ESTIMATING GROWTH TRENDS OF CEREAL CROPS YIELD AND PRICES IN NIGERIA (1981-2020)

***Umbugadu, G.B. and Ochoche, C.O.**
Department of Agribusiness and Management
College of Agriculture, Science and Technology, Lafia, Nasarawa State, Nigeria
*Corresponding Author's Email: blessynumbugadu@gmail.com

ABSTRACT

This study assessed the growth rate of selected cereal crops in Nigeria. The study adopted a longitudinal survey design using time series data from 1981 to 2020. Data on yields and prices were collected from Food and Agriculture Organization, and analyzed using trend graphs and growth model. The result of the trend of the variables revealed that maize yield ranged between 0.97 and 2.18 with a mean of 1.46; rice yield ranged between 1.29 and 2.38 with a mean of 1.74; sorghum yield ranged between 0.96 and 1.63 with a mean of 1.17 tonnes/hectares respectively; maize price ranged between 210 and 68760 with a mean of 31049.15; rice price ranged between 400 and 71550 with a mean of 34586.29; while sorghum price ranged between 180 and 79452 with a mean of 26424.32 Naira/tonnes respectively. The result of the growth model showed that the compound growth rate of maize yield was 1.92%; rice yield was 8.76%; sorghum yield was 1.61%; maize price was 50.22%; rice price was 46.81%; while sorghum price was 52.95%. The result of the direction of growth showed that all the variables had an accelerated growth except maize yield that had a stagnated growth process. The study concluded that the accelerated growth pattern in prices raises concerns about the sustainability of cereal crop production and affordability, especially given the importance of these crops in ensuring food security in Nigeria. The study recommended that Government should implement measures to stabilize crop prices, especially for staple crops like maize, rice, and sorghum.

Keywords: *Cereal, Yield, Prices, Crops, Growth*

INTRODUCTION

Cereal crops play a pivotal role in Nigerian agriculture and food security, contributing significantly to the output of subsistence farmers, constituting about 55-60% of their total output. Additionally, cereals generate income and serve as a dietary staple for many households, both in rural and urban areas (Abah, Esheya, and Ochoche, 2021; Balami *et al*., 2011). Cereals are a primary source of sustenance for human consumption on a global scale. FAO (2021) posited that cereal crops such as rice, maize, sorgum and millet holds the key to feeding the continually growing global population. They emphasize that meeting the dietary needs of an additional 80-100 million people each year will necessitate a 75% increase in cereal production over the next two decades.

Over various historical periods, the growth trajectory of the cereal sector has been subject to temporary disruptions caused by transient factors. These disruptions have sometimes persisted for many years before returning to the underlying growth pattern:

In the 1960s, growth was significantly accelerated by the Green Revolution, which brought about advancements in agricultural practices and technologies. During the 1990s, production experienced a decline in transition economies as they grappled with economic downturns following the collapse of command economies. In the latter part of the 1990s, supply outpaced demand, primarily due to economic crises in East Asian economies and unpredictable weather patterns. The early 2000s saw depressed growth in the cereal sector, mainly attributable to low prices and an oversupply of stocks (FAO, 2008). In recent years, global demand growth has been constrained by economic downturns in major consuming countries. Furthermore, since 2005, a series of unfavorable weather events in significant cereal-producing nations, coupled with reduced levels of investment and stockholding, has led to sudden increases in international cereal prices (Abah, Esheya, and Ochoche, 2021; FAO, 2020), Additionally, the expansion of non-food uses of cereals, such as their use as feedstocks in the fuel ethanol sector, has exerted further upward pressure on prices while creating incentives to boost production (FAO, 2020).

There is a prevailing belief that farmers possess substantial influence over the practical aspects of agricultural production. This implies that farmers have the autonomy to make choices regarding what crops to cultivate, the methods of cultivation, and the selection of inputs to employ. Price considerations play a pivotal role in these decisions, with farmers taking into account prevailing crop prices as a significant factor in their decision-making process (Bor and Bayaner, 2009). Consequently, it is expected that rational producers will respond to increases in crop prices by intensifying the utilization of agricultural inputs. This suggests that farmers make their choices based on their expectations regarding future crop prices (Bor and Bayaner, 2009).

In a competitive economic system, commodity prices serve as crucial signals for producers, offering insights into both the type and quantity of commodities that should be produced in a specific location and at a particular time (Reddy *et al.* 2009 in Abu, 2015). As a result, the relationships between prices have a substantial influence on decisions pertaining to the nature and extent of agricultural production activities. It is widely held that farmers are generally responsive to producer prices (Ezekiel *et al*., 2007). Producers tend to be particularly concerned about low prices, as these can not only threaten their immediate livelihoods but also their long-term viability when income falls too low to support their families or sustain their agricultural operations. It's important to note that the prices of most agricultural commodities fluctuate throughout the season, following regular seasonal patterns (Abu, 2015). Typically, these seasonal prices are at their lowest during harvest periods and reach their highest levels a few weeks prior to the new harvest, especially for storable products such as cereals and leguminous grains (Olukosi *et al.*, 2007). These price fluctuations play a significant role in shaping farmers' decision-making processes and strategies.

In recent years, Nigeria has grappled with a notable surge in food prices, particularly in the case of cereal crops. Audu (2012) has pointed out that cereals are becoming increasingly scarce and expensive, underscoring the pressing need to ramp up cereal production in the country. This urgency stems from a surge in demand for cereal crops due to population growth and rising incomes. However, this increased demand has not been met by corresponding gains in productivity from local farms. Consequently, Nigeria has found itself in the position of being a net importer of certain cereal crops from other countries. The primary objective for Nigeria is to fulfill its domestic demand for these cereal crops. Subsequently, if feasible, the nation aims to compete with other countries in the production of these essential crops. This dual approach seeks to address the immediate food security needs of the population while simultaneously striving for self-sufficiency and competitiveness in the global cereal market.

Food production in Nigeria has been struggling to keep up with the rapid increase in population. Addressing food insecurity and hunger has become even more challenging due to factors like unpredictable rainfall patterns, the global population surge, and the prevalence of high and fluctuating food prices. Another significant factor exacerbating issues related to food security and hunger is the rising levels and volatility of food prices. In light of these complex challenges, this study embarked on the task of assessing the growth trends in cereal crop yields and prices in Nigeria. The objective was to gain insights into how these trends may impact food security in the country. This research is a critical endeavor, given the need to develop strategies that can help Nigeria meet its food needs in the face of a growing population, climate variability, and global economic dynamics.

METHODOLOGY

Study Area

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

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

The vegetation also varies accordingly, with grassland savannah in the north and forests in the south. Agriculture plays a crucial role in Nigeria, employing a significant portion of the population. It is estimated that at least 60% of the projected population is engaged or employed in agriculture, primarily as smallholders. The agricultural sector not only provides employment opportunities but also plays a critical role in ensuring food security and contributing to the country's economy.

Methods of Data Collection and Analytic Technique

The study used time series data spanning from 1981 to 2022. Data on yields and prices were collected from the records of Food and Agriculture Organization (FAO). Data for this study were analyzed using descriptive statistics and growth model.

Model Specification

Growth Model

The trend equation is given as:

$Y_t = Y_0(1+r)^t$……..……..…(1)

Where;

Y_t = Cereal yields or prices in year t. Y_0 = Cereal yields or prices in the base year.

r = compound rate of growth of Y. t = time in chronological years.

Taking the natural log of equation (1) to make it linear, it is stated thus

$InYt = In\ Y_0 + tIn(1+r)$ ...……(2)

Substituting in InY_0 with β_1 and $In(1+r)$ with β_2, equation (2) is rewritten as

$InYt = \beta_1 + \beta_2 t$……..…… (3)

Adding the disturbance or error term to equation (3), we obtain

$InYt = \beta_1 + \beta_2 t + Ut$……..……. (4)

Equation (4) is the growth rate model developed for this study.

Trend model used to ascertain direction and growth rates of variables of interest was specifically stated for the variables of interest as follow:

$\ln Y_t = \alpha + \beta_{cy} t + \mu_t$ ……..…… (5)

$\ln Y_t = \alpha + \beta_p t + \mu_t$ ……..…… (6)

Where:

α = intercept; β = vector of the trend variable and μ is the econometric error term.

β_y, β_p = coefficients of the trend variable for cereal yields and prices of selected cereal crops respectively.

A semi-log growth rate model was developed for this study instead of a linear trend model because the study is interested in both absolute and relative change in the parameters of interest for this study. The parameter of utmost interest in equations (5-6) is coefficient of β, the slope coefficient which measures the constant proportional/relative change in Y for a given absolute change in the value of the regressor t.

Firstly, multiplying b by 100, gives the instantaneous growth rate (IGR) at a point in time.

$IGR = \beta \times 100$ ……..…… (7)

Where:
IGR = Instantaneous growth rate and
β = is the least-square estimate of the slope coefficient

Secondly, taking the antilog of β subtracting 1 from it and then multiplying the difference by 100 gives the compound growth rate (CGR) over a period of time. The compound growth rate (CGR) in percentage in each of the five cases can be recovered from the equations 1-4 in the following manner:

$CGR = (e^{\beta i} - 1)*100$ …….. (8)

Where:
β_i = the coefficient of the trend variable in the respective cases
e= Euler's exponential constant (=2.71828)

In order to estimate the direction or pattern of growth so as to determine whether there is acceleration, deceleration or stagnation, quadratic equation in time trend variable was fitted as follows:

$Y_t = \beta_o + \beta_1 t_i + \beta_2 t_i^2 + Ut$ …….. (9)

All variables as previously defined, β_o, β_1 and β_2 are parameters to be estimated. In the specification of equation 9, the linear and quadratic time terms indicate the circular path in the dependent variable (Y_t). The quadratic time variable (t^2) allows for the possibility of determining whether there was acceleration, deceleration or stagnation in the study. In determining the direction or pattern of growth, the main concern is on β_2 (i.e. coefficient of t_i^2) which reveals the measure of the growth pattern.

Finally, in equations 9, if β_2 is positive and statistically significant there is acceleration in growth, if β_2 is negative and statistically significant there is deceleration in growth, if β_2 is not statistically significant there is stagnation in the growth process.

RESULTS AND DISCUSSION

Summary statistics of the variables

The summary statistics of the variables used in the study is presented in Table 1. The result showed that the variables maize yield, rice yield, sorghum yield and sorghum price were positively skewed to the right tail implying the presence of more values that are higher than the sample mean while the variables maize price and rice price were negatively skewed to the left tail implying the presence of more values that are lower than the sample mean.

The result further showed that the variables rice yield, maize price, sorghum price and rice price were platykurtic (negative kurtosis) with a kurtosis value less than 3 implying that the distribution had a flatten curve relative to the normal. This shows that there were more values that are lower than the sample mean. The variable maize yield was mesokurtic showing a normal distribution of the variable. However, the variables sorghum yield was leptokurtic (positive kurtosis) a kurtosis value greater than 3 showing that the distribution had a peaked curve relative to the normal.

More so, the result of the Jarque-Bera probability test of normality showed that the variables rice yield, maize yield, maize price, sorghum price and rice price were not statistically significant at 5% significant level having probability values greater than 0.05 (5%) which indicated the normal distribution of the variables used in the study. However, the variable sorghum yield was not normally distributed.

Table 1. Summary Statistics of the Variables

	Maize Yield	Rice Yield	Sorghum Yield	Maize Price	Rice Price	Sorghum Price
Mean	1.46894	1.74620	1.17929	31049.15	34586.29	26424.32
Median	1.49490	1.75210	1.14435	32155.00	35090.00	24100.00
Maximum	2.19610	2.38930	1.63320	68760.00	71550.00	79452.00
Minimum	0.970700	1.29990	0.969100	210.0000	400.0000	180.0000
Std. Dev.	0.253188	0.287681	0.164853	25385.00	25650.82	22141.64
Skewness	0.436271	0.070658	1.434259	-0.006561	-0.147291	0.279330
Kurtosis	3.325710	1.810607	4.763232	1.323519	1.354513	2.012769
Jarque-Bera	1.445696	2.391044	18.89563	4.684599	4.657344	2.144544
Probability	0.485368	0.302546	0.000179	0.096106	0.097425	0.342230
Sum	58.77180	69.90600	47.19940	1241966.	1383452.	1056973.
Sum Sq. Dev.	2.503541	3.203408	1.061832	2.51E+10	2.57E+10	1.91E+10
Observations	40	40	40	40	40	40

Source: Data Analysis, 2023.

Trends of Maize, Rice and Sorghum Yield in Nigeria

The trend of selected crops yield is presented in Figure 1. The result showed that maize yield ranged between 0.97 tonnes/hectares and 2.18 tonnes/hectares with a mean of 1.46 tonnes/hectares during the period under study. This is comparable with reports by IITA (20120) who observed an average maize yield of 1.69 tonnes per hectare in Nigeria in the year 2019. The average yield is low when compared to world average of 4.3 tonnes/ha and to that from other African countries such as South Africa with 2.5 tonnes/ha, Cameroon, 1.9 tonnes/ha, Ethiopia, 1.8 tonnes/ha and Kenya, 1.7 tonnes/ha (FAO, 2019). Specifically, maize yield decreased drastically between 1981 and 1983. However, maize yield increased from 1984 to 1989 but decreased from 1989 to 1992.

Furthermore, maize yield increased from 1992 to 2009 amidst intermittent fluctuations. However, maize yield decreased drastically between 2009 and 2011 from whence it has continued to increase howbeit at a slow pace. This can be attributed to the fact that the planted lands of maize and grain production have increased significantly across regions in SSA since 1961 (FAOSTAT, 2015).

The result showed that rice yield ranged between 1.29 tonnes/hectares and 2.38 tonnes/hectares with a mean of 1.74 tonnes/hectares during the period under study. This is consistent with findings IITA (2020) who reported that average rice yield in Nigeria is low and have remained at 2 tonnes/hectares. Yield per hectare is low due to production systems, aging farming population and low competitiveness with imported rice. pecifically, rice yield decreased from 1981 to 1982 but increased sharply between 1982 and 1985. Rice yield fluctuated between 1985 and 1987 where highest yield was recorded in Nigeria. A decreasing trend was observed from 1988 till 1996 where rice yield declined sharply. A fluctuating trend was noticed from 1996 till 2007 where rice yield was lowest. Rice yield increased sharply howbeit with intermittent fluctuations between 2008 and 2015 where a drastic decreased was noticed. This could be due to the impact of Covid-19 that hampered most production activities in the world (Abah, Ochoche, and Teran, 2021). However, an upward trend was observed from 2016 to 2019 where a slight decrease was noticed between 2019 and 2020.

The result also showed that sorghum yield ranged between 0.96 tonnes/hectares and 1.63 tonnes/hectares with a mean of 1.17 tonnes/hectares during the period under study. Specifically, sorghum yield was fairly constant between 1981 and 1983 but decreased drastically from 1983 to 1984. Furthermore, sorghum yield fluctuated tremendously and hovered around 1.0 to 1.2 tonnes/hectares between 1984 and 2003. It however increased drastically from 2003 to 2006 where a decreasing trend was noticed. Furthermore, sorghum yield picked up the pace of growth and increased drastically from 2009 to 2010 but decreased yet again in 2011. The fluctuating pattern was noticed from 2012 to 2020 in sorghum yield. This can be attributed to the fact that sorghum production in Nigeria has been considerably low over the years. This is due to both a lag in crop improvement efforts in these crops and the extreme environmental conditions and the low input agriculture under which these crops are grown. (Abah, Emmanuel and Ochoche, 2021). Similar sorghum growth pattern was reported by Abah, Emmanuel and Ochoche (2021) who reported that sorghum production in Nigeria had fluctuated tremendously alternating between increases and decreases over the past 38 years.

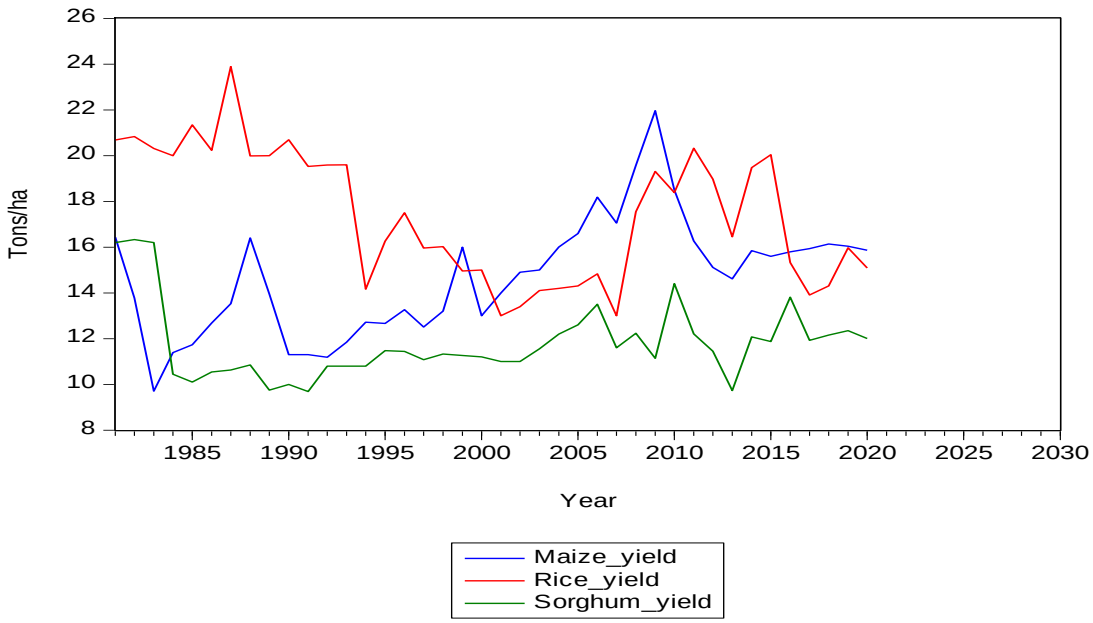

Figure 1. Trend of Rice, Maize and Sorghum Yields in Nigeria (1981-2020)
Source: Data Analysis, 2023.

Trends of Maize, Rice and Sorghum Prices in Nigeria

The trend of selected crops prices is presented in Figure 2. The result showed that maize price ranged between 210 Naira/tonne and 68760 Naira/tonnes with a mean of 31049.15 Naira/tonnes during the period under study. The increase in maize price can be attributed to increased demand as a result of population explosion, climate change amongst other factors constraining the supply of maize in Nigeria. Specifically, maize price was fairly constant from 1981 to 1990 but increased sharply from 1990 to 1994 where a slight noticeable decrease was experienced till 1995. More so, there was a sharp increase in maize price from 1995 to 1999 from where a declined was noticed in the trend of maize price. This increasing trend in maize price has continued over the years in Nigeria. The result further showed that maize price has increased considerably amidst little fluctuations from 2000 to 2020. The increase in maize price can be attributed to increased demand as a result of population explosion, climate change amongst other factors constraining the supply of maize in Nigeria. This finding is in line with Oyiga *et al.* (2011) who showed that prices of selected staple crops (maize, wheat and rice) have been increasing for the last decade; the price increases have become more volatile in recent years.

The result also showed that rice price ranged between 400 Naira/tonnes and 71550 Naira/tonnes with a mean of 34586.29 Naira/tonnes during the period under study. Specifically, rice price was fairly constant from 1981 to 1990 but increased sharply from 1990 to 1994 where a slight noticeable decrease was experienced till 1995. More so, there was a sharp increase in rice price from 1995 to 1999 from where a declined was noticed in the trend of rice price. As observed in the trend of maize price, this increasing trend in rice price has continued over the years in Nigeria.

The result further showed that rice price has increased considerably amidst little fluctuations from 2000 to 2020. This can be attributed to various policies such as import restriction on rice that has increased the demand for domestic rice thereby causing an upward surge in the price of rice in Nigeria. Climate change is one of the factors driving prices in Africa. A 7 percent rise in price of rice is projected for 2050 due to climate change in the continent (Ringler *et al.*, 2010).

The result further showed that sorghum price ranged between 180 Naira/tonnes and 79452 Naira/tonnes with a mean of 26424.32 Naira/tonnes during the period under study. Specifically, sorghum price was fairly constant from 1981 to 1990 but increased sharply from 1990 to 1994 where a slight noticeable decrease was experienced till 1995. Furthermore, there was a sharp increase in sorghum price from 1995 to 1999 from where a declined was noticed in the trend of sorghum price. More so, sorghum price increased sharply between 2000 and 2003 but however declined slightly from 2003 to 2004. There was a drastic decrease in sorghum price from 2009 to 2010. The result further showed that sorghum price has increased considerably amidst little fluctuations from 2010 to 2020. This agrees with the various studies such as Oyiga *et al.* (2011) and Ringler *et al.* (2010) who reported that prices of selected staple crops have been increasing for the last decade.

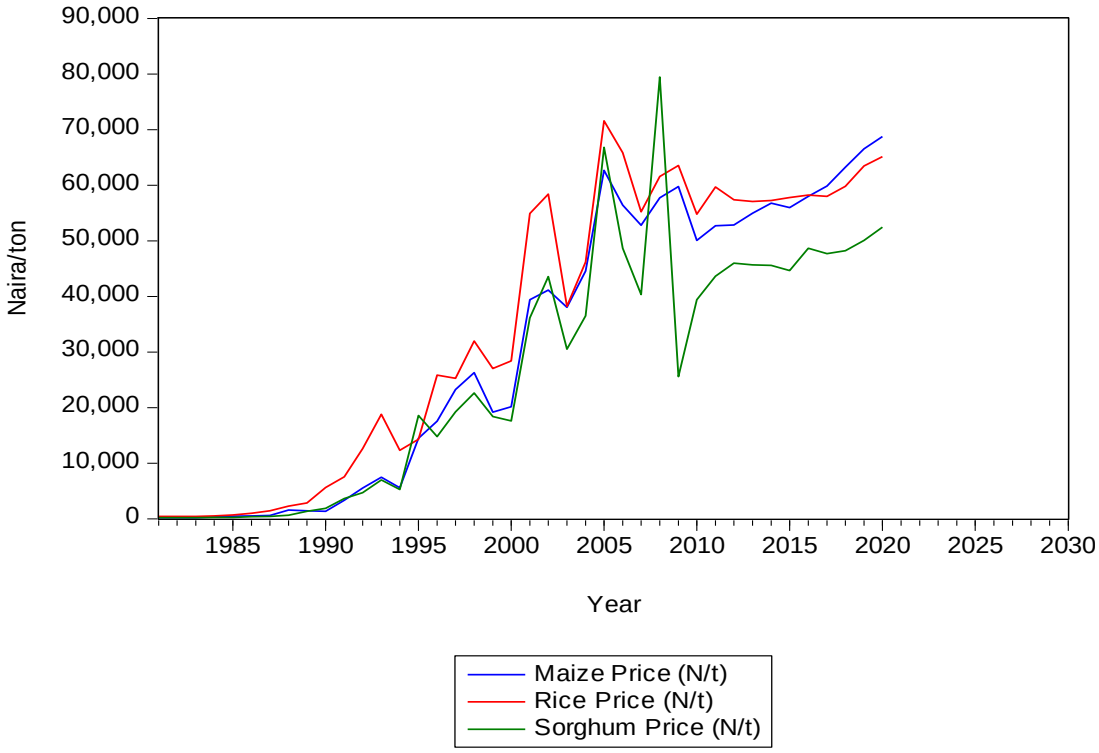

Figure 2. Trend of Rice, Maize and Sorghum Prices in Nigeria (1981-2020)
Source: Data Analysis, 2023.

Growth of Maize, Rice and Sorghum Yields in Nigeria

The summarized result of the growth trend analysis is presented in Table 2 and summarized in Table 3. The exponential growth model was chosen from different functional forms as a good fit based on the low value of Akaike information criterion (AIC) and coefficient of determination (R^2). The result revealed that the coefficient for estimating the growth of maize yield was positive (0.009) and significant at 1%. The instantaneous growth rate (growth at a point) was 1.90 suggesting that there has been a 1.90% per annum increase in maize yield for the period 1981-2020. The compound growth rate of maize yield was 1.92%. This implies a relatively slow process of growth in maize yield particularly during the period 1981-2020. The quadratic term (t^2) allows for the possibility of acceleration, deceleration or stagnation in the area growth processes. Results in Table 2 showed that the value of the coefficient of t^2 for maize yield (-0.001) was negative and not significant implying a stagnated growth process in maize yield over time. This is in contrast with the findings of Abah, Esheya and Ochoche (2021) who reported a decelerated growth pattern in the production of maize in Nigeria between 1981 and 2018. However, this observed difference could be attributed to the difference in the span of time the studies were carried out.

Table 2. Growth Rates and Direction of the Variables

Variables	IGR (%)	CGR (%)	Direction of growth
Maize yield	1.90	1.92	Stagnation
Rice yield	8.40	8.76	Acceleration
Sorghum yield	1.60	1.61	Acceleration
Maize price	40.70	50.22	Acceleration
Rice price	38.40	46.81	Acceleration
Sorghum price	42.50	52.95	Acceleration

Note: IGR = Instantaneous growth rate; CGR = Compound growth rate

Similarly, the result revealed that the coefficient for estimating the growth of rice yield was positive (0.084) and significant at 1%. The instantaneous growth rate (growth at a point) was 8.40% suggesting that there has been an 8.40% per annum increase in rice yield for the period 1981-2020. The compound growth rate rice yield was 8.76%. This implies a relatively slow process of growth in rice yield particularly during the period 1981-2020. Results in Table 2 showed that the value of the coefficient of t^2 for rice yield (0.007) was positive and significant implying an accelerated growth process in rice yield over the years.

Furthermore, the result revealed that the coefficient for estimating the growth of sorghum yield was negative (-0.016) and significant at 5%. The instantaneous growth rate (growth at a point) was 1.60% suggesting that there has been an 1.60% per annum increase in sorghum yield for the period 1981-2020. The compound growth rate of sorghum yield was 1.61%.

This implies a relatively slow process of growth in sorghum yield particularly during the period 1981-2020. Results in Table 2 showed that the value of the coefficient of t^2 for sorghum yield (0.004) was positive and significant implying an accelerated growth process in sorghum yield over the years. This is in line with the findings of Abah, Emmanuel and Ochoche (2021) who reported a similar sorghum growth pattern in Nigeria between 1981 and 2019.

Growth of Maize, Rice and Sorghum Prices in Nigeria

The result revealed that the coefficient for estimating the growth of maize price was positive (0.407) and significant at 1%. The instantaneous growth rate (growth at a point) was 40.70% suggesting that there has been a 40.70% per annum increase in maize price for the period 1981-2020. The compound growth rate of maize price was 50.22%. This implies a very fast process of growth in maize price particularly during the period 1981-2020. Results in Table 2 showed that the value of the coefficient of t^2 for maize price (0.007) was positive and significant implying an accelerated growth process in maize price over the years.

More so, the result revealed that the coefficient for estimating the growth of rice price was positive (0.384) and significant at 1%. The instantaneous growth rate (growth at a point) was 38.40% suggesting that there has been a 38.40% per annum increase in rice price for the period 1981-2020. The compound growth rate of rice price was 46.81%. This implies a very fast process of growth in rice price particularly during the period 1981-2020. Results in Table 2 showed that the value of the coefficient of t^2 for rice price (0.007) was positive and significant implying an accelerated growth process in rice price over the years.

Finally, the result revealed that the coefficient for estimating the growth of sorghum price was positive (0.425) and significant at 1%. The instantaneous growth rate (growth at a point) was 42.50% suggesting that there has been a 42.50% per annum increase in sorghum price for the period 1981-2020. The compound growth rate of sorghum price was 52.95%. This implies a very fast process of growth in sorghum price particularly during the period 1981-2020. Results in Table 2 showed that the value of the coefficient of t^2 for sorghum price (0.0069) was positive and significant implying an accelerated growth process in sorghum price over the years.

CONCLUSION AND RECOMMENDATIONS

In conclusion, this research provides valuable insights into the growth trends of selected cereal crops (maize, rice, and sorghum) in Nigeria. The analysis revealed that maize, rice, and sorghum yields exhibited varying patterns over the years. On the pricing front, maize, rice, and sorghum prices displayed a wide range, with maize prices experiencing a significant compound growth rate. These price trends suggest significant fluctuations in the pricing dynamics of these cereals. A noteworthy observation from the study is that all variables, except maize yield, exhibited accelerated growth.

This acceleration in prices raises concerns about the sustainability of cereal crop production and affordability, especially given the importance of these crops in ensuring food security in Nigeria. Overall, the findings underscore the need for targeted agricultural policies and interventions to boost cereal crop yields, stabilize prices, and enhance food security. Addressing the challenges associated with these decelerated growth rates is essential for ensuring a consistent and affordable supply of these vital staple crops for the Nigerian population.

Recommendations

i. Government should increase investment in agricultural research and development to develop and disseminate improved crop varieties and farming techniques. This can help boost crop yields.

ii. There should be improved market access for farmers by investing in transportation infrastructure and creating marketing channels that allow farmers to sell their crops at fair prices. This can incentivize increased production.

iii. The government should implement measures to stabilize crop prices, especially for staple crops like maize, rice, and sorghum. Price stabilization can help make food more affordable and accessible to consumers.

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Table 2. Growth Trend Model

Variables	Model	Determinant	Coefficient	t-stat	Prob.	R^2	F-stat	Prob.
Maize yield	Linear	Trend	0.132	4.755	0.0000	0.373	22.607	0.000
		Constant	12.110	19.210	0.0000			
	Exponential	Trend	0.019	5.066	0.0000	0.413	25.666	0.000
		Constant	2.491	59.584	0.0000			
	Quadratic	Trend	0.012	1.627	0.1123	0.405	12.602	0.000
		$Trend^2$	-0.001	-0.358	0.7224			
		Constant	2.475	40.222	0.0000			
Rice yield	Linear	Trend	-0.130	-3.837	0.0000	0.279	14.720	0.000
		Constant	19.998	26.039	0.0000			
	Exponential	Trend	0.084	10.721	0.0000	0.976	133.174	0.000
		Constant	7.091	27.304	0.0000			
	Quadratic	Trend	0.083	25.589	0.0000	0.778	743.697	0.000
		$Trend^2$	0.007	17.361	0.0000			
		Constant	5.495	43.407	0.0000			
Sorghum yield	Linear	Trend	0.0013	0.056	0.956	0.375	2.065	0.053
		Constant	11.768	22.702	0.0000			
	Exponential	Trend	-0.016	-2.403	0.6720	0.509	2.864	0.048
		Constant	2.444	59.999	0.0000			
	Quadratic	Trend	0.007	2.427	0.0214	0.407	3.501	0.040
		$Trend^2$	0.0004	2.606	0.0131			
		Constant	2.548	46.165	0.0000			
Maize price	Linear	Trend	0.035	14.157	0.0000	0.881	244.202	0.000
		Constant	6.765	25.608	0.0000			
	Exponential	Trend	0.155	13.517	0.0000	0.828	182.722	0.000
		Constant	6.327	24.336	0.0000			
	Quadratic	Trend	0.407	26.266	0.0000	0.980	909.048	0.000
		$Trend^2$	0.007	16.804	0.0000			
		Constant	4.735	36.288	0.0000			
Rice price	Linear	Trend	0.092	12.801	0.0000	0.785	158.045	0.000
		Constant	7.818	29.909	0.0000			
	Exponential	Trend	0.132	11.540	0.0000	0.778	133.174	0.000
		Constant	7.091	27.309	0.0000			
	Quadratic	Trend	0.384	25.589	0.0000	0.976	743.697	0.000
		$Trend^2$	0.007	17.361	0.0000			
		Constant	5.495	43.407	0.0000			
Sorghum price	Linear	Trend	0.189	13.226	0.0000	0.814	166.625	0.000
		Constant	4.168	22.553	0.0000			
	Exponential	Trend	0.154	12.106	0.0000	0.794	146.562	0.000
		Constant	6.168	21.351	0.0000			
	Quadratic	Trend	0.425	20.532	0.0000	0.965	516.034	0.000
		$Trend^2$	0.0069	3.532	0.0000			
		Constant	4.451	25.491	0.0000			

Source: Data Analysis, 2023.