Dynamics of food price volatility and households' welfare in Nigeria: implications for post-COVID-19 recovery

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Abstract

One of the most important economic factors in food choice is the price. Its value in food dynamics is a subject of controversies and opinions, especially price issues, and sensitivity is often peculiar to seasons, crisis and market forces. Price dynamics have the potential to introduce and change consumptions, thus affecting household welfare. In this study, we examined the dynamics of food price volatility and households' welfare in Nigeria from 1990: Q1 to 2019: Q4n. . We sourced the data for the study from FAO and the World Bank. We estimated the Quadratic trend equation, Generalized Autoregressive Conditional Heteroscedasticity (GARCH) and Auto-Regressive Distributed Lag (ARDL) models and forecast the changes in food price past COVID-19 pandemic period. Food prices, depth of food deficiency, food import, and food production index had a significant short-run impact on the households' welfare. Policymakers should focus on the short-term benefits while formulating policies aimed at households' welfare. The post-COVID -19 recovery policies aimed at the household level will be impactful in the short-run compared to the long-run.

Keywords: food, price, household, welfare, volatility, pandemic

Introduction

One of the primary goals of economic development in the actual term is to improve household welfare. In Nigeria, although economic indicator based on 2019 reports from both World Bank and African Development Bank shows that she is the largest economy in Africa with a Gross Domestic Product of $446.543 and GDP growth rate of 2.3%, evidence shows that Nigeria has the highest number of poor people in the world, with a majority of the population struggling to survive on less than $2 daily. Poverty has economic and social implications such as productivity, especially food production and price, and household welfare. Nigeria's challenge is complicated because, over the year, there is a gap between food production and population growth, leading to an increase in food prices and the multiplicity of hungry people. Given that Nigeria is a food deficit, and there is an ever-increasing demand for food, market forces play its natural role in price determination, leading to many low-middle-income households spending the most substantial proportion of the income on food; the welfare of households largely depends on the quantity and quality of food consumed. Amongst other welfare indicators such as shelter, health care, education, access to essential utilities like electricity and water are vital, but the food is pivotal in determining individual and household welfare; hence it is at the centre of global Sustainable Development Goals (SDGs). In recent times, global food demand and other uses of agricultural products put pressure on food production, leading to sharp increases in food prices in both global and national markets. The susceptibility of food prices to changes exposes the fragile nature of the global food system. Therefore, how to address this has continued to command the interest of policymakers because food price is an essential aspect of inflation, and inflation affects the consumption expenditure of households. Although

global food commodity price has been on the decline since 2008, in Nigeria, the reverse is the case as food prices have continued to increase (SIFSIA/FAO, 2008; Pinstrup-Andersen, 2015). The continuous rise in food prices has many severe consequences on the welfare of individuals and may lead to food riots, unrest, and crime (Braun, 2008). Although the food price increase is not peculiar to Nigeria like other developing countries (Salman & Adnan, 2013), it has continued to exacerbate due to its population growth. The population's geometric growth has dire consequences on the price of food products, affecting the welfare of households.

The nexus between post-war periods or post-pandemic periods or post-political crisis period and food demand is to hold strong potential for food price volatility. For instance, evidence shows that the Nigerian civil war outbreak in 1967 and resultant agricultural challenges and the food blockade of the region occupied by secessionist Biafra led to food price volatility after the war (Iwuagwu, 2012), resulting in high food insecurity in Southeast Nigeria. With the recent coronavirus pandemic (COVID-19) that has disrupted the livelihood of many households and food supply chains, it has become imperative to study the trend of food prices this period, household welfare, and understand the impact of food prices on households' welfare.

Literature Review

Price volatility changes the price of a commodity, and it measures price changes between specific periods (IFPRI, 2011; FAO et al., 2011). It is also the long-term fluctuations in the trend of food prices (Food Monitor, 2020). Food price volatility refers to the significant, persistent changes in the direction and weight of food prices (FAO, 2011). Food price volatility may not be problematic, mainly when the variation follows a known trend and market conditions. Changes in food prices become an issue of worry when there are distortions in the trend. Such worrisome distortions affect the farmers, value chain actors, and

households. Food price is an essential variable in household income and consumption decisions. Price levels and fluctuations in the price levels of food commodities affect household income and consumption (Diaz-Bonilla, 2016). Food price changes affect economic decisions both at the micro and macro levels. At the macro and micro levels, the agribusiness firms and industry consider the price of food commodities before taking input, demand, and output supply decisions. Agribusiness households are against low food prices that may affect their welfare when income becomes too low to cater to production factors and take care of the households (FAO et al., 2011). Changing political and economic situations such as rural-urban drifts, regional crises, the integration of markets, and pandemics such as the COVID-19 pandemic have disrupted food supply chains, and revealed the cracks in the global food system. Although this disruption is minimal and varies across economies, it encouraged less food production with an attendant increase in food prices because of local logistics challenges and import difficulties. Sub-Saharan Africa is a food deficit region. The food deficit levels in the other countries in Sub-Saharan African countries are severe, and Nigeria will endure if the situation worsens (Ojo & Adebayo, 2012). The population growth rate of 2.6 per cent causes insufficient food (World Bank, 2019). Factors such as the high level of dependence of agriculture on rainfall, a low level of mechanisation, no automation, and small value addition have affected the production of food in Nigeria negatively. The most important crops in Nigeria include rice, cowpeas, beans, wheat, yam, cocoyam, cassava, vegetables, and palm oil with a promising value chain capable of improving households' welfare through job creation and nutrition (PARI, 2015).

According to the National Social Register of Poor and Vulnerable Households (PVHHs) published that 2, 644, 495 households live in poverty with 11, 045, 537 individuals (NSIP, 2020). About 42, 912, 900 households, and 200, 963,600 million people make up the population of Nigeria and thrive on insufficient food (Euromonitor International, 2020). the

statistics imply that 5.5 per cent of the entire Nigerian population live in poverty and vulnerable and can barely afford three portions of food per day. Since Nigeria is a food deficit, and there is an ever-increasing demand for food, the law of supply and demand plays a significant role in food price determination. Food cost takes the most substantial proportion of the income of low to middle-income households; the welfare of households largely depends on the quantity and quality of food consumed with all things being equal. Amongst other welfare indicators such as shelter, health care, education, access to essential utilities like electricity and water, food is pivotal in determining individual and household welfare. The food price hike is a global phenomenon. It occurs because of a convergence of factor– economic, social, and environmental factors and often leads to unimaginable circumstances both at the micro and macro levels. For instance, the world experienced a food price peak in 2008 and 2011 (FAO, 2017; Tadasse et al., 2016), which resulted in violent riots and social unrest in over 33 countries (IFPRI, 2011). The increase in the price of major foods like cereals, meat, and edible oil led to a rise in food price volatility by 30 per cent from 2010 to 2011 (ADB, 2011; Oyinbo & Rekwot, 2014). Other causes are poor market infrastructure, supply chain dynamics, and import restrictions. With Nigeria and other developing economies, inconsistent and inadequate implementation of agricultural policies and corruption are also the causes of food price volatility (Tiri, Ogoh & Ekpa, 2017). Food price volatility is associated with food security, which is very crucial to household welfare. Food price depends on food availability, economic and physical access to food, utilisation of food and food stability (Kalkuhl, von Braun, Torero, 2016; FAO, 1996, 2015). The stability of food price trend is necessary for policies that address extreme poverty, hunger and malnutrition (Kalkuhl et al., 2016). Since 2016 till date, Nigeria has continued to experience significant food price volatility above 20.32 per cent as inflation continue to rise at double digits, leading to an increase of 73 per cent of households spending on staple foods and

beverages (Egwuma, Ojeleye & Adeola, 2017; Onyewuchi, 2016; Egwuma, Ojeleye & Adeola, 2017). There are several indicators to measure household welfare. They include, but limited to, access to essential services and goods such as food, health care, electricity, education, and internet access. Unfortunately, these factors are not a holistic and realistic approach to household welfare determination (Hentschel & Lanjouw, n.d.). Evidence from several studies shows that household welfare is more tested correctly, in terms of household consumption per capita and expenditure, including other measures of wellbeing such as food security and household asset holding (ICRW, 2017; Moratti & Natali, 2012). Household consumption expenditure reflects their welfare status, consumption expenditure reveals the portion of income and return on investments (assets) that the households are willing and able to spend on food, education and basic amenities that make up their welfare. Household consumption expenditure is the approach we have adopted for this study to reflect both global practices while taking cognisance of our local peculiarities.

Agribusiness households are economic entities that make an agricultural investment, production and consumption decisions, and these decisions are instrumental to their welfare (Wang et al., 2017; Moratti & Natali, 2012). As expected, high risk will reflect better economic opportunities that enhance better welfare. Households could make their living from agricultural base livelihood options or not, and this gives households a logical line of demarcation of being agribusiness or not. In this study, we aligned with the opinion of Hentschel & Lanjouw, (n. d) that welfare is the total utility gotten from the consumption of goods and services. Therefore, it is subject to the expenditure capabilities of the household; implying that we may assume households in similar geographical terrain with the same size and composition to have similar consumption expenditure pattern because they share common socioeconomic attributes. Such consumption expenditure approach to household welfare measurement is more realistic and reflects the procedure we adopted for this study.

Materials and Methods

Nigeria is a country in West Africa along the Atlantic Ocean's Gulf of Guinea, and its land borders are with Benin of west Cameroon and Chad to the east and Niger to the North. It is between latitudes 40N and 140N and longitudes 30E and 150E Meridian. We sourced the data for this study from reliable data sources such as the Food and Agriculture Organization database, World Bank Development Indicators, Central Bank of Nigeria's statistical bulletin. The data covered a period of 1990: Q1 to 2019: Q4. We used the generalised Autoregressive Conditional Heteroscedasticity (GARCH) model and the Auto-Regressive Distributed Lag (ARDL) model regression approach for the data analysis

Model Specification

Trend Analysis

$$InAVP = a + b_i + b_i^2 + u_i \quad \ldots 1$$

$$InHHW = a + b_i + b_i^2 + u_i \quad \ldots 2$$

Where:

AVPF = the average price of selected food commodities in Naira

HHW= the Household welfare (Household final consumption expenditure (₦))

a= the constant

b= coefficient of time

ln= Natural log

ui= error term

The Generalised Autoregressive Conditional Heteroskedasticity (GARCH)

Time series data, such as food prices are volatile, heteroscedasticity and leptokurtic (Kenen and Rodrik, 1986, Bailey et al., 1986; Peree and Steinherr, 1989; Cote, 1994; McKenzie and

Brooks, 1997). To address this, we adopt the GARCH model as expressed by Bollerslev (1986).

The standard GARCH (p, q) specification;

$$y_t = a + \sum_{i=1}^{k} \quad n_i x_t - 1\, \varepsilon_t \qquad \ldots 3$$

Where;

y_t= measure of food price volatility at time t,

a= mean,

x_{t-1}= exogenous variables,

ε_t = error term.

$$\delta = \sqrt{\frac{1}{N} \sum_{i=1}^{k} (X_i - \bar{X})} \qquad \ldots 4$$

Where;

δ = variance,

x_i = mean,

ẍ = standard deviation.

$$\delta t^2 = \omega + \sum_{i=1}^{p} ai\, \epsilon_{t-i}^2 + \sum_{i=1}^{q} \beta_i\, \delta_{t-i}^2 \qquad \ldots 5$$

Where;

δt^2 = conditional variance,

p = order of the GARCH,

δ_{t-i}^2 = the GARCH term.

The Auto-Regressive Distributed Lag Model

We estimate the Auto-regressive Distributed Lag (ARDL) model also referred to as bounds testing approach to cointegration in line with Pesaran et al. (2001) to examine the dynamics of food price volatility and household welfare. The ARDL applies on time series data with

the order of integration I (0) and I (1) (i.e. Mixed order of the order of integration) and results in an unbiased long-run estimate, where a long-run relationship exists (Bawa et al., 2016; Udo et al., 2015). We estimated the model as follows.

$$HHW = c_o + \delta_1 HHW_{t-1} + \delta_2 CPIF_{t-1} + \delta_3 AVPF_{t-1} + \delta_4 DFD_{t-1} + \delta_5 ACF_{t-1} + \delta_6 ELE_{t-1} + \delta_7 EMP_{t-1} + \delta_8 FE_{t-1} + \delta_9 FI_{t-1} + \delta_{10} FPI_{t-1} + \sum_{i=1}^{p4} b_1 HHW_{t-1} + \sum_{i=0}^{p} b_2 CPIF_{t-1} + \sum_{i=0}^{p1} b_3 AVPF_{t-1} + \sum_{i=0}^{p4} b_4 DFD_{t-1} + \sum_{i=0}^{p} b_5 ACF_{t-1} + \sum_{i=0}^{p} b_6 ELE_{t-1} + \sum_{i=0}^{p1} b_7 EMP_{t-1} + \sum_{i=0}^{p} b_8 FE_{t-1} + \sum_{i=0}^{p4} b_9 FI_{t-1} + \sum_{i=0}^{p} b_{10} FPI_{t-1} + \varepsilon_t \quad \ldots 6$$

Where δ_i represent the long-run multipliers, co is the constant, bi is the coefficients p is the lag length and t is the error term. We conducted the ARDL bound test following equation (6) to test for the existence of a long-run relationship. We tested the following hypotheses

$H_0=\delta_1=\delta_2=\delta_3=\delta_4=\delta_5=\delta_6=\delta_7=\delta_8=\delta_9=\delta_{10}=0$

$H_a=\delta_1\neq\delta_2\neq\delta_3\neq\delta_4\neq\delta_5\neq\delta_6\neq\delta_7\neq\delta_2\neq\delta_8\neq\delta_9\neq\delta_{10}\neq0$

We made use of the tabulated asymptotic critical valued bound by Pesaran et al. (2001), which provide a test for cointegration with I(0) and I(1) lower and upper boundaries, respectively. If the F-calculated value falls within or equal to the tabulated values it suggests a long-run relationship, otherwise, it implies that only short-run relationships exist. Since there was cointegration among the variables, we estimate the conditional ARDL model.

$$HHW = c_o + \sum_{i=1}^{p4} b_1 HHW_{t-1} + \sum_{i=0}^{p} b_2 CPIF_{t-1} + \sum_{i=0}^{p1} b_3 AVPF_{t-1} + \sum_{i=0}^{p4} b_4 DFD_{t-1} + \sum_{i=0}^{p} b_5 ACF_{t-1} + \sum_{i=0}^{p} b_6 ELE_{t-1} + \sum_{i=0}^{p1} b_7 EMP_{t-1} + \sum_{i=0}^{p} b_8 FE_{t-1} + \sum_{i=0}^{p4} b_9 FI_{t-1} + \sum_{i=0}^{p} b_{10} FPI_{t-1} + \mu_t \quad \ldots 7$$

We got the short-run dynamic parameters by estimating the error correction model

$$\Delta HHW = c_o + \sum_{i=1}^{p4} b_1 \Delta HHW_{t-1} + \sum_{i=0}^{p} b_2 \Delta CPIF_{t-1} + \sum_{i=0}^{p1} b_3 \Delta AVPF_{t-1} + \sum_{i=0}^{p4} b_4 \Delta DFD_{t-1} + \sum_{i=0}^{p} b_5 \Delta ACF_{t-1} + \sum_{i=0}^{p} b_6 \Delta ELE_{t-1} + \sum_{i=0}^{p1} b_7 \Delta EMP_{t-1} + \sum_{i=0}^{p} b_8 \Delta FE_{t-1} + \sum_{i=0}^{p4} b_9 \Delta FI_{t-1} + \sum_{i=0}^{p} b_{10} \Delta FPI_{t-1} + \vartheta ecm_{t-1}$$

…8

Where ECM is the error correction term of equation (6) and ϑ is the speed of adjustment. We define the other symbols in the equations:

HHW= household welfare (Household final consumption expenditure (₦))

CPIF= Consumer Prices, Food Indices

AVPF=average producer price of selected basic food commodities (₦) (i.e. beans, cassava, cocoyam, cowpea, millet, palm oil, rice, vegetables, wheat and yam)

ELE = access to electricity (% of the population in millions)

DFD= depth of food deficiency (kilocalories per person)

ACF = access to cooking fuel (% of the population in millions)

EMP = employment status (% of population in millions)

FPI = food production index (2004-2006=100)

FI = food import (% of merchandise import)

F.E. = food export (% of merchandise export)

Δ= Difference operator

$\sum$ = summation sign

Results and Discussion

Unit root tests results and trend in the price of selected food commodities

We tested the properties of the time-series data used for the analysis. We used Phillips-Peron (1988) test (P.P.) in determining the stationarity of the variables under consideration, and we presented the results in Table 1. The unit root tests revealed that all the variables considered in this study were stationary at first difference

Table 1 Unit root test using Phillips Perron

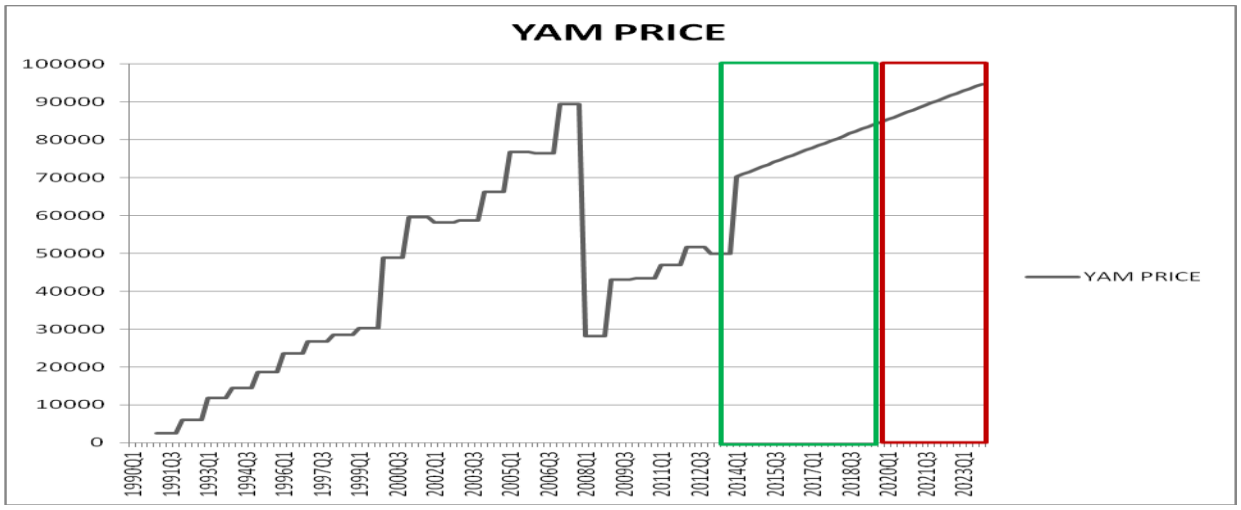
Variables	Level	First difference	Decision
Access to cooking fuel and gas	-1.911024	-10.77033	I(1)
Price of Beans in Naira (per ton)	-2.106437	-10.96121	I(1)
Price of cassava in Naira (per ton)	-1.604460	-10.90058	I(1)
Price of Cocoyam (per ton)	-1.720703	-10.77033	I(1)
Price of Cowpea in Naira (per ton)	-2.125041	-11.52827	I(1)
Depth of food deficiency	-2.146940	-11.24664	I(1)
Access to electricity	-1.300126	-10.79099	I(1)
Employment status	3.984839	-17.21190	I(1)
Food export	-2.663116	-11.47534	I(0), I(1)
Food import	-2.732243	-10.78255	I(0), I(1)
Food production index	-1.413168	-10.78326	I(1)
Household Welfare	-1,575734	-10.81241	I(1)
Price of Millet in Naira (per ton)	-1.897739	-11.40523	I(1)
Price of palm oil in Naira (per ton)	-1.565957	-10.77033	I(1)
Price of rice in Naira (per ton)	-1.757772	-10.93934	I(1)
Price of vegetable in Naira (per ton)	-1.553928	-10.77033	I(1)
Price of wheat in Naira (per ton)	-1.509354	-10.77970	I(1)
Price of yam in Naira (per ton)	-1.586433	-10.81144	I(1)
Consumer Price index(Food indices)	-3.672372	-11.28320	I(0), I(1)

Source: World Bank development indicators and FAO data in various years

From Table 1, the entire test variables for the assessment of food price volatility on the welfare of households in Nigeria were stationary at the first difference based on the P.P. test statistics. One could reject the null hypothesis of nonstationary. The occurrence of unit roots in the data generation preliminarily shows shocks having a permanent or long-lasting effect.

The trend in the prices of selected food commodities in Nigeria from 1990 to 2019

We examined the trend in the price of selected food commodities (yam, rice, cowpea, beans, millet, vegetable, oil palm, cassava, cocoa yam) which are some common food commodities consumed by households in Nigeria and the outcome presented in the figures 1-8.

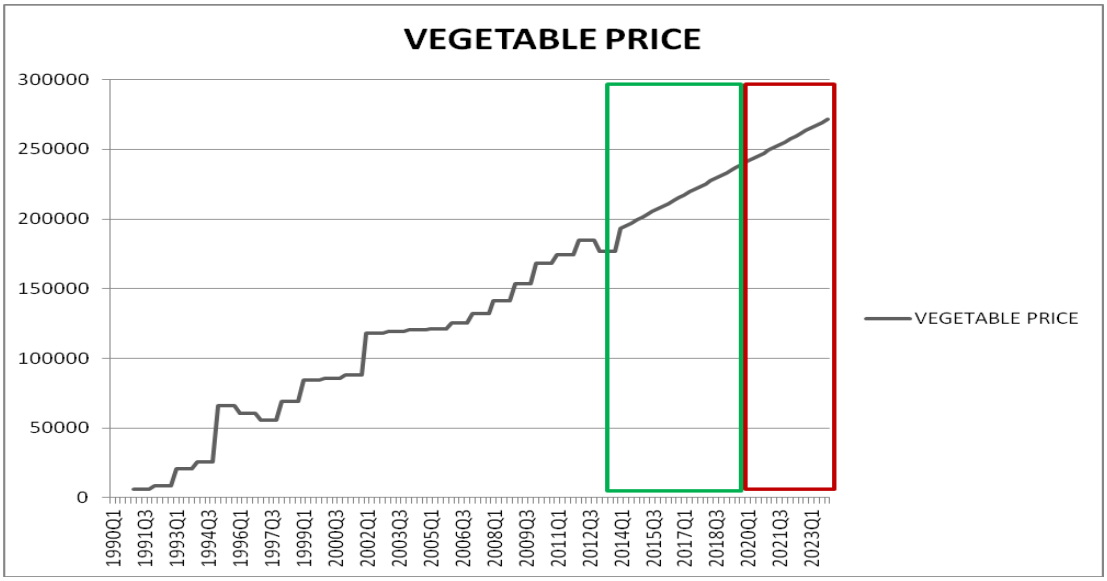


Source: Authors' Analysis Based on FAO, 2020. Note: Portion bounded in green are estimates while portion bounded in red are forecasts

Figure 1: Trend in Yam price in Nigeria

Yam is a tuber crop in all parts of Nigeria. It is a major starchy staple crop for almost all households in Nigeria (IITA, 2020). It has a cultural significance for most tribes in Nigeria, and this may be responsible for the volatility in it, especially during new yam festivals or other yam related festivals. From Figure 1, the prices of yam hit N30,000 per ton from 1991:Q1 to 1999:Q2. This rise in price to N90, 000 in 2008:Q1 and we relate it to the lost in yam reported by Nahaya & Vera (2015). The report detailed the records of lost in yam in Nigeria, which amounted to over 3.7 million tons and showed that yam loss started in 1987 and reduced significantly in 2009. The findings support our findings, as we relate the yam loss to the rise in the price of yam in many local markets across Nigeria, especially the festivity induced hike. Yam lost may have resulted in the shortage of yam supplies in the market and the increase in the price for yam. This supply deficit resulted in the persistent

increase in the price of yam from 1991:Q1 to 2009:Q1. Asante et al., (2007); IITA, (2020) and Nahaya & Vera, (2015) attributed the yam lost to sparse inputs, pests, inadequate preservation, storage and processing). The price decrease of yam experienced from 2009:Q2 was because of the reduction in the quantity of yam lost from 2008 (Nahaya & Vera, 2015). The forecast shows that the price of yam may be above N90,000 per ton by 2023:Q1.



Source: Authors' Analysis Based on FAO, 2020. Note: Portion bounded in green are estimates while portion bounded in red are forecasts
Figure 2: Trend in vegetable price in Nigeria

Location and other demographic variables influence the price of households to pay for vegetables; the household demand for vegetables largely depends on availability and price (Obisesan, 2019). From Figure 2, the trend in the price of vegetables thrived from less than N50,000 per ton in 1991:Q3. By 2002: Q1 the price of vegetables rose to N130, 000 per ton and in 2012:Q3 the price of vegetables grew to N180,000 per ton. The forecast revealed that the prices of vegetables would be above N250,000 per ton by 2023. Bawa et al. (2015) reported that there is a significant difference in the retail/farm gate price of vegetables in the

different regions of Nigeria. This difference in price is because of seasonal variation and climate change. For instance, in the Northern part of Nigeria production of vegetable are very difficult during the wet season because of the higher pest and disease attack, during the wet season vegetables are sufficient in the South and are available at lower prices. The South supplies the needed vegetables to the North during the wet season. During the dry season vegetable price increase in the South because of inadequate irrigation facilities and agriculture that is 95 per cent rain-fed. s The continuous surge in the price of vegetables is because of the seasonality of production and the impact of global warming.

Source: Authors' Analysis Based on FAO, 2020. Note: Portion bounded in green are estimates while portion bounded in red are forecasts

Figure 3: Trend in wheat price in Nigeria

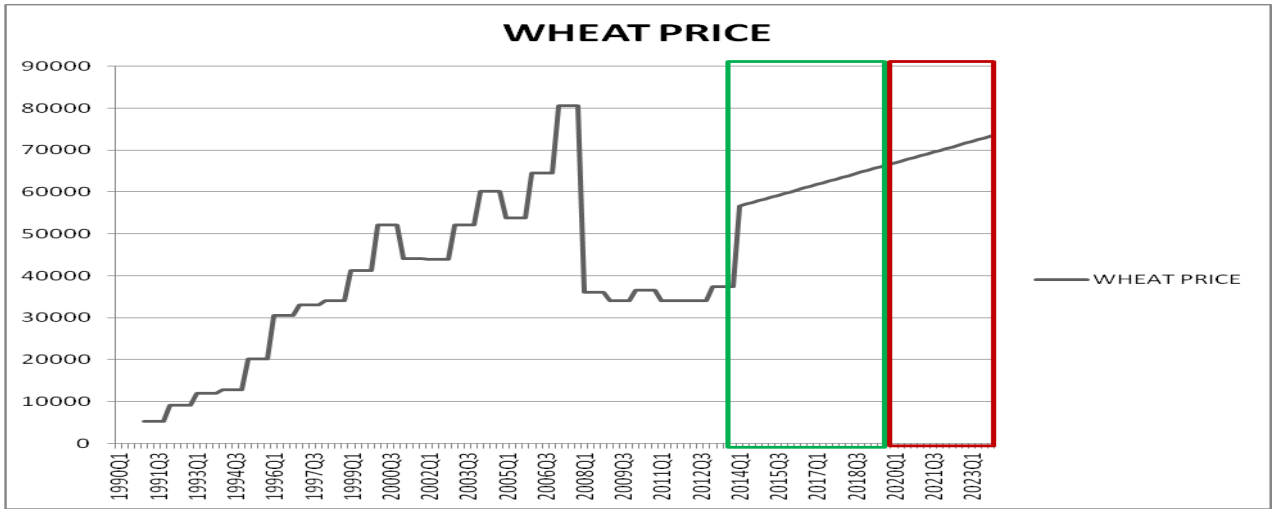
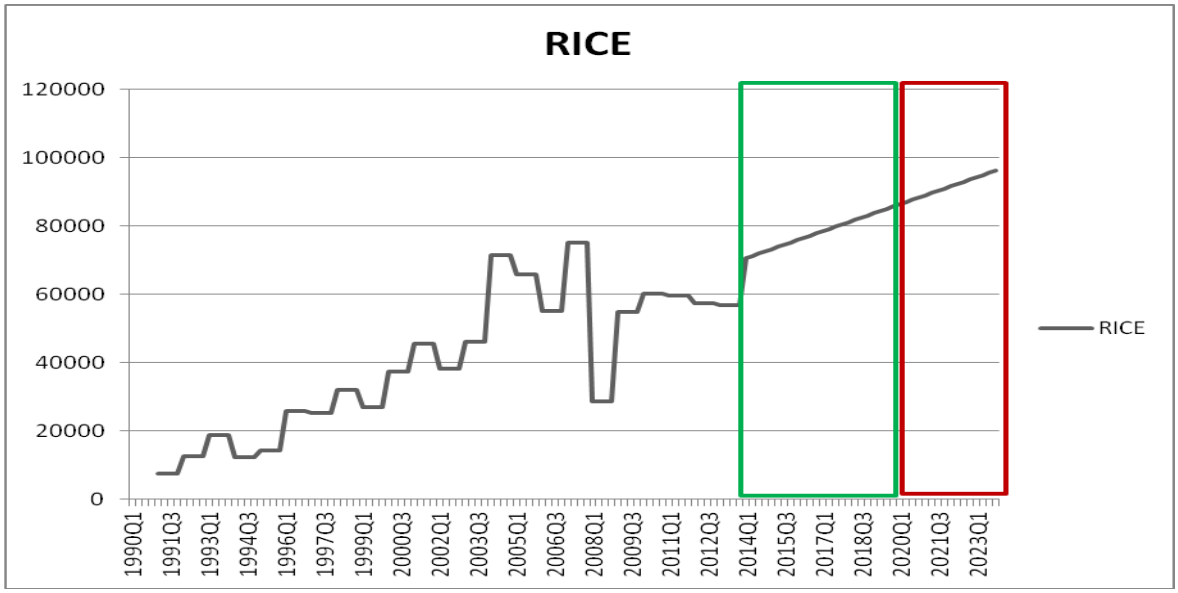


Figure 3 shows growth in the price of wheat from 1993:Q1 at less than N10,000 per ton to above N50,000 per ton in 1999:Q1. The price of wheat was the highest from 2006 to 2008. It increased to N80,000 per ton; this is in tandem with the report of Olamola (2015). In 2009 the importation of wheat rose to 4,000,000 metric tons from 3,000,000 metric tons in 2004 with local production of wheat, increasing above 50,000 metric tons from less than 45,000 metric tons in 2007 (Tradingeconomics, 2020, KPMG, 2016), the price of wheat was relatively stable from 2008 to 2012 below N40,000 per ton. In 2016:Q2 the Wheat Farmers Association and Flour Millers Association agreed to peg the price of wheat at N140, 000 per

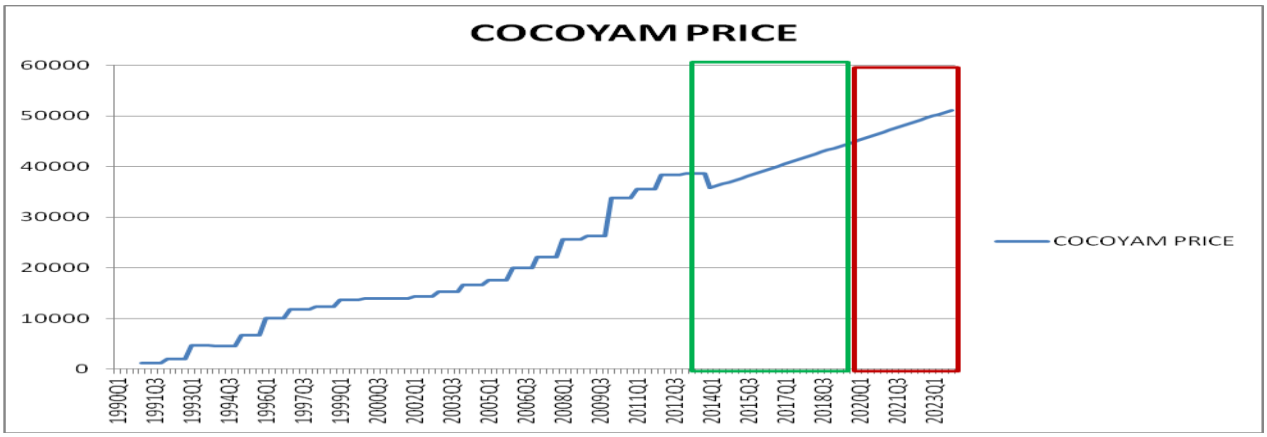
ton and the Wheat Transformation Agenda aim to increase production produced the desired result as the price of wheat was a little above N60,000 per ton (KPMG, 2016; Ohimain, 2014). The forecast section in the red-bound area of Figure 3 shows that the price of wheat may increase above N70, 000 per ton by the first quarter of 2023.



Source: Authors' Analysis Based on FAO, 2020. Note: Portion bounded in green are estimates while portion bounded in red are forecasts
Figure 4: Trend in rice price in Nigeria

Akande & Akpokodje, (2003) observed that rice availability and accessibility had become a significant welfare determinant for poor households in Nigeria, especially as government increase emphasis on local rice consumption and ban in the importation of foreign rice; and this makes the price of rice very important. Figure 4 showed the trend shows that there has been a growth in the price of rice from 1991:Q1 to 2003:Q3. The price of rice was at a peak in 2008:Q1 before taking a nosedive in 2008:Q3. Aina, Ayinde and Folola (2015) reported that the price of rice has been fluctuating from 1995 to 2008 before decreasing significantly in 2011, this is contrary to the report that the price of rice had a positive trend (Mark et al., 2015).

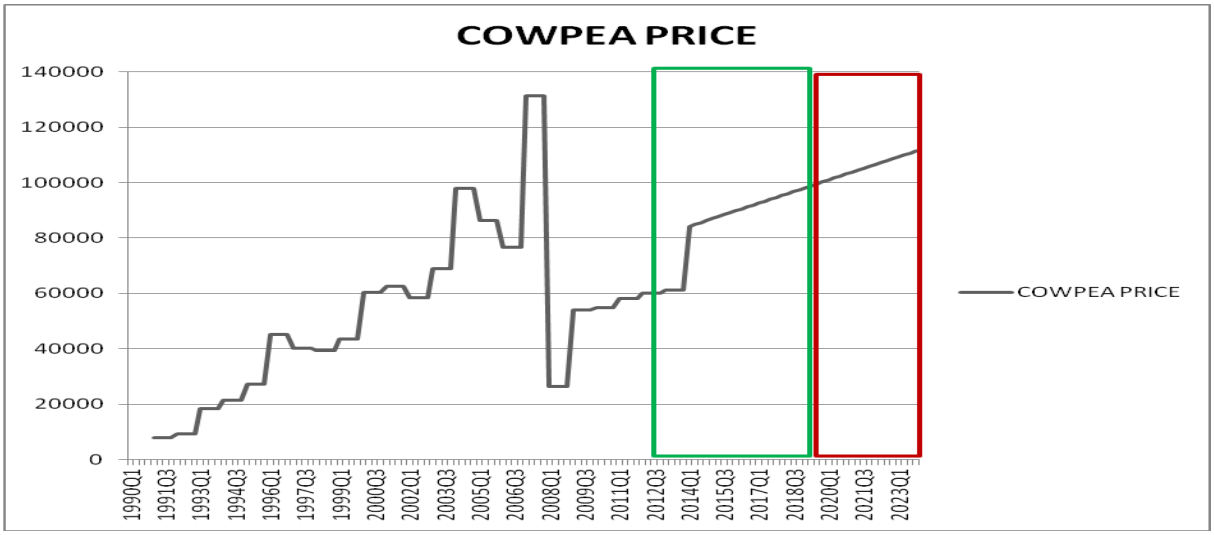
To curb the price increase in 2008, the government introduced the policy of buying up excess rice produced by the farmers to hedge against a sharp rise or fall in the price of rice (Codoni & Angleccu, 2013). Another policy of the federal government aimed at stopping the importation of rice and smuggling of rice into the country (Udumezue, 2018), to encourage the local production of rice and its value chain development yielded a positive result in terms of increased production and processing capacity. However, there was a hike in the price of rice from 015 to 2018. We estimated the price of rice at N80, 000 per ton in 2018, and it may increase closer to N100, 000 per ton by 2023. Nevertheless, Okafor (2019) reported a distinct figure which showed that the actual price of rice in Nigeria was N140, 000 per metric ton in 2019.



Source: Authors' Analysis Based on FAO, 2020. Note: Portion bounded in green are estimates while portion bounded in red are forecasts
Figure 5: Trend in cocoyam price in Nigeria

Evidence shows that Nigeria is the largest producer of cocoyam in the world. Cocoyam is very important in the diet of most households in Nigeria (Nwaobiala and Uchechi, 2016) and has a high market potential because of its nutritional value. Figure 5 presents the trend in the prices of cocoyam. The trend in the price of cocoyam has experienced growth. The price increased from N10, 000 per ton in 1996:Q1 to N30,000 per ton in 2009: Q3. Horton et al.

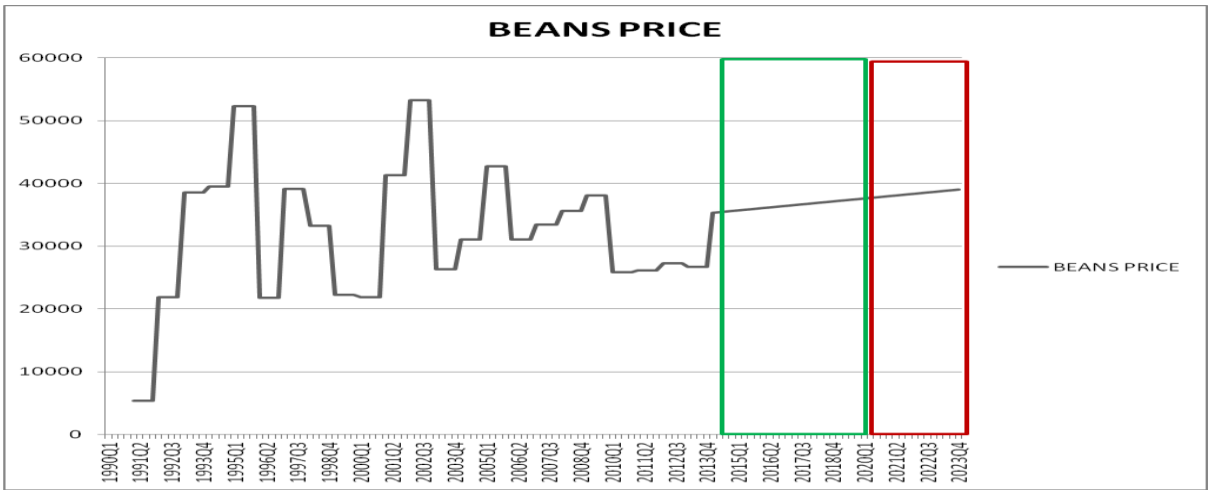
(n.d.) reported that cocoyam maintained an average price compared to other root and tuber crops. The current yield of cocoyam id far below its potential yield despite the growth in production, area cultivated and productivity of cocoyam farmers; We attribute this to poor cultural practices, lower-yielding varieties, attack of pests and disease and the impact of climate change (Ifeanyi-Obi et al., 2017; Nwaobiala and Uchechi, 2016; Okoye et al., 2006). These challenges account for the continuous growth in the price of cocoyam. We expect the price of cocoyam to increase above N50, 000 per ton by 2023.



Source: Authors' Analysis Based on FAO, 2020. Note: Portion bounded in green are estimates while portion bounded in red are forecasts
Figure 6: Trend in cowpea price in Nigeria

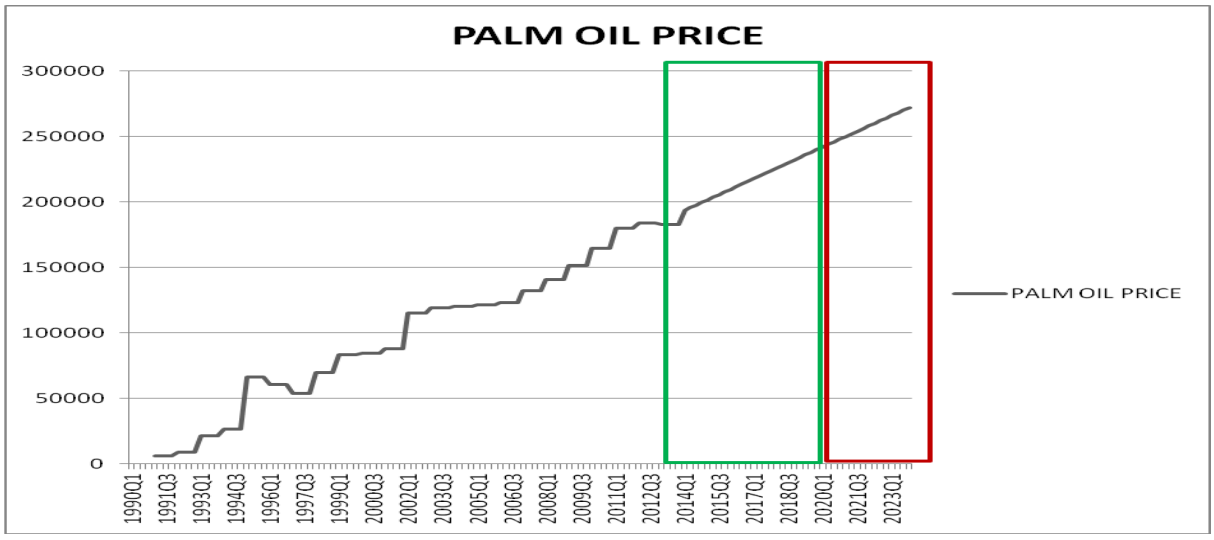
Cowpeas are rich in protein and form part of households' diet in most households in Nigeria. We present the trend in the price of cowpeas in Figure 6. The price of cowpeas increased from less than N20, 000 per ton in 1993:Q1 to N60, 000 per ton in 2003:Q3. The price of cowpea was at its peak in 2008:Q1 rising above N120,000 per ton, global hike in food prices marked 2008 (FAO, 2017). The price of cowpea decreased above N20,000 in 2009:Q3 owing to the effort of the government to boost production of farmers, ensure sustainable cowpea supply and a better return on the investment of cowpea farmers (Pingali, 2012). In 2012: Q3 the price increased to N60, 000 due to the Agricultural Transformation Agenda (ATA)

program of the government that led to a significant investment in agricultural production and development of value addition technologies to boost the market value of staple crops like cowpea (FMARD, 2016; PARI, 2015). We project that the price/ton of cowpea to be above N120, 000 in 2023.



Source: Authors' Analysis Based on FAO, 2020. Note: Portion bounded in green are estimates while portion bounded in red are forecasts
Figure 7: Trend in Beans price in Nigeria

Beans serve as a multipurpose meal which can be consumed after boiling and can produce other foods through value addition such as Moi *Moi* or *Akara*. Men, women and children in the household can consume it; it is very rich in protein (Isheghe, 2020). The trend in the price of beans has been fluctuating over the years studied. In 1991:Q2 the price of beans was below N10, 000 per ton, but by 1995:Q1 the price was N40, 000 per ton. The price of beans dropped below N30, 000 in 1996:Q1. In 1995 and 2003 the price of beans hit an all-time high of above N50, 000 per ton. We project the price of beans to be almost N40,000 per ton by 2023.

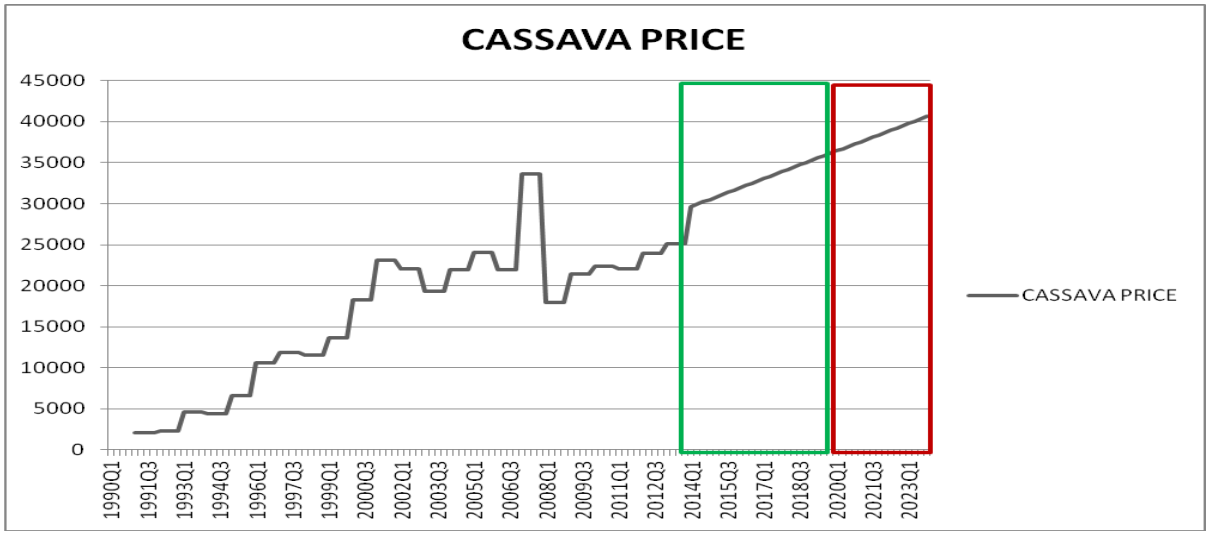


Source: Authors' Analysis Based on FAO, 2020. Note: Portion bounded in green are estimates while portion bounded in red are forecasts

Figure 7: Trend in Palm oil price in Nigeria

Palm oil essential in considering household welfare, it is a significant component of meals. Oil palm-based enterprises generate income for households, especially in rural areas (Adeoye et al., 2019; Eule et al., 2015; Shibhatu, 2019). The trend in the price of palm oil in Nigeria has been growing, as pictured in Figure 7. The price of palm oil increased significantly above N150, 000 per ton in 2012, this may be because of the protective policy of the government for the oil palm farmers in which they received incentives to cushion the effect of the 2007/2008 global high food price (Onwusiribe & Okpokiri, 2015; Gourichon, 2013). In 2001 there was an outright ban on the importation of refined vegetable oil in Nigeria to boost local production, but due to the widening supply and demand gap, the price of palm oil kept increasing. The price of palm oil increased from N87, 977 per ton in 2001:Q4 to N119, 000 in 2003: Q4 (PIND, 2011). Before 2003, there was limited participation of the private sector in palm production while the government acted as a price regulator. However, since 2003 government and private sector participation in palm oil production have improved significantly and the price of palm oil has become competitive with the price of imported palm oil, hence this prompted the lifting on the ban on import in 2008 (Gourichon, 2013;

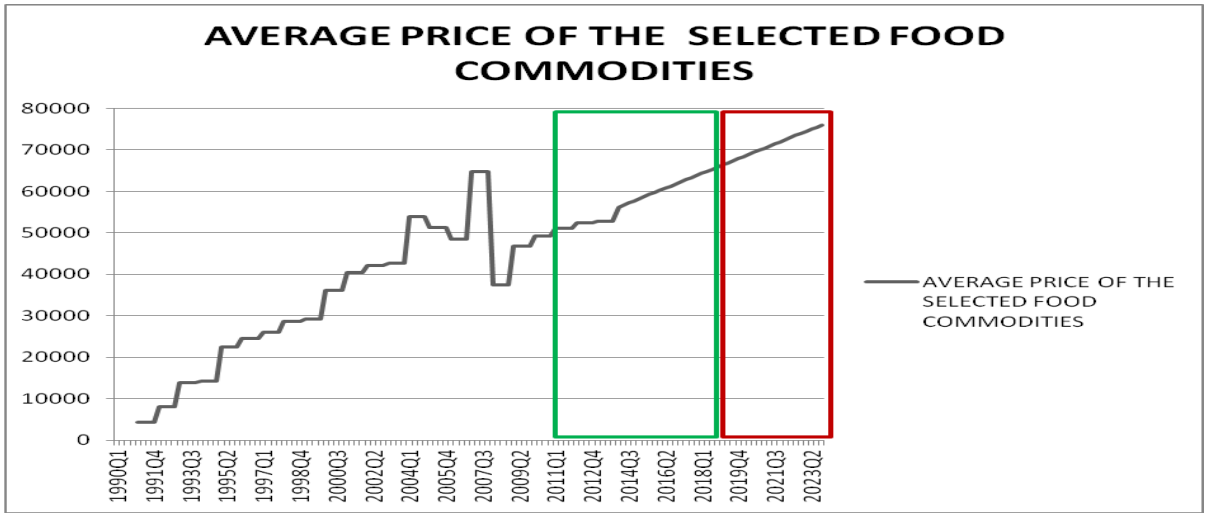
PIND, 2011; UNIDO, CBN, BOI, 2010). In 2009:Q3 the price of palm was below N150, 000 per ton, it increased to N164, 500, N179, 920 and N182, 920 for 2010:Q4, 2011:Q4 and 2013:Q4 respectively. We attribute the price fluctuations to seasonal variations (Gourichon, 2013). We project the price of palm oil in Nigeria to increase above N250, 000 per ton against the projected global downturn in the price of palm oil (PWC, 2019; PIND, 2011).



Source: Authors' Analysis Based on FAO, 2020. Note: Portion bounded in green are estimates while portion bounded in red are forecasts

Figure 8: Trend in cassava price in Nigeria

The producer price of cassava has been growing; we present this in Figure 8, where the producer price of cassava maintained a growing trend. Obayelu and Ebute (2016) reported that cassava price increased from 1990. Our analysis showed that cassava maintained a quarterly growth from 1990:Q1 at N2,066 per ton, and rise to N33, 646 per ton in 2007:Q3. The price of cassava dropped significantly in 2008: Q3 to N17, 980. The sharp rise in the price of cassava was because of the global hike in food prices (FAO, 2017). The glut caused the subsequent sharp decrease in the international market (Obayelu and Ebute, 2016). We project the price of cassava to hit N40, 000 per ton by 2023.



Source: Authors' Analysis Based on FAO, 2020. Note: Portion bounded in green are estimates while portion bounded in red are forecasts

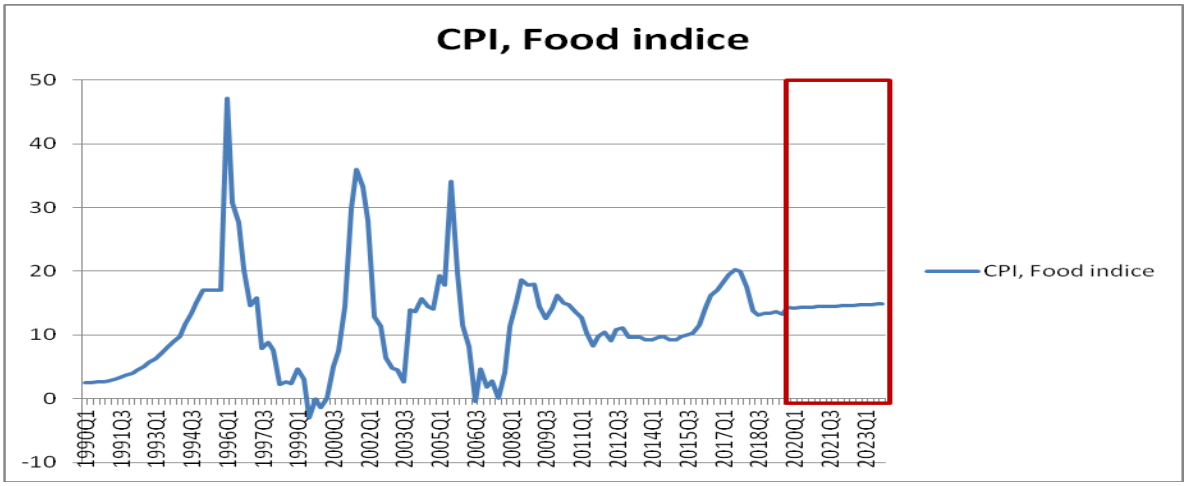
Figure 9: Trend in the average price of selected food commodities in Nigeria

There has been considerable variability and instability of the prices of these food commodities. As shown in Figure 9, sharp growth, steady fluctuations and also a sharp decline characterised the general trend pattern for cassava, cowpea, rice, wheat, palm oil, cocoyam, beans, vegetable, and yam for the period under study.

Egwuma, Ojeleye and Adeolu (2017) reported that food inflation has been on the increase with it influencing other macroeconomic variables. Taru (2014) reported that the price of cereals, such as rice, has been fluctuating over the years and very volatile. He reported that seasonal factors were responsible for the volatility in price.
We relate the global hike in food price to the trend shows that the prices of the selected food commodities have grown from the first quarter of 1990 before hitting the peak in the last quarter of 2007 (FAO, 2017). Compton, Keats and Wiggins (2010) argued that the increase in the oil price affected the food prices in oil-producing economies in Nigeria because of excess foreign reserves available for food importation. The sharp decrease in the prices of food in 2012:Q4 is because of the increased funding of agriculture through the Agricultural

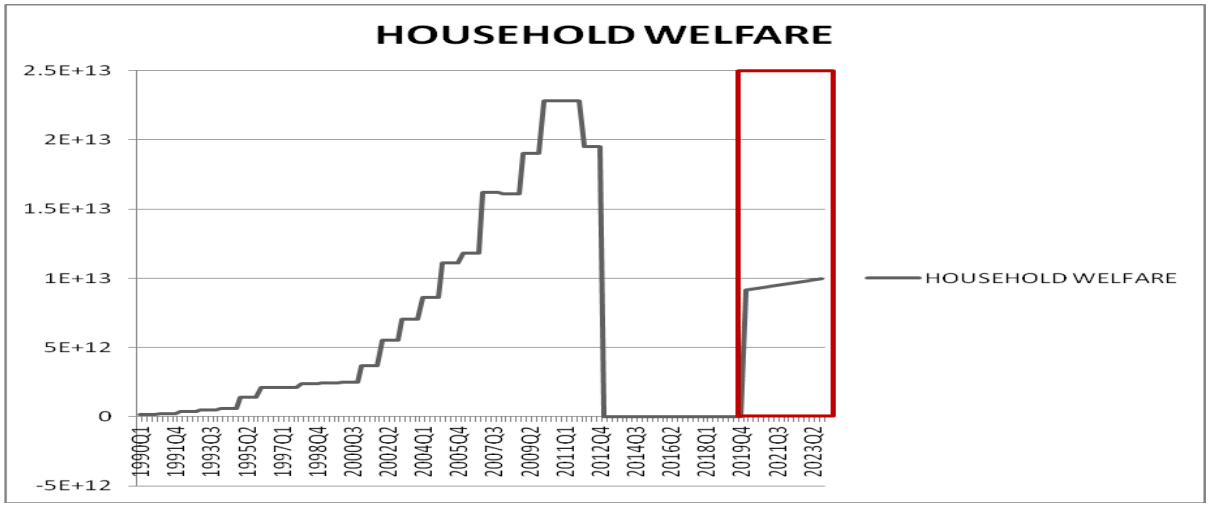
Transformation Agenda (ATA) and NIRSAL that lead to the increase in food production; the increase in food production forced the prices of food down (Olomola & Nwafor, 2018).

TREND IN HOUSEHOLD WELFARE IN NIGERIA FROM 1990 TO 2019



Source: Authors' Analysis Based on FAO, 2020. Note: Portion bounded in red are forecasts
Figure 10: Trend in the Consumer Price Index (food index) in Nigeria

We show the trend of Nigeria household welfare in Nigeria in Figure 11. It shows that final household consumption increased gradually from 1990 to 2000. For a realistic analysis, household welfare represents the total consumption expenditure of households (Akanle & Adesina, 2017); from the result, the trend of household welfare was at its peak in 2012:Q3. This fluctuation in the trend was the fluctuation in the Nigerian inflation rate that leads to variance either increase or decrease in household consumption (Omeka, 2010). We expect the trend in the household consumption expenditure to improve marginally from 2019:Q4.



Source: Authors' Analysis Based on FAO, 2020. Note: Portion bounded in green are estimates while portion bounded in red are forecasts

Figure 11: Trend in Household welfare (Household final consumption) in Nigeria

Estimated growth in the trend of household welfare and cause of the average price of the selected food commodities

Table 2 shows the growth equation on household welfare and the average price of the selected food items. The growth equation shows a remarkable deceleration in the estimated quadratic time trend (b^2), which was negative and significant for the household welfare and the average price of the selected food commodities.

Table 2: Estimated growth in the trend of Household welfare and Average price of the selected food commodities

Variable	A	B	b2	R2	F	R
HHW	-7.4E+12 (-4.566)***	5.55E+11 (8.931)***	-4.1E+09 (-8.343)***	0.410	40.661***	0.640
AVF	-359.646 (-0.247)	992.576 (17.892)***	-3.963 (-8.923)***	0.926	734.899***	0.962

Source: Authors' Analysis Based on FAO and WDI.

The volatility of household welfare in Nigeria from 1990 to 2019

We tested for volatility in households' welfare in Nigeria as specified in equation 3 and 4. The heteroscedasticity test presented in Table 3 shows that there are the presences of

conditional volatility or ARCH (Autoregressive Conditional Heteroscedasticity); this implies that there is the need to run a GARCH model.

Table 3: Heteroskedasticity Test: ARCH

F-statistic	1326.216	Prob. F(1,117)	0.0000
Obs*R-squared	109.3528	Prob. Chi-Square(1)	0.0000

Table 4 shows the result of the volatility test for household welfare, and the result shows that the welfare status of the households proxy by the households' consumption expenditure. The ARCH (RESID(-1)^2) and the GARCH (GARCH(-1)) terms are significant at 5% level. The result shows that household welfare is volatile. The summation of the coefficients of the ARCH (0.104270) and GARCH (-0.992148) is very close to one, and this shows that household welfare will continue to be volatile and it is in line with a priori expectation. Observations show that inflations in Nigeria fluctuate and affect household spending patterns.

Table 4 GARCH result in the volatility of household welfare

Variable	Coefficient	Std. Error	z-Statistic	Prob.
AR(1)	0.442103	8.592191	0.051454	0.9590
AR(2)	0.304629	4.358685	0.069890	0.9443
AR(3)	0.247449	6.835254	0.036202	0.9711
AR(4)	0.079214	1.938554	0.040863	0.9674
MA(1)	0.654233	8.606472	0.076016	0.9394
MA(2)	0.368062	5.569844	0.066081	0.9473
Variance Equation				
C	6.19E+25	1.21E+25	5.099465	0.0000
RESID(-1)^2	0.104270	0.039742	2.623678	0.0087
GARCH(-1)	-0.992148	0.003017	-328.8383	0.0000

R-squared	0.927886	Mean dependent var	6.17E+12
Adjusted R-squared	0.924609	S.D. dependent var	7.60E+12
S.E. of regression	2.09E+12	Akaike info criterion	60.26488
Sum squared resid	4.79E+26	Schwarz criterion	60.47852
Log-likelihood	-3486.363	Hannan-Quinn criteria.	60.35161
Durbin-Watson stat	2.027215		

Inverted AR Roots	1.04	-.13-.46i	-.13+.46i	-.34

Estimated AR process is nonstationary.

Inverted MA Roots	-.33+.51i	-.33-.51i

Source: Authors' Analysis Based on FAO and WDI.

The volatility of the average price of the select food commodities in Nigeria

We test for the volatility of the average price of the selected food commodities in Nigeria as specified in equation 3 and 4. The heteroscedasticity test presented in Table 5 shows that there are the presences of conditional volatility or ARCH (Autoregressive Conditional Heteroscedasticity); this implies that there is a need to run a GARCH model.

Table 5: Heteroskedasticity Test: ARCH

F-statistic	27.90642	Prob. F(1,113)	0.0000
Obs*R-squared	22.77567	Prob. Chi-Square(1)	0.0000

Table 6 presents the result of the volatility test for the average price of the selected food commodities, and the result shows that the average food price of the selected commodities. The GARCH (GARCH(-1)) terms are significant at 5% level, which implies the possibility of a future forecast of the variance to be high for a prolonged time. The result shows that the average price of the selected food commodities is volatile in the long-run. The summation of the coefficients of the ARCH (-0.601548) and GARCH (-0.949755) is very close to one, and this shows that the average price of the selected major food items will continue to be high will continue to be volatile.

Table 6 GARCH result for the volatility of the average food price

Variable	Coefficient	Std. Error	z-Statistic	Prob.
AR(1)	0.336793	29.95812	0.011242	0.9910
AR(2)	0.227950	71.47802	0.003189	0.9975
AR(3)	0.303969	70.39683	0.004318	0.9966
AR(4)	0.135266	8.608052	0.015714	0.9875
MA(1)	0.634141	29.28592	0.021653	0.9827

MA(2)	0.280506	54.81140	0.005118	0.9959
Variance Equation				
C	1.34E+09	2.92E+08	4.598828	0.0000
RESID(-1)^2	-0.601548	2.834950	-0.212190	0.8320
GARCH(-1)	-0.949755	0.039145	-24.26272	0.0000
R-squared	0.956586	Mean dependent var		41823.20
Adjusted R-squared	0.954613	S.D. dependent var		17813.89
S.E. of regression	3795.123	Akaike info criterion		22.15944
Sum squared resid	1.58E+09	Schwarz criterion		22.37308
Log-likelihood	-1276.248	Hannan-Quinn criteria.		22.24617
Durbin-Watson stat	1.983681			
Inverted AR Roots	1.00	-.13-.56i	-.13+.56i	-.41
	Estimated AR process is nonstationary.			
Inverted MA Roots	-.32+.42i	-.32-.42i		

Source: Authors' Analysis Based on FAO and WDI.

Determinants of food price volatility on household welfare in Nigeria from 1990 to 2019

The bound test presented in Table 7 shows that a long-run relationship exists between the variables, making it necessary for the estimation of an ARDL model. The F-statistics value of 4.862, which is higher than the lower I(0) and upper I(1) bound.

Table 7 Bound Test

Test Statistic	Value	K
F-statistic	4.861904	9
Critical Value Bounds		
Significance	I0 Bound	I1 Bound
10%	1.88	2.99
5%	2.14	3.3
2.5%	2.37	3.6
1%	2.65	3.97

Source: Authors' Analysis Based on FAO and WDI.

Table 8 shows the short-run ARDL model estimates. The estimates show that households' welfare in the 1st, 2nd and 3rd lags were statistically significant at 1% and with a negative coefficient, this implies that in the short-run changes in the household welfare had a negative effect on household welfare. The average price of the selected food commodities is

statistically significant at 1% and has a short-run positive effect on household welfare. Minot & Dewina (2015) and Mbegalo & Yu (2016) reported that the price of food had a negative effect on household welfare in the short-run for Ghana and Tanzania respectively, except if the households are producers of the food commodities. In Nigeria, agriculture has accounted for approximately 50 per cent in the last ten years and uses 35.1 per cent (World Bank, 2020). The households consume most of the food commodities produced. The households take advantage of the price of the food commodities produced to improve their welfare; this is because they sell some food commodities produced in the market to generate income. Vu and Glewwe (2011) reported that higher food prices in 2007 and 2008 globally resulted in improved household welfare in Vietnam because most households are agribusiness-based households.

On the hand, food price increase for non-agribusiness households implies welfare decrease as they spend some resource meant to meet other aspects of their welfare on the purchase of food. The depth of food deficiency is statistically significant at 1% and has a short-run positive effect on household welfare. Household consumption expenditure is a determinant of access to food. Food insecurity is a threat to poor households because they have limited access to food (FAO, 2013). The 3 rd lag of depth of food deficiency is also significant at 1% and positively influences the household consumption expenditure. Households with experience of food deficiency seek for ways to remedy by channelling future income to meet the household food needs. WHO (2006) reported that households with a very-low-income population like Nigeria are micronutrient deficient because of inadequate food intake. Food imports in the 3rd lag are statistically significant at 10% and have a short-run positive impact on household welfare. Food imports in the past affected the consumption expenditure of households. Food imports force households to increase their consumption expenditure to afford the luxury nature of imported food items. The food Production index was statistically

significant at 10% and negatively influencing the household welfare in the short-run; this implies that food production in the economy increases the consumption expenditure of households' decreases. The Error Correction Term is the speed of adjustment of the variables returns to equilibrium because of a change in other variables included in the model. The ECM coefficient of -0.007 shows that the speed of adjustment of the variables included in the model is 0.07%; also shows that the model is converging at equilibrium, and the estimated model is very stable.

Table 8 ARDL (4, 0, 1, 4, 0, 0, 1, 0, 4, 0) Short-run coefficients

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(HHW(-1))	-0.341393	0.096825	-3.525863	***
D(HHW(-2))	-0.339852	0.096661	-3.515896	***
D(HHW(-3))	-0.340465	0.096726	-3.519889	***
D(CPIF)	-20811432310.939084	15999086418.111919	-1.300789	NS
D(AVPF)	135401122.296175	34291837.699029	3.948494	***
D(DFD)	285279206926.61019	21293295178.207372	13.39761	***
D(DFD(-1))	258447945.003402	35435137584.675394	0.007293	NS
D(DFD(-2))	-140766975.048923	35434744037.538625	-0.003973	NS
D(DFD(-3))	111470405306.23238	31913406396.362925	3.492902	***
D(ACF)	-390007104245.42650	551713410533.25719	-0.706902	NS
D(ELE)	45815793604.319944	53004503739.920538	0.864375	NS
D(EMP)	324013.955604	248797.232207	1.302321	*
D(F.E.)	-75225025745.378025	134802468888.01236	-0.558039	NS
D(F.I.)	-37077861351.360175	28302548359.728450	1.310054	*
D(FI(-1))	2808055951.445594	34837838456.009700	0.080603	NS
D(FI(-2))	-60513273.700693	34761926150.438200	-0.001741	NS
D(FI(-3))	44819061950.947756	26738246825.300275	1.676215	*
D(FPI)	-9455347305.833638	6646449994.291192	-1.422616	*
ECM(-1)	-0.011922	0.034890	-0.341711	NS

*,**,*** and N.S. indicates that the values are significant at 10%, 5%, 1% and not significant respectively

Source: Authors' Analysis Based on FAO and WDI.

The long-run coefficients in Table 9 were not statistically significant. In the long-run consumer price index (food indices), access to cooking fuel and gas, employment status and food import have a negative coefficient. In the long-run, these variables have a negative impact on the household. The average price of the selected food commodities, depth of food deficiency and access to electricity has positive coefficients, showing a positive influence of household welfare

Table 9 ARDL (4, 0, 1, 4, 0, 0, 1, 0, 4, 0) Long-run coefficients

Variable	Coefficient	Std. Error	t-Statistic	Prob.
CPIF	-1745571569839.7238	5299087346563.3750	-0.329410	NS
AVPF	4258466803.616772	12647321060.753120	0.336709	NS
DFD	519708482170.93831	1449757430504.9781	0.358480	NS
ACF	-32712083581507.925	73175513970390.175	-0.447036	NS
ELE	3842827613710.5919	9031113341031.7975	0.425510	NS
EMP	-6873788.171901	25380204.619056	-0.270833	NS
FE	-6309544884739.7450	26413259650338.219	-0.238878	NS
FI	-8526687345852.7825	24716357175221.463	-0.344982	NS
FPI	-793073018398.08163	2332649058914.1319	-0.339988	NS
C	237282314784740.22	1016429983640436.6	0.233447	NS

*,**,*** and N.S. indicate that the values are significant at 10%, 5%, 1% and not significant respectively. Source: Authors' Analysis Based on FAO and WDI.

The Ramsey RESET test presented in Table 10 shows that the ARDL model is statistically stable. The t- statistics and F-statistics are statistically significant at 1% showing that the model is statistically significant.

Table 10; Ramsey RESET Stability Test

Test Statistic	Value	k
F-statistic	4.861904	9

Critical Value Bounds

Significance	I0 Bound	I1 Bound
10%	1.88	2.99
5%	2.14	3.3
2.5%	2.37	3.6
1%	2.65	3.97

Source: Authors' Analysis Based on FAO and WDI.

The Breusch-Godfrey Serial Correlation L.M. Test presented in Table 11 with an F-statistics value of 12.326 indicates that the model is free from serial correlation.

Table 11 Breusch-Godfrey Serial Correlation L.M. Test:

F-statistic	12.32641	Prob. F(2,91)	***
Obs*R-squared	24.72682	Prob. Chi-Square(2)	***

*,**,*** and N.S. indicate that the values are significant at 10%, 5%, 1% and not significant respectively. Source: Authors' Analysis Based on FAO and WDI.

The wald test presented in Table 12 shows that the explanatory variables are important and significant in the model with a chi-square value of 1410.627 which significant at 1%.

Table 13 Wald Test:

Test Statistic	Value	Df	Significance level
F-statistic	156.7363	(9, 92)	***
Chi-square	1410.627	9	***

Null Hypothesis: C(1)=0, C(2)=0, C(3)=0, C(4)=0, C(5)=0,C(6)=0, C(7)=0, C(8)=0, C(9)=0

*,**,*** and NS indicates that the values are significant at 10%, 5%, 1% and not significant respectively. Source: Authors' Analysis Based on FAO and WDI.

Conclusion

The study assessed food price volatility and the welfare of households in Nigeria with specific reference to the prices of selected food items. The trend in household welfare in Nigeria, the volatility of household welfare and food price, the effect of food price volatility on household welfare in Nigeria. The study made use of time series data sourced from reliable data sources such as the Food and Agriculture Organization database and World Bank Development Indicators. Data were quarterly covering 1990: Q1 to 2019: Q4. We analysed the data using trend analysis, GARCH model and the ARDL regression approach. The results on the application of Unit root test shows that the variables attained stationarity at a level or after differencing once and thus, one may conclude that the variables are suitable for ARDL estimation. The occurrence of unit roots in the data generation preliminarily shows shocks having a permanent or long-lasting effect.

The trend in the price of yam, wheat, rice, cowpea and cassava were similar, and the trend reflects the global hike in the price of food commodities in 2007/2008 before a decline in 2009. The trend in food commodities like vegetable and palm oil experienced a positive,

relatively smooth trend while the trend in the price of beans has more fluctuation within the period studied. We expect the average price of the selected food commodities to keep increasing through 2023. The trend in household welfare was at the peak from 2009 to 2011 before dropping due to increasing levels of increasing unemployment, corruption and economic downturns. The quadratic trend equation also shows that household welfare has experienced a remarkable deceleration in Nigeria. The price of the selected food commodities and household welfare was volatile. In the short-run average price of food, depth of food deficiency, food imports and food production index was significant. In the long-run, the coefficients of the variables in the model were not statistically significant; this implies that the variables do not impact on the households' welfare strongly in the long-run. These variables should be the focus of governments in improving household welfare in the post-COVID-19 period.

Based on the findings and conclusion of this study, we recommend the following. The results revealed that food prices are highly volatile and respond to shocks from macroeconomic variables in the short-run. Government as a significant policymaker should consider the fact that food prices are sensitive to changes in macroeconomic policies while formulating such policies and post COVID-19 pandemic recovery programmes; this is because any wrong macroeconomic policy results in a food price increase which affects household expenditure. Efforts to curtail extreme spikes in the price of cereals can substantially enhance food security and overall economic welfare of the households in the post-pandemic period. Strategies for growth in household income is critical for improved access to foods in terms of quantity and diversity and overall economic wellbeing of households. If policy actions are complemented with food distribution and sensitively guided welfare-related short-term interventions, more improvements for livelihoods can be achieved. Effectiveness of complementary efforts can be enhanced through a proper appraisal of local context and by

investing in sectors where the households living in poverty benefits the most, and by proper identification of socially deserving people to better allocate resources for poverty alleviation, food insecurity and malnutrition reduction programs. Households spend most of their consumption expenditure on expensive food imports. Food importation can be reduced by increasing the production of imported foods; this will leave households with more income to probably save or invest. Access to electricity by the household has a positive coefficient in the short-run; this implies that households spend a fortune on electricity, and this increases their consumption expenditure. Electricity generation and distribution have been a source of concern for the governments in Nigeria. They should be a true liberation and privatisation of the power sector, to give access to more competitors. With increased competition in the power sector, there will be more supply of electricity for household productivity as subsequent welfare. Policymakers should focus on the short-term benefits while formulating policies aimed at households' welfare; This is because policies focused aimed at the household level are more impactful on the short-run compare to the long-run.

Authors' Contributions

CNO sourced the data, statistical analysis and wrote the first draft, NPO contributed to the writing, OOU contributed to the interpretation of results, ANM contributed to the final writing.

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