant effect on short-term consumption expenditure of households in South Africa (SA). It is recommended that policies that will improve production and creates job be incorporated as a strengthening mechanism. Tuttle *et al.*, (2017) evaluated the effects of energy price shocks on household food security in low-income households in United State using time series data (2000-2014). Findings reveal that an unexpected rise in the prices of gasoline, natural gas, and electricity increases the probability of food access problems by 0.012per cent, while an unexpected drop in the price of each energy source decreases the probability by 0.002per cent. The study also ascertained that low-income households are more vulnerable to unexpected jumps in energy prices than households with higher incomes. Bhuvandas and Gundimeda (2020) ^[6] assessed the welfare impacts of transport fuel price change on India Households using a cross sectional data from National Sample Survey Organization (NSSO) 2011-2012. The study employed the Almost Ideal Demand System involving two stages (fuel expenditure function and Linear Approximate-AIDS model) and seemingly unrelated regression (SUR). Findings reveal that price of kerosene has a negative effect on household expenditure in India across different income levels (low, medium and high- income households). The study suggests the use of cleaner energy and the use of public transport in order to cut cost and

increase household expenditure. Nwoko *et al.* (2016) [17] studied the effect of oil price on Nigeria’s food price volatility using time series data from 2000 to 2013. The price volatility for each crop was obtained using Generalized Autoregressive Conditional Heteroscedasticity while the vector autoregression (VAR) was used to investigate the relationship between oil price and food price. Results shows that increase in oil price has a positive effect on food price which in turn reduces the amount spent on consumption. The study recommends a control on fuel pump prices and the use of alternative energy source to reduce food price in the country.

From the above review of literature, most previous studies concentrated on aggregate macroeconomy. Indigenous studies in this regard such as (Nkang, 2018; Aniekan *et al.* 2018; Nwoko *et al.* 2016) [16, 2, 17] among others, have neglected the farm household level analysis in their work. Thus, this study filled up this gap by providing empirical evidence from Nigeria on the effect of petroleum fuel use on farm households consumption expenditure. Therefore, an analysis of the socioeconomic factors that influence petroleum fuel use and the effect on farm household consumption expenditure is necessary for policy to address poverty and pollution that are linked to household consumption of fuels.

Methodology and Data.

1. Methodology

Petroleum fuel use among the farm household could be best described by the theory of agricultural household production and consumption. This is because it considers resources from household and market. For any production cycle, the household is assumed to maximize utility. The theory according to Becker (1965) [5] and Singh *et al.* (1986) [23] assumes that household acts as a unified unit of production and consumption which aims to maximize utility subject to its production function, income and total time constraint. The household’s utility maximization function is given as:

$$U_{max} = u(C_m, C_r, C_l; Z) \dots \dots \dots (1)$$

Where U is a well-behaved utility function that is increasing and twice differentiable; C_l is the leisure time; C_m is purchased goods from the market (including petroleum fuel); C_r is the retained household’s staple food for consumption and Z is a vector of household demographic characteristics which influence preference of households in their utility maximization. These include farmer’s age, household size, education, land size, remittances, and wealth. The fundamental hypothesis is that a rational consumer will always chose the most preferred bundle from a set of feasible alternatives (Ogwumike *et al.*, 2014). Most households make their decisions on the use of fuel based on

some factors, quantitative or qualitative, economic or non-economic, cultural, individual and psychological. On the basis of the foregoing theoretical foundation, the empirical model for estimating factors influencing petroleum fuel consumption is given as:

$$P_{it} = \theta_{it} + \alpha D_{it} + \mu_{it} + \varepsilon_{it} \dots \dots \dots (2)$$

Where P is the amount spent on fuel, θ is the intercept for each household, D is the demographic and socioeconomic characteristics of i^{th} household at time t , α are the vectors of parameters that were estimated, μ is the error terms between households, ε is the error term within households. The vector of household and community characteristics mainly demographic and socioeconomic household characteristics includes the education, age, gender, of household head, sex of household head, marital status, dependency ratio, landholdings, ownership of storage facilities, ownership of mobile phone, household size, access to extension services, access to remittances, access to credit, household income and geographical zones, and ε_{it} is the error term.

Further, the empirical model for evaluating effect of petroleum fuel on per capita consumption expenditure is given as:

$$H_{exp} = \varphi_{it} + \alpha 1 D_{it} + \alpha 2 P_{it} + \alpha 3 Agric_{pro} + \varepsilon_{it} \dots \dots \dots (3)$$

Where, H_{exp} is the household per capita consumption expenditure. P_{it} is the amount spent on fuel, D_{it} is the demographic and socioeconomic characteristics of household. $Agric_{pro}$ is agricultural productivity per hectare. Random effect model in equation (2) was used to assess the factors that determines fuel consumption among farming households in Nigeria. This model was selected on the premise that the variation in fuel consumption across households is assumed to be random and uncorrelated with the predictor or independent variables included in the model (Greene, 2008). Another rationale is that time invariant variables (those that do not change over time) such as gender, ethnicity can be included in the RE model. Fixed effect model in equation (3) was used to evaluate the effects of petroleum fuel use on the household per capita consumption expenditure. Although the random effect was also estimated and the lead equation was chosen by applying the Hausman test for selecting the most robust outcome.

2. A Priori Expectations of the Signs of the Coefficients of Explanatory Variables in equations (2) and (3) of the specified Model.

The theoretical expectations of the model in equations 2 and 3 is summarised in Table 3.2

Table 1: Theoretical Expectations of Signs of the Coefficients of Variables in the specified models.

A priori Expectations: (Positive (+) or Negative (-) for Factors Influencing Consumption of Petroleum Fuels in equation (2)		A priori Expectations: Positive (+) or Negative (-) of Effects of Petroleum Fuel Use on Household Real Per Capita Consumption Expenditure in equation (3)	
Household size	+	Real cost of petroleum fuels consumption	+
Sex of the household head	+ or -	Real value of output per hectare	+
Age of the household head	+ or -	Household size	+ or -
Years of education	+	Sex of household head	+ or -
Access to extension service	+	Age of household head	+ or -
Access to remittances	+	Years of education	+

Access to credit	+	Access to extension service	+
Area harvested	+	Access to remittances	+
Use of machinery	+	Access to credit	+
Access to mobile phone	+		
Ownership of generator	+		
Ownership of refrigerator	+		
Ownership of vehicle	+		

3. Data

Secondary data were used in this study. The underlying data is the General Household Survey-Panel (GHS-Panel data) collected by National Bureau of Statistics in conjunction with the Federal Ministry of Agriculture and Rural Development (FMA&RD). The rural segment of the data that spanned four waves were used. The first wave of the GHS-Panel was carried out in two visits to the panel households (post-planting visit in August-October 2010 and post-harvest visit in February-April 2011). The second wave of the GHS Panel was carried out in two visits (post-planting visit in September – November 2012 and post-harvest visit in February-April 2013). The third wave was carried out in two visits (post-planting visit in September – November 2015 and post-harvest visit in February-April 2016). The fourth wave was also carried out in two visits (post-planting visit in July - September 2018 and post-harvest visit in January - February 2019). Information were obtained from the same set of households in the four waves. The data included, amount spent on the consumption of three selected petroleum fuels namely gasoline (petrol), diesel and kerosene, household food and non-food expenditure, socioeconomic characteristics of rural farm households, and enterprise characteristics of farm households, output and area planted and harvested of food staples.

Farm household consumption of each of the petroleum fuels was proxied by valued cost of each petroleum fuel, gasoline (petrol), diesel and kerosene, since the volume of each of the petroleum fuels consumed by the farm household was not available. in the four waves of the GHS Panel Data. The nominal value of the annual amount spent on each product which was available was obtained directly from the GHS panel data. In order to obtain real value of each fuel, the nominal value was deflated by inflation rate obtained from the same source. Real value of each fuel consumed was summed up to obtain the aggregated value of petroleum fuels consumed by the farm household.

Output of each agricultural commodity produced by the household was obtained directly from the GHS. Selected agricultural commodities included the major staples essentially cereal grains, legumes, roots and tubers that

constituted the bulk of the major staples produced and consumed by farm households across the geopolitical zones in Nigeria. Value of each agricultural output produced was obtained by the product of the output and the respective producer price obtained directly from the GHS. Values of the agricultural output with respect to the selected commodities were summed up to obtain aggregated values in nominal terms. The nominal value of each agricultural output produced in each wave was deflated by the inflation rate for the respective wave to obtain the real value for each product. Real values for all products were aggregated and divided by land hectare harvested of the selected commodity to obtain the agricultural productivity that was used to proxy agricultural productivity per hectare. All monetary measurements of variables were in their real forms.

Since household infrequently report income with an acceptable degree of accuracy probably due to concerns of taxation, consumption expenditure as opposed to income reflects the achievement of a particular level of welfare or utility by a household (NBS, 2019). Consumption expenditure on food and non-food is given as the monetary value of food and non-food items consumed by the farm households. It included expenditure on food, education, health care, clothing, household items and repairs. All components were calculated and added up for each farm household to obtain nominal consumption expenditure which is adjusted by the inflation rate and the household size to obtain the real per capita food and non-food consumption expenditure of farm household.

Results and Discussion.

1. Socioeconomic Characteristics of Farm Households.

Socioeconomic characteristics of the farm households are important variables that may influence the consumption of petroleum products among the farm households. Gender of a household head is relevant to household entitlement to land and access to farm mechanization which is a function of petroleum fuel consumption. The results presented in the table 4.1 shows that majority of the agricultural households were male-headed. They constitute 84.64 per cent.

Table 2: Socio-economic Characteristics of Rural Farm Households.

Variables	Frequency (n = 2,084)	Percentage (%)
Sex		
Female	320	15.36
Male	1,764	84.64
Age (Years)		
≤ 30	66	3.17
31 – 40	316	15.16
41 – 50	478	22.94
51 – 60	479	22.98
> 60	745	35.75
Mean	55.08	
Marital Status		
Single	394	18.91

Married	1,690	81.09
Formal Education		
None	379	18.19
Primary	1,146	54.99
Secondary	451	21.64
Tertiary	108	5.18
Year of education		
Mean	6.50	
Household size (Persons)		
≤ 5	818	39.25
6 – 10	1,005	48.22
11 – 15	225	10.80
16 – 20	29	1.39
> 20	7	0.34
Average	6.70	
Access to Extension Service		
Yes	236	11.32
Access to Remittance		
Yes	177	8.49
Access to Credit		
Yes	486	23.32
Access to Machineries		
Yes	426	20.44
Access to Phone		
Yes	1,790	85.89
Average farm Size	3.31	

Source: Computed using the 4 waves of the Nigeria GHS panel data

This indicates predominance of males in agricultural production in the rural sector. The larger proportion of males points to the fact that they dominate decision making process that may affect consumption of petroleum fuels among farm households.

Age is an indication of the active working life and ability to access relevant community networks and information on agricultural development issues. It affects the decision-making role of the heads of households within the village community. Age of household head may be an important determinant of age distribution of other household members. The younger the head of household the more probable the high dependency burden in terms of children and non-workers. The age distribution of the household heads as presented in table 4.1. shows that majority of the farmers belong to the active working age group 31 to 60years. This group constitutes 61.08 per cent of the overall sample. The youth who were within 30 to 40 years constitute 18.33 per cent of the whole sample. The distribution also shows that 35.75 per cent of the farmers were over 60 years of age. The overall pattern of age distribution of the farming households may be an indication that more of the farmers in the working age group may substitute human labour with agricultural machines and machineries in their farming operations. They are more likely to consume petroleum fuels and other purchased inputs such as agrochemicals to enhance their productivity. Note that the average age is 55.08 years which is fragile for farming activities that involve use of crude technology.

With respect to marital status, the results indicate that 81.09 per cent in the rural households were married while 18.91 per cent were single. The substantial proportion of rural households that were married provides opportunity for family labour. Educational Status of the farmers indicate how informed the farmers are likely to be. It also portrays the relative ease of adopting new farming techniques and new livelihood pattern which could positively influence fuel

use. A household with higher level of literacy will be more informed of the use of farm machinery and petroleum fuels in agricultural production. The results show that a large proportion, about 55 per cent of them, had primary education, 22 percent had secondary education, about 5 per cent had tertiary education while 18per cent have no formal education. Overall, the average years of education among the farmers is 6.5 years. The results showed that majority of the farmers have at least six years of formal education. This implies that majority of them can read and write. The literacy level of the farming households indicates that the prospects of farmers adopting new farming techniques and livelihood pattern are high. This could create potential for increased use of petroleum fuels to bring about significant improvement in their agricultural productivity. About 39 per cent of the farmers have small household size. A large household size means increased demand for petroleum fuels for livelihoods and welfare of household members. A larger proportion, about two third of the farmers have household size that is not less than six. Overall, the average household size for the sample is about seven. The farmer with larger household size will have large members in the family and they have the tendency to supply more family labour than the farmer with smaller household size. More food and more non-food items will be needed for consumption in a household with larger members in the family than the household with smaller household members.

In addition, table 4.1 presents other socioeconomic characteristics that could positively impact productivity among the farm households. These included access to extension services, remittance, credit, machineries, tractors as well as access to phones. Extension contact is an important variable that could drive delivery of adequate agricultural information and education to farmers. When such information and education reach the farmers on time it could enhance their capacity to consume more fuels and thus raise their level of productivity required to boost their

farm profitability and farm income. Table 4.1 shows that 11.32 per cent of the rural agricultural households had access to extension services. Majority of the farmers 88.68 per cent lack access to extension services which could deprive them of important information that may be of great help to improve their productivity. This is an indication of weakness of extensions with low coverage of farmers in the rural sector. However, the farmers who have extension contact will be well informed about improved farming techniques and can easily adopt new technologies such as farm mechanization. Application of farm mechanization would lead to consumption of petroleum fuels such as petrol and diesel to power farm machinery to achieve improved farm productivity.

Furthermore, the same table 4.1 revealed that only low proportion, 8.49 per cent, of the farmers have access to remittance while a larger proportion of them, 91.51 percent, had no access to remittance. Remittance from within and outside the country could help those that have access to augment income and savings from farm income. In this way, they would be able to meet their financial needs. This could ultimately lead to improvement in their productivity. Apart from extension contact, agricultural credit is another important variable that could facilitate adoption of high productivity technology such as improved seed, chemical fertilizer, agrochemicals and agricultural machinery which in turn could result into consumption of petroleum fuels and improved productivity.

Table 4.1 shows that about 23 per cent of the farmers have access to credit facilities while 77 per cent do not have access. Those farmers with credit access would have liquidity they require to purchase improved agricultural inputs and consume more petroleum fuels. They would likely undertake investment that are associated with higher yields and increase adoption of new technologies. Also, access to agricultural credit could drive the use of farm machines and plays a fundamental role in determining access to improved farm mechanization which may facilitate farm operations and practices. This could ultimately lead to increased consumption of petroleum fuels and hence increased agricultural productivity. The same table 4.1 shows that about one out of every five farmers have access to agricultural machines while the remaining four do not have access. The farmers that have access are more likely to adopt high productivity technology and participate in processing of agricultural products thereby generating

higher valued products than their counterparts who did not have access to agricultural machines and machineries. Also, table 4.1 shows majority of the farmers, 86 per cent had access to phone in the rural communities while only 14 per cent did not have access to phone. Access to phone could enable farmers get more information. This suggests that farmers who had access to phone could easily access information on production activities, prices of agricultural products and prices of agricultural inputs, as well as prices and availability of petroleum fuels especially during crisis period. Ultimately, this could positively affect their agricultural activities and induce higher productivity. It is also shown in Table 4.1 that average area of land cultivated was 3.31 hectare.

2. Socioeconomic Determinants of Petroleum Fuel Use among Farm Households.

The estimated parameters and the related statistical tests results for the factors influencing petroleum fuel consumption among the farm households are shown in Tables 4.2. As presented in the table, seven variables significantly influenced petroleum product consumption among the rural farm households. These are size of household, years of education, access to remittances, access to credit, access to mobile phone, ownership of generator, and vehicle. The coefficients of the variables have the expected signs and they are statistically significant at 10 per cent or less. The estimated coefficient of household size is positive as expected. The positive sign shows increasing household size will lead to an increase in consumption of petroleum fuels. Marginal effect of 0.026 indicates that a unit change in household size will result in 0.03 increase in the cost of petroleum fuels consumed in the household. The coefficient of years of education is positive and consistent with theoretical expectation indicating that increase in years of education of the head of household will induce an increase in the consumption of petroleum fuels. The magnitude of the marginal effect is 0.017 suggesting that a unit increase in years of education will raise the cost of petroleum fuels consumed by 0.02 per cent. Concerning access to remittance, the sign of its coefficient is positive implying that inflow of remittance to the household will spur an increase in the amount spent on consumption of petroleum fuels. There is also a positive relationship between access to credit and cost of petroleum fuels consumed in the household.

Table 3: Socio-economic Factors Influencing Petroleum Fuels' Consumption

Independent Variables.	Dependent Variable: Log of Real Cost of Petroleum Fuels.			
	Coefficient	Standard Error	Marginal effect	p-value
Household size	0.026***	0.003	0.026	0.000
Sex of the household head	0.014 (0.032)	0.032		0.700
Age of the household head	-0.0004	0.0007		0.615
Years of education	0.0164***	0.002	0.017	0.000
Access to extension service	0.0317	0.036		0.383
Access to remittances	0.0715* (0.043)	0.043	0.074	0.096
Access to credit	0.058**	0.028	0.060	0.037
Area harvested	-4.041e-08 (0.0003)	0.0003		1.000
Use of machinery	-0.024	0.028		-0.393
Access to mobile phone	0.0612*	0.033	0.063	0.060
Ownership of generator	0.09183*** (0.034)	0.034	0.095	0.007
Ownership of refrigerator	0.013	0.038		0.726
Ownership of vehicle	0.147***	0.031	0.158	0.000
Constant	2.481 (.071)		0.953	0.000

<i>Diagnostic results</i>	
Number of observations = 2084	
F (14)= 19.40	
Prob>F = 0.0000	
R-square = 0.85	
Rho = 0.1962	
Hausman test: Chi2 (14) = 268.23; Prob>chi2 =0.0000	

Source: Computed using the 4 waves of the Nigeria GHS panel data

This is plausible because access to agricultural credit could drive the use of farm household productive assets such as vehicles, mobile phones, generator, and motor vehicle. All of these productive assets could enhance the use of new technologies.

Obviously, the results in the same table 4.2 shows that access to mobile phone, ownership of generator, and motor vehicle, all have positive influence on the consumption of petroleum fuels in the farming households suggesting that

an increase in the use of each of these household assets will bring about increase in consumption of petroleum fuels.

3. Effects of Petroleum Fuels’ Use on Farm Household Per Capita Consumption Expenditure.

This section discusses the effects of petroleum fuel consumption on per capita consumption expenditure among the rural farm households. The empirical results presented in table 4.3 show that only three variables have significant effects on real per capita consumption expenditure.

Table 4: Effects of Petroleum Fuels’ Use on Real Per Capita Consumption Expenditure.

Independent Variables	Dependent Variable: Log Real Per Capita Consumption Expenditure.			
	Coefficient.	Standard Error	p-value	Marginal effect
Real Cost of Petroleum Fuels consumption	0.00248*	0.001	0.080	0.002
Real Value of Output per hectare.	0.001**	9.71e-11	0.002	0.001
Household size	-0.057***	0.005	0.001	-0.053
Sex of household head	-0.013	0.037	0.744	
Age of household head	0.006	0.003	0.145	
Years of education	0.001	0.004	0.725	
Access to extension service	0.003	0.054	0.953	
Access to remittances	0.094	0.049	0.158	
Access to credit	-0.007	0.025	0.801	
Constant	2.293	0.123	0.000	
Diagnostic Statistics				
F= 57.31				
Prob>F =0.0000				
Wald Chi ² =229.51				
Prob> Chi ² = 0.0000				
R-Square = 0.66				

Source: Computed using the 4 waves of the Nigeria GHS panel data

These are cost of petroleum fuels, productivity per hectare, and household size. The coefficients of the variables have the expected signs and they are statistically significant at 10 per cent or less. The results conform to the findings by Habanabakize, 2021 ^[13] and Amare *et al* 2016 ^[11]. The estimated effect of cost of petroleum fuels on real per capita consumption expenditure is 0.002 indicating that a one percent increase in the cost of petroleum fuels will bring about 0.002 per cent increase in the real per capita consumption expenditure. This implies that increase in the cost of petroleum fuels will lead to increase real per capita consumption expenditure among rural farm households.

Kerosene is undeniably important for lightening, while petrol and diesel are significant for powering farm machinery as well as for movement of farm products from the farm to the consumers in the urban centres. They are equally important for transportation of farm inputs from the industrial centres to the farms. Moreover, the results in table 4.3 show that productivity per hectare positively affect the real per capita consumption expenditure among the rural farm households. The magnitude of the estimated effect is 0.001 suggesting that a one per cent increase in productivity per hectare will lead to 0.001 per cent increase in real per capita consumption expenditure among the rural farm

household. This suggests that increased farm productivity would spur increased per capita consumption expenditure among the farm households. This underscores the need for increased use of petroleum fuels in farm mechanisation to raise farm productivity per hectare among the farming households in Nigeria. This is plausible because an increase in the value of agricultural output per hectare could spur an increase in the purchasing power of household which could lead to higher per capita consumption expenditure. This is consistent with the finding of Darko *et al* 2018 who found that increase in the value of crop significantly increase per capita expenditure by 0.096 per cent in rural Malawi. Dzanku, 2015 ^[9] also found that increase in value of output per hectare will increase per capita consumption expenditure. In the case of household size, the variable has a negative and significant effect on the real per capita consumption expenditure among the farm households. The magnitude of the effect is -0.053 meaning that a one per cent increase in the size of household will induce -0.05 per cent decrease in the real per capita consumption expenditure. This suggest that increasing household size lead to a decline in real per capita consumption expenditure which could lead to a deterioration of welfare of household member.

Policy Recommendations and Conclusion.

This study focused on socioeconomic determinants of petroleum fuel use and the effects of petroleum fuel use on per capita consumption expenditure of farm households based on a comprehensive and representative household survey data. It has shown that rural farm households in Nigeria chose to consume petroleum fuels on the basis of some socio-economic variables which significantly determined the use of petroleum fuels. These factors are household size, years of education of household head, access to remittances, access to credit, access to mobile phone, ownership of generator, and ownership of vehicle. The study has also shown that three factors significantly affect per capita consumption expenditure of farm households. These are cost of petroleum fuel consumed, productivity per hectare attained by the farm household and the household size. The socioeconomic factors influencing petroleum fuel use should serve as invaluable guide to the government and policy makers in formulation and implementation of policies and strategies that will guarantee optimal access to petroleum fuel by farming households.

Government and policymakers should take adequate steps and actions to ensure that all rural farming households have adequate access to petroleum fuels. Targeted petroleum fuel subsidy should be given to farm households to encourage rural farm households easy access to petroleum fuel particularly to power their farm machines and machinery as well as household gadgets. Government should improve the supply and distribution of petroleum fuel and environmentally friendly energy sources to the rural sector. Efforts should be made by the government by taking appropriate steps to achieve rejuvenation of domestic petroleum refineries to improve domestic production and supply of refined petroleum fuels in Nigeria rather than depending on importation that suffers volatility of exchange rate pricing and the associated domestic shortages that predisposes rural dwellers to suffer pains of petroleum crisis.

Government and policy makers should take appropriate actions to ensure easy access to adequate fuels at affordable prices. Easy access to adequate fuels to power farm machines, machinery, and households' assets and gadgets for productive activities can be facilitated through effective and timely delivery of adequate credit facilities to farming households to encourage increased use of petroleum fuels for farm mechanisation. This is very crucial to improve farm productivity per hectare among farm households. In this way, farm profitability and income as well as purchasing power of the household would be raised. This will help to break the yoke of low productivity, and the vicious cycle of poverty among farm households in Nigeria. This is very important to improve the per capita consumption expenditure of farm households and thus raise the welfare status of the households. Finally, farm households should be enlightened through appropriate education and awareness programme on the need for improved use of family planning method to control household size and keep a small family size. This will help to improve per capita consumption expenditure and welfare of the farm households in Nigeria.

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