
INTRODUCTION

Rice is Nigeria’s main staple food crop, and it is grown in almost all of the country’s coastal mangrove and swamp regions, as well as the dry zones of the Sahel in the north (Akande, 2002). Rice production, processing, and marketing is the primary source of income for people living in rice-producing areas of Nigeria. The majority of rice actors, however, are resource poor and constrained. Their operations are distinguished by limited access to commodity and service markets, as well as limited access to information and technology (FAO 2008). Furthermore, rice is currently one of Nigeria’s most important staple food crops, and it is primarily grown by smallholder farmers (Oladimeji et al., 2020). Rice production has become increasingly market-oriented in recent years, becoming an important food and cash crop for the country’s smallholder farmers. According to the National Food Reserve Agency, which Onu et al. (2015) cite, approximately 1.7 million hectares of land were under cultivation in Nigeria in 2007. However, rice demand has been increasing over the years (Ayanwale and Amusan, 2012). The study also reveals that since 1970, rice consumption in Nigeria has risen tremendously by 10.3% per annum due to accelerating population growth rate, increase income levels as well as associated changes in family occupational structures. Successive government in Nigeria have continued to encourage rice farmers to increase their output in order to meet with domestic and market demand. Such efforts include the establishment of National Cereals Research Institute (NCRI) which has release over 54 varieties to serve different ecologies in Nigeria. Despite rice becoming one of Nigeria’s most consumed staples and the country making boosting rice produce, a priority, 60% of rice purchased in urban areas is imported due to weak links in the Rice Value Chain in Nigeria (Ayoola and Kwon-Ndung, 2013). Nigeria is the second largest importer of rice in the world, buying at least Two million metric tons per year.
from exporting countries like China and Thailand (USAID Markets, 2009, FAO 2013). Nigeria’s fertile land and rich climatic condition could easily produce rice to feed the entire country. Total potential land for irrigated rice production is estimated at 1.6 million hectares out of which only 471,798 ha is available (Ileso, 2000). In the last 15 years, the Federal Government of Nigeria has been desirous to make Nigeria self-sufficient in rice production.

However, Nigerian population has increased from about 60 million in 1963 to 88.5 million in 1991 (National Population Census, 1963 and 1991) with about 48% increase during that period. In recent time, the population has increased from 88.5 million to a recent estimated figure of over 184 million in 2016 (NPC, 2016). This scenario, 1991-2016) increase in population, shows that population has double in 25 years with about 107% increase. In the past, hunting and fruit gathering was the principal occupation and also means of acquiring food. Population has continued to grow at geometric progression. The history of dramatic growth in Nigeria population began when hunting and gathering was abandoned for farming, animal husbandry, and increase in permanent settlement and eventually formation of cities (Ewugi and Illyasu, 2012). In Nigeria and mostly developing countries, the demand for food products has exceeded supply creating a huge deficit (Macauley, 2019). Although importation of food products was used partially to fill the growing deficits in the past, and presently, its continuation constitutes an avoidable drain on Nigeria’s scarce foreign earnings, especially during this period of economic instability and dwindling oil prices (Oladimeji, 2017).

In 2006, the Bill and Melinda Gates Foundation and The Rockefeller Foundation came together to establish the Programme for Africa’s Seed Systems within the Alliance for a Green Revolution in Africa to address the challenges associated with supplying Africa’s farmers with high-yielding improved adapted seeds (Joe DeVries AGRA 2018). Seeds of improved varieties are important in raising yields and ensuring food security, proper nutrition and prosperity for not only smallholder farmers but the general population. The irony of the seed industry globally is that smallholder farmers who need seeds the most to make more from their small pieces of land have the least access to these seeds (Kalibata AGRA 2016).

High quality seed is fundamental to the farming business. Most annual crops are established each season from seeds, and seed quality has a major impact on potential crop yield. Seeds can serve as the delivery system not only for improved genetics but for new planting and production methods (Thirtle et al., 2013). And also crop protection strategies that improve the overall efficiency of agriculture and reduce its environmental impact. The purity of any commercial product propagated by seed begins with the genetic purity of the seed planted (Phillip et al., 2009). The Production of quality rice seed is one of the major areas taken for granted by rice farmers, this is because farmers realize crop growth even from traditional seed. However, the benefit of good seed does not stop at crop growth but also to grain quality and yield.

Production of high-quality rice seed is an exacting task thus seed producers take many steps to protect genetic integrity of the seed. Such steps include ensuring the integrity of their planting seed, properly identifying and labelling plants and fields, planting seeds on clean land which has not been used to grow the same crop in the recent past, removing rogue plants, or plants which are not true to the variety’s characteristics, and employing physical isolation. This is the last stage which actually reaches the farmer. Certified seed is the progeny of foundation seed and it is grown by selected farmers to maintain sufficient varietal purity. Production is subject to field and seed inspections prior to approval by the certifying agency. Harvest from this class is used for producing again (paddy).

Rice has become a highly strategic and priority commodity for food security in Africa (Wopereis et al., 2013). Consumption is growing faster than that of any other major staple on the continent because of high population growth, rapid urbanization and changes in eating habits (Seck et al., 2013). It is the single most important source of dietary energy in West Africa and the third most important for Africa as a whole (Oladimeji et al., 2020). Although local rice production increased rapidly after the 2007–2008 food crisis, a key problem facing the rice sector in Africa in general is that local production has never caught up with demand. The continent therefore continues to rely on importation to meet its increasing demand for rice. Although Nigeria has made significant strides in increasing the rice production through the adoption of new and improved varieties and especially through area expansion and intensification (Onu et al., 2015).

Agricultural crop production is essentially a rural affair (Asiabaka and Owens, 2002; Chukwuemeka and Nzewi 2011). Several studies have recognized increased agricultural productivity as a means for reducing rural poverty (Prabha and Chatterjee, 2009; Prabha and Chatterjee, 2010). Therefore, an analysis of the growth rates in output, hectarage, productivity and price of the maize seeds crop in Nigeria is not only expected to contribute to literature, but also towards reducing rural poverty. The broad objective of this paper is to analyze the growth rates in output, hectarage, productivity and price of the rice seeds crop in Nigeria. Specifically, the study seeks to (i) Estimate the instantaneous and compound growth rates of rice seeds production, hectarage, productivity and price over the study period (2007-2017). (ii) Investigate the existence of acceleration, stagnation or deceleration in growth rates of rice seeds production, hectarage, productivity and price over the study period (2007-2017).

METHODOLOGY

The study area

The study was conducted in Nigeria; the country is situated on the Gulf of Guinea, in sub-Saharan Africa. Nigeria lies...
between Longitudes 2° 49' E and 14° 37' E and Latitudes 4° 16'N and 13° 52' N. It has a total land area of 923,768,622 km² and an estimated population of over 160 million as of 2016 (NPC, 2016). The climate is tropical, characterized by high temperatures and humidity with marked wet and dry seasons, though there are variations between the South and North. Total rainfall decreases from the coast northwards. The South, below Latitude 8° N has an annual rainfall ranging between 1,500 and 4,000 mm and the extreme North between 500 and 1000 mm (Izuchukwu, 2011). Over 60 per cent of the population lives in the rural areas (Obiechina, 2007).

Farming, mining and manufacturing, craft works and trading to mention a few assume a major share of occupation of the people. However, agriculture is the dominant sector of the economy and contributes immensely to the Gross Domestic Product (GDP) and employs about 68 per cent of the working population (Ammani, 2011). According to World Bank records, Nigeria GDP has been shown a downfall movement from that past three years; $481.1 billion in 2015, $404.7 billion in 2017 while $375.8 billion in 2017. Agriculture as one of the critical sectors of the economy contributed about 21% of the total GDP in 2017.

**Method of Data Collection**

Time series data on aggregate certified rice seed production, hectarage and price in Nigeria for the period 2007-2017 were collected through primary data. The certified rice seed productivity data was estimated from the collected time series data at North West, North Central and South West Nigeria. For the purpose of this study, yield in metric tonnes (MT) per hectare is taken as proxy for productivity.

**Model Specification**

This sub-section is based on (Chiang and Wainwright, 2005; Gujarati and Porter, 2009; Gujarati, 2003). Semi-log trend equation is utilized in estimating compound growth rates (CGR), where a given year’s output depends upon that of the preceding year. The used of CGR in studying the growth rate of agricultural crops has been documented. Applying the well-known compound interest formula to the problem of rice production/hectarage/yield/price.

\[
Y_t = Y_0 (1+r) t 
\]

Where

\[
Y_t = \text{Quantity of rice produced/hectarage/yield/price in year } t 
\]

\[
Y_0 = \text{The quantity of rice produced/hectarage/yield/price in the base year} 
\]

\[
r = \text{Compound rate of growth of Y} 
\]

\[
t = \text{Time in chronological years} 
\]

Taking the equation (1) linear, we take the natural log to give

\[
\ln Y_t = \ln Y_0 + t \ln (1+r) \quad \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots (2)
\]

Substituting \( \ln Y_0 \) with \( \beta_1 \) and \( \ln (1+r) \) with \( \beta_2 \), we then rewrite equation (2) as

\[
\ln Y_t = \beta_1 + t \beta_2 \quad \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots (3)
\]

Adding the disturbance or error term to equation (3) to get new equation (4)

\[
\ln Y_t = \beta_1 + \beta_2 t + \epsilon_t \quad \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots (4)
\]

The equation (4) is the growth rate model developed for, and estimated in, this study. Instead of a linear trend model, a semi-log growth rate model is developed for this study because the study is interested in both absolute and relative change.

The parameter of utmost interest in the equation (4) is the coefficient of \( \beta_2 \) (b2), the slope coefficient which measures the constant proportional or relative change in \( Y \) for a given absolute change in the value of the regress or \( t \).

First, to get the instantaneous growth rate (IGR) at a point in time we multiplying b2 by 100.

\[
\text{IGR} = \beta_2 x 100 \quad \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots (5)
\]

Where:

\[
\text{IGR} = \text{Instantaneous Growth Rate} 
\]

\[
\beta_2 = \text{Is the least-square estimate of the slope coefficient} \beta_2 
\]

Second, taking the antilog of b2 and subtracting 1 from it and then multiplying the difference by 100 gave the compound growth rate (CGR) over a period of time.

\[
\text{CGR} = \frac{[\text{antilog b2 - 1]} x 100}{1} \quad \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots (6)
\]

Finally, if b2 is positive and statistically significant there is acceleration in growth, if b2 is negative and statistically significant there is deceleration in growth, if b2 is not statistically significant there is stagnation in the growth process. The growth model equation (4) was estimated using SPSS 20.0

Several institutes, bodies and individual has conducted studies to measure different types of cereal crop productivity in terms of yield per hectare; only a small fraction of such studies employed total factor productivity (TFP) trends (Pingali and Heisey, 1999). Though partial factor productivity (PFP) measures, such as yield per hectare, do not sufficiently addressed the long-term impact of technological changes on crop productivity, a task well beyond the scope of this paper, it is free of the major limitations of the TFP especially in developing countries: (i) obtaining consistent data (ii) selecting which factor, of the many that can affect TFP growth, to study and (iii) the almost always impossible task of defining and measuring all of the inputs and outputs in the crop production process (Alston et al., 1995). This informed the choice of yield per hectare as the measure of rice seed productivity used in this study.

**RESULTS AND DISCUSSION**

**Trends in Rice Seed Production (2007-2017)**

The coefficient of the trend variable, b2, in the growth
Table 1. Results of growth rate analysis for rice seed production, area cultivated/hectarage, productivity and price in Nigeria for the period of 2007-2017.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Rice Seed Production (MT)</th>
<th>Rice Seed Area cultivated (Ha)</th>
<th>Rice Yield (MT/Ha)</th>
<th>Avg. Price/Kg in NGN</th>
</tr>
</thead>
<tbody>
<tr>
<td>b2</td>
<td>0.071</td>
<td>0.18</td>
<td>3.264</td>
<td>0.044</td>
</tr>
<tr>
<td>F(p-value)</td>
<td>9.356</td>
<td>5.704</td>
<td>15.716</td>
<td>37.303</td>
</tr>
<tr>
<td>(0.041)*</td>
<td>(0.041)*</td>
<td>(0.003)*</td>
<td>(0.0003)*</td>
<td></td>
</tr>
<tr>
<td>IGR (%)</td>
<td>7.10</td>
<td>18.00</td>
<td>326.40</td>
<td>4.40</td>
</tr>
<tr>
<td>CGR (%)</td>
<td>17.76</td>
<td>51.36</td>
<td>183,553.84</td>
<td>10.66</td>
</tr>
<tr>
<td>R</td>
<td>0.714</td>
<td>0.623</td>
<td>0.797</td>
<td>0.898</td>
</tr>
<tr>
<td>R²</td>
<td>0.510</td>
<td>0.388</td>
<td>0.863</td>
<td>0.806</td>
</tr>
<tr>
<td>Mean</td>
<td>33.374</td>
<td>11.798</td>
<td>2.537</td>
<td>225.091</td>
</tr>
<tr>
<td>Std. Deviation</td>
<td>33.169</td>
<td>11.445</td>
<td>0.810</td>
<td>68.259</td>
</tr>
</tbody>
</table>

Statistically significant level at α = 5%
Source: Field Survey Data 2019

Figure 1: Rice Seed Production trend in Nigeria

Figure 5: Percentage Change in Rice Seed Production and Area Cultivated/Hectarage in Nigeria

model of equation (4) has a value of. This indicates that over the period 2007-2017, rice production in Nigeria had an annual instantaneous growth rate of %; and a compound growth rate of % (Table 1). Thus it can be concluded that there is accelerated growth in rice production over the study period (Figure 1), while the percentage change in production moved downward negatively (Figure 5).


From the analysis, the coefficient of the trend variable, b₂,
in the growth model equation (4) has a value of. This indicates that over the period 2007-2017, area cultivated for rice seed in Nigeria had a positive annual instantaneous growth rate of %; and a compound growth rate of % (Table 2). Thus it can be concluded that there is stepping up in rice area cultivated/hectarage over the period 2007-2017 (Figure 2). Over the years, the area dedicated to rice crop cultivation in Nigeria has been increasing. This could be elucidated as resulting from maize seed producers/farmers gradually seeing the great importance of maize seed production. This finding suggests that the increase in rice seed production observed earlier in this study is more likely as a result of intensification of rice seed production rather than through hectarage expansion. It is also observed that, the percentage change in area cultivated/hectarage (Ha) moved downward negatively (Figure 5).


The coefficient of the trend variable, $b_2$, in the growth model equation (4) has a value of 3.925. This indicates that over the period 2007-2017, rice seed yield in Nigeria had an annual instantaneous growth rate of 392.50%; and a compound growth rate of 841,295.10% (Table 1). Thus it can be concluded that there is very high acceleration in rice yield growth rate over the study period (Figure 3). The average annual yield calculated for rice seed in Nigeria ranges from 1.12 to 2.2MT/Ha in the 90's and early 2000 which was below the expected yield range of 1.5-6.0 MT/Ha based on recommended agronomic practices (IAR, undated).


The coefficient of the trend variable, $b_2$, in the growth model of equation (4) has a value of 0.04. This indicates that over the period 2007-2017, average price of rice seed in Nigeria had an annual instantaneous growth rate of 4.00%; and a compound growth rate of 9.65% (Table 1). Thus it can be concluded that there is accelerated growth in average price of rice seed over the study period (Figure 4).
CONCLUSION

Rice area cultivated in Nigeria had a very good positive annual instantaneous growth rate of 19.30%; and a high compound growth rate of 55.96%. Furthermore, there is a very high significant growth rate acceleration in rice productivity over the period 2007-2017. Certified rice seed yield in Nigeria had an annual instant growth rate of 392.50% and a very high compound growth rate of 841,295.10%. Additionally, the period 2007-2017, average price of certified rice seed in Nigeria had an annual instantaneous growth rate of 4.00% with a compound growth rate of 9.65%. For Africa to attain food and nutrition security that will spur inclusive growth and development, local production of seeds of high yielding varieties must be increased. These seeds should be tailored for specific ecological conditions to adapt to the changing climate and must also be disease and pest resistant.

Based on the above findings of this study, the following recommendations are cutting-edge: Considering Nigeria’s rapid population growth rate, there should be deliberate effort to increase rice production geometrically in order to maintain pace with the population growth in order to ensure food security in Nigeria. It can be achieve through adequate and timely financing of rice production. Secondly, in view of Nigeria’s abundant land resources especially in the savanna zones, extensification of rice production is another alternative to increase production by putting more land area under rice cultivation with the use of modern technologies.

Conflict of interests

The authors declare that they have no conflicting interests.

REFERENCES


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