THE TRENDS OF OUTPUTS AND PRICES OF SELECTED FOOD GRAINS IN NIGERIA (1981-2020)

*La'ah, D., Weye, E.A. and Ayoola, J.B.

Department of Agricultural Economics, College of Agricultural Economics & Extension,
Joseph Sarwuan Tarka University, Makurdi, Benue State, Nigeria

*laahdauda@gmail.com

+234-8083410992

Abstract

The study examined the trends of outputs and prices of selected food grains in Nigeria from 1981 to 2020. Time series data were collected from National Bureau of Statistics as well as Food and Agricultural Organization Statistical Databasess. The data for this study was analyzed using descriptive statistics. Results revealed that, the mean output for wheat was 67,498.53 tonnes, maize 6,279,013.00 tonnes and rice 3,786,425.00 tonnes during the period under review; while the mean price for rice was ₦34,586.29 per tonne, wheat ₦33,625.00 per tonne and maize ₦31,049.15 per tonne; the mean outputs for maize was 6,279,013.00 tonnes, rice had 3,786,425.00 tonnes and wheat 67,498.53 tonnes. The skewness of rice (-0.147291) and maize (-0.006561) were negatively skewed to the left tail implying the presence of more values that are lower than the sample mean and wheat (0.022889) skewed positively to the right tail implying the presence of more values that are higher than the sample mean; kurtosis for rice and wheat output may be described as leptokurtic (positive excess kurtosis), maize output had a kurtosis less than 3 (negative excess kurtosis) and may be described as platykurtic; while wheat, rice and maize prices had kurtosis less than 3; the Jarque-Bera probability test of normality shows that the output and prices of rice, maize and wheat were statistically significant at 5% level of significance, thereby accepting the null hypotheses. The Augmented Dickey-Fuller test for unit root also revealed that, the series of interest rate is stationary at first difference and implied that the variables of selected food grains cannot be specified at their levels without the risk of obtaining spurious regression. The trends of outputs of rice, maize and wheat grains decreased; thus the trends of prices of rice fall but maize and wheat rose, respectively in 2020. The study conclude that, trends of outputs and prices of rice, maize and wheat were erratic in Nigeria from 1981 to 2020. Thus, the study recommends that farmers should utilize improved seeds and increase the irrigated areas for food grains'

production.

Keywords: Trends, outputs, prices, food grains, Nigeria.

Introduction

Agricultural production trends dwindled between 1960 and 2015, owing in part to productivity-enhancing Green Revolution technologies and a significant expansion in the use of land, water and other natural resources for agricultural purposes [Food and Agriculture Organization (FAO) of the United Nations, 2017]. The same period witnessed a remarkable process of industrialization and globalization of food and agriculture. Food supply chains have lengthened dramatically as the physical distance from farm to plate has increased; the consumption of processed, packaged and prepared foods has increased in all – except for the most isolated rural communities.

Nevertheless, persistent and widespread hunger and malnutrition remain a huge challenge in many parts of Nigeria. According to the Udegbunam (2020), the current rate of progress will not be enough to eradicate hunger by 2030, and not even by 2050. At the same time, the evolution of food systems has both responded to and driven changing dietary preferences and patterns of overconsumption, that is reflected in the staggering increases in the prevalence of overweight and obesity around Nigeria.

Expanding food production and economic growth have often come at a heavy cost to the natural environment. Almost one half of the forests that once covered the Earth are now gone. Groundwater sources are being depleted rapidly. Biodiversity has been deeply worn. Every year, the burning of fossil fuels produces into the atmosphere billion of tonnes of greenhouse gases, which are responsible for global warming and climate change (Adekunle *et al.*, 2020).

All of these negative trends are accelerating in pace and intensity, and agriculture is an important part of the problem. Deforestation, largely for farming, produces an important share of global greenhouse gas emissions and causes the destruction of habitats, the loss of species and the erosion of biodiversity. The incidence of natural disasters has increased 5-fold since the 1970s (Nzeka and Taylor, 2017). Deforestation, the degradation of natural buffers protecting coastlines and the poor state of infrastructure have increased the likelihood that extreme weather events will escalate into full-fledged disasters for affected communities and the economy. The lengthening of food chains and changes in dietary patterns have further

increased the resource-, energy-, and emission-intensity of the overall food system.

These trends threaten the sustainability of food systems and undermine the flora and fauna capacity to meet its food needs. Although the full implications of climate change on agriculture, forestry and fisheries are difficult to predict, it is expected that the impacts will be of different levels and of a different nature in each region, ecological zone and production system. For example, even small changes in the climate slight shifts in annual rainfall or seasonal precipitation patterns, can severely affect productivity of food grains like rice, maize and wheat in Nigeria.

The main food grains in Nigeria whose production is being emphasized to remedy food deficit and importation include maize, sorghum, millet, rice, wheat, and pulses (Aina *et al.*, 2015). Prices are a standard and important component of market and food security analysis because they serve as an indicator of both food availability and food access. Prices are a measure of availability because they tend to rise as the supply of food falls with demand such as situations of (like poor production or constrained imports of food), and they tend to fall when supply expands with demand such as at times of (example, a bumper harvest). Food prices are also a measure of food access because they affect the purchasing power of households: the ability of a household to acquire goods and services is based on the amount of money or other forms of wealth they possess.

Output and price changes observed through time are a result of a complex mixture of changes associated with seasonal, cyclical, trend, and irregular factors. The most common regularity observed in agricultural outputs and prices is a seasonal pattern of change. Normally, outputs and prices of storable commodities are lowest at harvest time, rise as the season progresses, and reach a peak before the next harvest (Aihonsu and Akorede, 2002)

Research works on agricultural commodity pricing and marketing have been conducted and a lot of recommendations made. Dahiru (2013) worked on grain crops as a major food crop investment that needed to be protected. He stated that grain quality does not improve in storage, but the initial quality must be maintained. According to Ladele and Ayoola (1997), an efficient food grains' marketing system would reduce post-harvest losses, ensure adequate returns to farmers' investment and stimulate expansion in food production thereby enhancing the level of food security in Nigeria. Food grains' marketing is a very important but rather neglected aspect of agricultural development. Their work however left out the aspect of pricing and did not make any particular reference to rice, maize and wheat.

Parmindar *et al.* (2000) adopted a linear equation and moving average to examine the trend as well as seasonal variation of arrivals and price of rape-seed and mustard in Haryana. The findings of the study revealed that price of raped-seed and mustard from 1985-86 to 1995-96 showed a general tendency of rising while the arrivals indicated great fluctuations from year to year in all markets.

Aminu (2010) considered only seasonal component in a study conducted on the analysis of seasonality and returns to the storage of tomatoes in Jigawa State, in Nigeria. It was found that tomato marketing was affected by seasons and that August to December were months that had the lowest supply while February to April was months of highest supply. Reuben and Mshelia (2011) conducted a study on price variation and decomposition in yam markets of southern Taraba state used a centered moving average method. Variability of prices over time was exhibited by plotting the average price per kg (an average yam tuber) over months. Results indicated that April-June were months with the highest price while October-December were months with the lowest price.

Despite the intensity of research work done on price volatility, the conversation about trends of outputs and prices of selected food grains in Nigeria from 1981 to 2020 is yet to converge; hence, the policy options available to mitigate the erratic nature of prices of most of the basic food items in the market and possible methods for implementation are very scarce. There is increasing need to promote this aspect of research with a view to open up options available to policymakers and market participants to take most informed business decisions. It is an inevitable mission which if left unattended to can hunt and hurt more of the national as well as international economy. The international financial crisis of 2007/2008 has proved the veracity of that assertion (Ikuemonisan and Deacue, 2017).

Considering the trends of outputs and prices of food grains is to first, distinguish between food net purchaser and net food sellers. On that account, therefore, net food purchasers always face the effect of high food prices resulting from trends of outputs and prices of food grains. To have the above dichotomy for studies is good but to think of how a society will exist without such is unimaginable. The dual can be found across rural and urban sectors. In developing countries such as Nigeria where the higher proportion of the population who engaged in agriculture are considered poor. Not only are they characterized with low income, most of their countries are still net food importers as government often spend huge on food importation. Extrapolating from different literature, one fundamental issue about trends

of outputs and prices of food grains remains lack of transparency in the inventory and arbitrage perhaps in response to macro-economic dynamics. Some countries have made efforts to intervene by building storage (silos) for food grains so that they can effectively manage distribution during scarcity. This has been found to significantly stabilize trends of outputs and prices of food grains. Beyond this, food demand is increasing daily and there is that compelling need to match it up with supply to keep that market equilibrium in shape. Many other factors keep raising the apprehension of food traders (middlemen) about the food market for possible fall in return and so, the need to be prepared for this too. By so doing, the risk premium dictates the increased new price. The following specific objectives were investigated:

- to describe the trends of outputs of rice, maize and wheat in Nigeria (1981-2020);
- to describe the trends of prices of rice, maize and wheat in Nigeria (1981-2020);

Methodology

The study area

The study area is Nigeria. It lies roughly between latitudes 4°N and 14°N as well as longitudes 3°E and 15°E (Federal Government of Nigeria, 2012). It covers a landmass of approximately 923,768 km^2 representing about 14% of the land area in West Africa (Water and Sanitation Programme, 2012). The population of Nigeria was projected at 211.40 million inhabitants in April 2021 (O'Neil, 2021). This makes the country the most populated nation and one of the largest countries in Africa CBN, 2013). The country is bordered by the elongated territory of Benin to the west, the semi-arid country of the Niger Republic to the North, the sub-equatorial Cameroun to the East, and the Atlantic Ocean to the South

Method of data collection

The data was obtained from records of the National Bureau of Statistics (NBS), Food and Agriculture Organization Statistical Database (FAOSTAT) publications. These sources were selected because of the consistency and long period of the coverage of data. The variables for which data was collected consists of production and prices of rice, maize and wheat grains' in Nigeria for a period of forty years (1981-2020).

Data analysis technique

Data for this study was analyzed using descriptive statistics such as mean, maximum and minimum to achieved objectives 1 and 2.

Unit root test for stationarity: As part of the preliminary analysis, the study used the

Augmented Dickey-Fuller (ADF) statistic to test for unit root stationarity status of rice, maize and wheat series in Nigeria. According to Oyinbo and Rekwot (2013), the Augmented Dickey Fuller (ADF) model has a constant term and trend that can be specified as follows:

Where:

Y is the value of the variable of prices and outputs of rice, maize as well as wheat,

 is the constant,

 is the coefficient of the trend series,

p is the lag order of the autoregressive process,

 is the lag value of order one of

 is the error term.

Results and Discussion

Descriptive statistics of the variables

The summary of statistics is presented in table 1. The result showed that, the mean output for wheat was 67,498.53 tons that of maize was 6,279,013.00 tons and rice 3,786,425.00 tonnes while the mean   price for rice was ₦34,586.29 per tonne, wheat ₦33,625.00 per tonne and maize ₦31,049.15 per ton.

For maximum outputs, maize was 11,547,980 tonnes, rice had 8,435,000 tonnes and wheat 165,000 tonnes. Similarly, a conspicuous increase in price was noticed for wheat ₦80500 per tonne, rice ₦71,550 per ton and maize ₦68,760 per ton.

The skewness, which is a measure of asymmetry indicated that rice (-0.147291) and maize (-0.006561) were negatively skewed to the left tail implying the presence of more values that are lower than the sample mean and wheat (0.022889) skewed positively to the right tail implying the presence of more values that are higher than the sample mean.

On one hand, the result shows that rice and wheat output may be described as leptokurtic (positive excess kurtosis) with a kurtosis greater than 3 relative to the normal while maize has a kurtosis less than 3 (negative excess kurtosis) and may be described as platykurtic implying that the distribution has a flattened curve relative to the normal. On the other hand, wheat, rice and maize prices have kurtosis less than 3 respectively implying that the distribution has a flattened curve relative to the normal.

The Jarque-Bera probability test of normality shows that the outputs and prices of rice, maize and wheat were statistically significant at 5% level of significance, thereby accepting

the null hypotheses. This implies that, the data for wheat, rice and maize output came from a normal distribution during the period of the study. It is also consistent with the findings of Rehman and Jindong (2017) who reported that, the test of Jarque and Bera probability test acknowledges that the sample data matches a normal distribution.

Unit root test for Stationarity

The Augmented Dickey-Fuller (ADF) test for unit root was employed to test whether or not a variable is stationary and also determine the order of integration of the variable. The null hypothesis of the Augmented Dickey-Fuller (ADF) is that the series of interest is stationary, hence the rejection of the null hypothesis implies the variables are not stationary. The result indicated all the variables were integrated at order one and stationary at first difference. This implies that all the variables exhibit random walk (unit root).

The result of unit root implies that, outputs and prices of rice, maize and wheat cannot be specified at their levels without the risk of obtaining spurious regression.

Table 2: Result of the Augmented Dicker -Fuller t est for unit root test for prices and outputs of rice, m aize and wheat in Nigeria

Variables	Crops	Level		First difference		Inference
		t-statistic	Prob.	t-statistic	Prob.	
Outputs	Rice	1.371769	0.9985	-3.650968***	0.0053	1(1)
	Maize	-1.177782	0.6743	-6.077182***	0.0000	1(1)
	Wheat	-3.175582	0.0292	-5.833755***	0.0000	1(1)
Prices	Rice	-0.051862	0.9473	-7.075982***	0.0000	1(1)
	Maize	-0.816441	0.8026	-10.40867***	0.0000	1(1)
	Wheat	-1.125538	0.6960	-5.809512***	0.0000	1(1)

Note: asterisks *** indicate stationarity at 1% level of significance.
Source: Data analysis (2021).

Trends of outputs of rice, maize and wheat in Nigeria

A visual plot of the data is usually the first step in the analysis of any time series. The descriptive statistics is presented in table 1 with the trends in figures 2, 3 and 4. The trends of outputs of rice, maize and wheat in Nigeria were described as follows:

Trend of the output of rice in Nigeria: The result revealed that, the mean rice output in Nigeria stands at 3,786,425 tonnes during the period of the study **(**table 1**).** While in figure 1,

the output of rice was fairly constant between 1981 and 1985 but however had a sharp increase from 1986 to 1988 where it continued to increase till 1989. The output of rice fell drastically in 1990 and rose in 1991 from where output was relatively stable till 1992, from where there was a fall in 1994. The production sharply increased up to 1995 and maintain the output up to 2000 where there was a dropped experienced in 2001. Also, the output of rice increased between 2001 and 2006, followed by a decline in 2007 and a positive peak in 2008. From 2008 to 2009, the output statistics show an increasing trend in production, associated with a decline in yield harvested between 2009 and 2010. This trend resulted into higher yields between 2010 and 2011, despite a rising output within 2011 to 2012. Increasing output between 2012 and 2013 can be explained as result of the implementation of the Presidential Initiative on increased Rice Production, although decreasing output between 2013 and 2014 is not in line with policies aimed at the development of the rice sector during those years, such as the National Rice Development Strategy and the Federal Market Stabilization Programme (Aina *et al.*, 2015). In 2014, the output of rice progressively increased from 2014 up to 2018. This is in line with the report of the Nigeria Customs Service (2021) that, the ban on the importation of rice by the Buhari administration encouraged local production and the establishment of more local rice mills, especially in the north part of Nigeria. The output fairly remains constant between 2018 and 2019 unexpectedly in 2020. This could be as a result of the Covid' 19 pandemic that affected agricultural output. Thus, there were different levels of increases, decreases and stability in rice production from 1981 to 2018, with the highest production level in 2019.
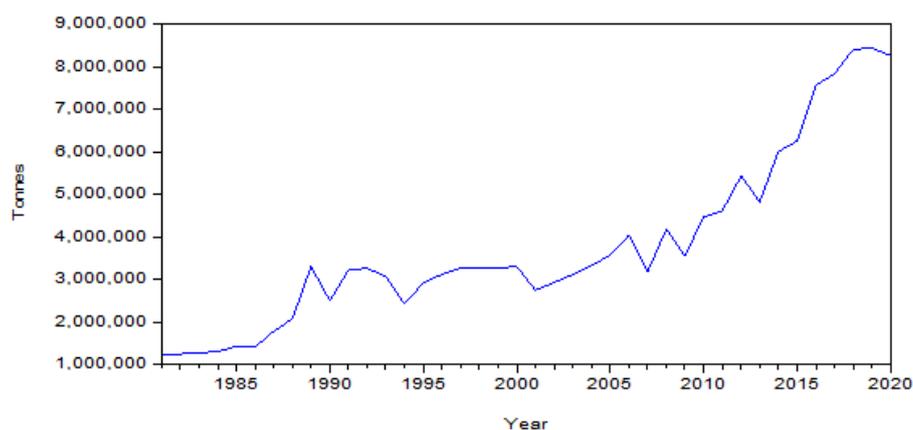

Figure 1: Trend of output of rice (1981-2020).
Source: Data analysis (2021).

Trend of the output of maize in Nigeria: The result showed that, the average output of maize in Nigeria stands at 6,279,013 **tonnes** during the period of the study **(**table 1**).** Whereas in figure 2, maize output was stagnant between 1981 and 1982. In 1982, the output of maize experienced a radical increase till 1987 when a slight decrease was noticed. There was a sharp increase in output of maize from 1989 to 1990. The output kept increasing from 1990 to 1993, reached a peak in 1995 and fairly remain constant till 1996. The output of maize showed a declining trend from 1996 to 1999 and later increased from 1999 till 2015. The increase in the production of maize grains could be attributed to the use of modern inputs such as high yielding varieties (HYV) seeds, fertilizers and farm implements (tractors as well as sprinklers). However, the production of maize showed a decrease from 2015 till 2017. It remained fairly constant till 2019 and later declined in 2020. This may be explained by the findings of Adekunle *et al.* (2020) who stated that, there is limited availability of inputs, low investment in irrigation systems, limited storage facilities, inadequate extension services for post-harvest losses, high cost of transportation and slow adoption of mechanisation in Nigeria experienced from 2020.
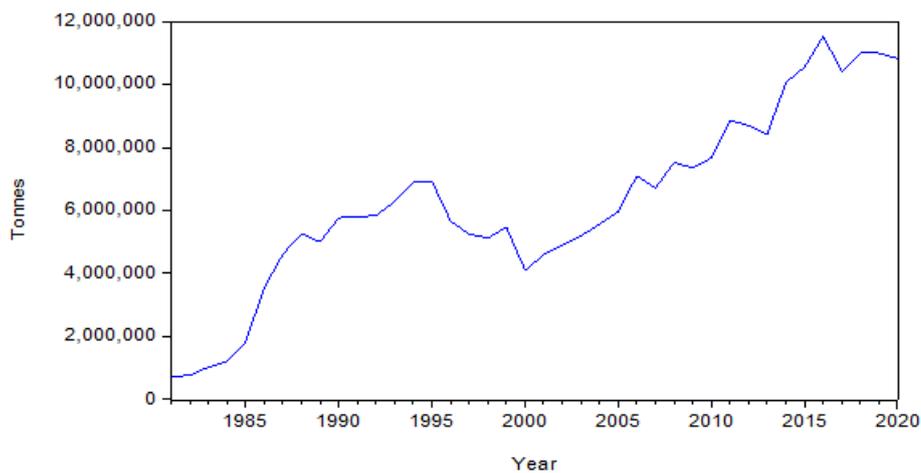

Figure 2: Trend of output of maize (1981-2020).
Source: Data analysis (2021).

Trend of the output of wheat in Nigeria: The result indicated that, the average output of wheat in Nigeria stands at 67,498.53 tonnes during the period of the study **(**table 1**).** Although in figure 3, the output of wheat was constant between 1981 and 1983. The trend of output of wheat increased from 1984 to 1987 but drastically decrease between 1987 and

1988. Again, it became undulating curves from 1988 to 2006 and consequently reached its lowest ebb in 2009. The output of wheat increased progressively between 2009 and 2014 but rather decrease sharply from 2014 to 2015. The output of wheat increased sharply between 2015 and 2017 but rather unfortunately had continued to decrease from 2017 to 2018. The trend increased from 2019, reached a peak and gradually decreased to 2015. There was also depressing outputs between 2011 and 2018. This is because the consumption level of wheat rose, the country failed to grow more wheat, instead it closed the shortfall in supply by significantly importing more wheat (Ekott, 2021). But from 2018 to 2019, the trend of output of wheat remain fairly constant and steadily increased from 2019 to 2020. This may be explained by the findings of Grote *et al.* (2021) who stated that wheat production would be strongly impaired by ecological drivers such as land degradation, water scarcity and climate change. There are promising innovations to increase and main productivity, but constraints in adopting these innovations have to be overcome (that is, access to seeds, finance and education/training) (Grote *et al.*, 2021).
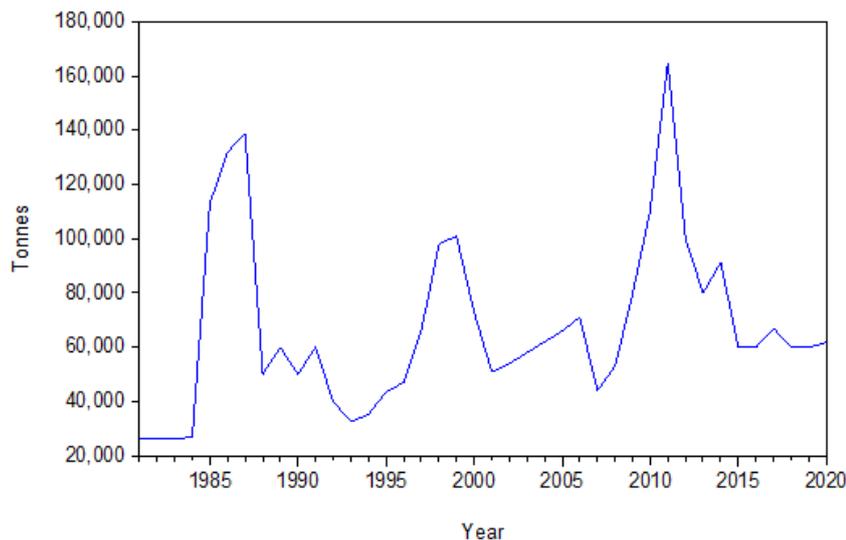

Figure 3: Trend of the output of wheat (1981-2020).
Source: Data analysis (2021)

Trends of prices of rice, maize and wheat in Nigeria

The descriptive statistics is presented in table 1 with the trends in figures 4, 5 and 6. The trends of prices of rice, maize and wheat in Nigeria were described as follows:

Table 1: Summary Statistics of the Variable

Statistics	Output (tonnes)			Prices (₦ per tonne)		
	Rice	Maize	Wheat	Rice	Maize	Wheat
Mean	3,786,425	6,279,013	67,498.53	34,586.29	31,049.15	33,625.00
Median	3,271,500	5,825,000	60,000.00	35,090.00	32,155.00	36,680.00
Maximum	8,435,000	11,547,980	165,000.0	71,550.00	68,760.00	80,500.00
Minimum	1,241,000	720,000.0	26,000.00	400.0000	210.0000	320.0000
Std. Dev.	2,045,400	2,905,056	31,971.09	25,650.82	25,333.79	25,385.00
Skewness	0.995267	-0.054576	1.124074	-0.147291	-0.006561	0.022889
Kurtosis	3.184810	2.564319	4.053192	1.354513	1.323519	1.753329
Jarque-Bera	6.660630	0.336220	10.27230	4.657344	4.684599	2.593807
Probability	0.035782	0.845261	0.05880	0.097425	0.096106	0.273377
Sum	1.51E+08	2.51E+08	2699941.	1383452.	1241966.	1345000.
Sum Sq. Dev.	1.63E+14	3.29E+14	3.99E+10	2.57E+10	2.51E+10	2.50E+10
Observations	40	40	40	40	40	40

Source: Data analysis (2021) .

Trend of the price of rice in Nigeria: The result found that, the mean price of rice in Nigeria stands at ₦34,586.29 per tonne during the period of the study (table 1). From the graph in figure 4, it is seen that from 1981 the price of rice was relatively steady till 1983. There was a significant increase from 1983 to 1993, from where the price of rice fell drastically all through the years to 1994 where it began to rise again at a high speed till 1996. There was fall in price between 1996 and 1997. The price of rice increased sharply from 1997 to 1998 and there again decreased within a year. Gradually, the price of rice picked up from 1999, increased from 2000 up to 2001 and slowly reached 2002 before declining to 2003. Progressively, the price of rice increased at an alarming rate from 2004 to the highest point ever in which rice price has ever gotten to in Nigeria in 2005. This could probably be due to a number of factors including variances in the bargaining power among consumers, cyclical income fluctuations among sellers and consumers, natural shocks such as floods, pests, diseases and inappropriate response by farmers to price over time (Aina *et al*, 2015). The price of rice has its highest point in 2005 from where it reduced gradually till 2013. The price of rice has been rising and falling around a particular point from 2016 to 2019, from there has been an increase at a relatively increasing rate up till 2020. This increase is largely caused by border closures, insecurity, flooding during the wet season and rising demand (Udegbunam, 2020).
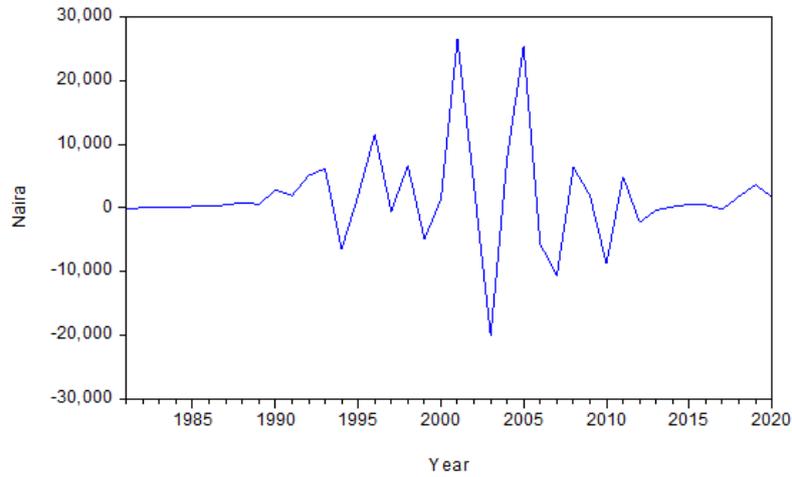
Figure 4: Trend of the price of rice (1981-2020).

Source: Data analysis (2021).

Trend of the price of maize in Nigeria: The result found that, the mean price of rice in Nigeria stands at ₦25, 333.79 per tonne during the period of the study **(**Table 1**).** Specifically, from 1981 to 1983 price of maize was stagnant but increases slightly from 1983 to 2002 and later decreased in 2003 (figure 5). The price of maize price further increased drastically from 2003 to 2005. The prices of maize continually fluctuated and rolled to its peak from 2005 to 2019. This fact confirms the assertion made by Akinfenwa (2021) that, the price of maize has risen steeply and is gradually going beyond the reach of the common man. The price of maize increased at a relatively increasing rate from 2019 to 2020. The increase may probably be due to factors responsible for maize price hike like the problem of armyworm infestation, insecurity and climate change affecting Nigeria (Akinfenwa, 2021).
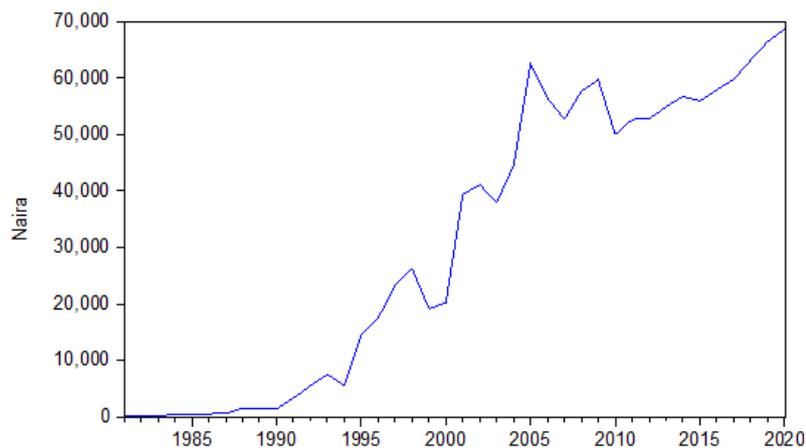

Figure 5: Trend of the price of maize (1981-2020).

Source: Data analysis (2021)**.**

Trend of price of wheat in Nigeria: The result found that, the average price of wheat in Nigeria remains at ₦33, 625.00 per tonne during the period of the study **(**Table 1**).** Figure 6 shows the fluctuation in the price of wheat from 1981. The price was fairly constant from 1981 to 1982 but significantly increased to the highest from 1982 to 1999. The price of wheat further remain stable (₦41, 230 per tonne) from 1999 to 2000. But from 2000 to 2011, the price later declined from ₦41, 230 to ₦34, 000 per tonne. As reported by Nzeka and Taylor (2017), rising cost of farming inputs and insecurity are limiting private efforts at increasing wheat productivity. Also, it might be due to unfavourable foreign exchange measures and weakening purchasing power that are causing declines in local consumption and imports of the wheat products in Nigeria. However, the price of wheat increasingly went up from 2011 to 2020. According to Enghiad *et al.* (2017), some of the factors that increased wheat prices include climate change, yields, oil prices, lagged prices, imports and consistent increase in global wheat demand.
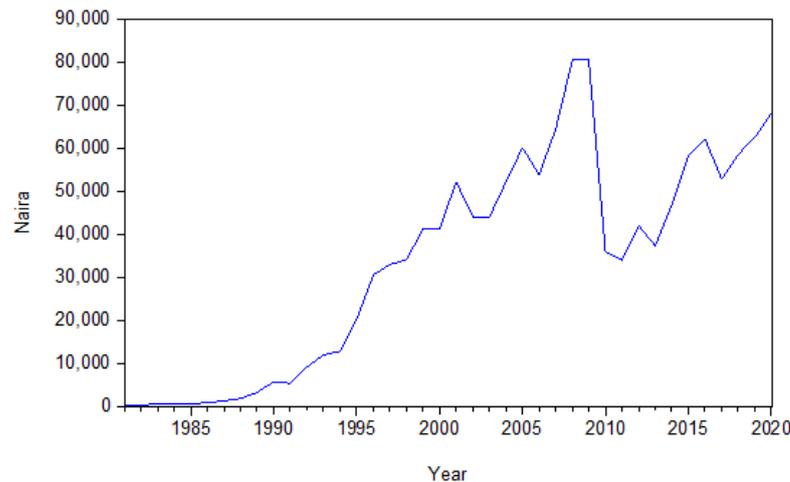

Figure 6: Trend of the price of wheat (1981-2020).
Source: Data analysis (2021).

Conclusion and Recommendations

The trends of outputs and prices of food grains had been erratic in Nigeria from 1981 to 2020. For instance, this assertion was in line with the market survey conducted by Udegbunam (2020) at Orange Market in Karu Local Government Area of Nasarawa State that, the average prices of local rice and imported rice had increased by 31.87% and 38.62%, respectively. One kilogram (kg) of local rice in October, 2019 cost ₦303.69 but ₦400.73 in October 2020; imported rice in 2019 was ₦382.59 while in 2020, it was ₦530.32. Thus, the rise and fall were probably caused by border closures, COVID-19 containment measures, insecurity, flooding during wet season, poor storage facilities and rising demand. These factors have meant limited

availability of food items plus rising demand, leading to rise in prices. Similarly, it is noteworthy that the increase in food production was due more to expansion of the area cultivated, than increase in productivity. The study therefore concludes that, trends of outputs and prices of rice, maize and wheat were erratic in Nigeria from 1981 to 2020.

The study recommends that, inputs such as improved seeds, fertilizers, herbicides and insecticides need to be commercialized through incentives to the private sector. Undoubtedly, the price response of farmers to these inputs is very low. With a strong farm advisory service, the adoption of these technologies may be enhanced in a profitable and environment friendly manner. Other steps to take may include utilization of improved seeds and increase the irrigated areas for food grains' production.

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