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Cassava Production in Nigeria: Trends, Instability and Decomposition Analysis

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Abstract
This study analyzed the compound growth rate (CGR) and the contributions of yield and area to cassava production output in Nigeria. In these analyses, the study factored into consideration, in each of the periods, the triennium beginning (TB) and triennium ending (TE). During the period, TB 1970 – TE 1995, yield oscillated between 10.7t/ha (TE 1972) and 10.6 t/ha (TB 1996). At this period, the CGR for yield (0.7%), area (10.8%) and production (11.5%) were positive. The decomposition analysis for the period revealed that increase in output was largely due to expansion of area under cultivation (115%). However, during the period, TB1996 – TE2017, the huge increase in production was largely as a result of interaction between yield and area effects (56.8%) and yield effect (43.8%). At this period, values of CGR for area (9.5%) and production (7.5%) were positive while that of yield was negative (-1.9%). There was a sharp decline from 11.7t/ha (TE 2011) to 7.9t/ha (TE 2014). The interaction between yield and area as well as yield effect compensated for the negative effect of the shrinking land for cassava cultivation. The study recommends that policy strategies geared towards cutting edge scientific methods can achieve optimum cassava production in Nigeria
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1. 0 Introduction

Nigeria remains a reference point among comity of countries producing cassava in the world. Nigeria currently holds the record of the largest producer of cassava in the world but among the seven world topmost current cassava producers. However, it recorded the highest dip in yield performance (-31512 Hg/ha) between the period, 1970 – 2017 (FAOSTAT, 2018). This trend in yield performance (production per hectare) confirms and corroborates the submission that African soils are poor in nutrients to support crop high performance (Tadele and Assefa, 2012; and Fakayode Babatunde and Ajao, 2012). According to FAO, without sustainable soil management and efficient use of other productive resources, achieving most of the targets of Sustainable Development Goals (SDGs) within the African context will be extremely difficult. It is also certain that without sustainable agriculture, eradicating hunger will remain a mirage. The general consensus is that poor management of agricultural lands in sub-Saharan Africa (SSA) has consistently affected sustainable production of food. This has largely contributed to why most countries in SSA are not food secured despite consistent growth in food production. The current food production is, undoubtedly, far from being able to meet the food needs of the geometrically growing population in the sub-region (Oxford Poverty and Human Development Initiative, 2017; and FAO, 2018). Besides, the pervasiveness of poverty in SSA has been strongly linked to under-utilization of factors of production in the agricultural sector (Tadele and Assefa, 2012; and Dennin, Kabambe, Sanchez, Malick, Fkor *et al.,* 2009). This is further highlighted by the fact that, despite employing over 70% of labour force in SSA with particular reference to Nigeria (Mgbenka et al., 2015), agricultural sector offers relatively less attractive and poor income due to its poor performance (low productivity).

Cassava is the main source of one of the most relatively stable staple food (gari – cassava flakes; fufu – cassava paste; lafun – cassava flour) in many Nigerian households' food baskets (FAO and IFAD, 2005). However, there are increasing concerns that sustaining the availability of this food to Nigerian households may be significantly affected by the expanding agro-allied firms/industries using cassava as critical input in Nigeria and the globe if nothing is done to deploy a more efficient use of productive resources by farmers. It is view of this, Juma (2015) advocates innovative approach to agriculture and food production. This is a way to avoid waste of productive resources i.e land and protect the environment while exploring the soil for sufficient food production with a view to ultimately achieving zero hunger.

Cassava, a perennial woody shrub with an edible root, was first cultivated in South America and introduced to Nigeria in the sixteenth century (Adeniji, Ega, Akoroda, Adeniyi, Ugwu and Balogun, 2005). Cassava is considered food of the poor and has been a widely criticized crop for its propensity to deplete soil nutrients and

open the farmland to erosion (Hershey, Henry, Best, Kawano, Howeler and Iglesias, 2001). Despite these, it is one of the fastest expanding staple crops in the world and has continued to gain prominence among farmers while the industrial demand is also rising consistently. Globally, cassava has experienced consistent growth of well above 3% annually (Food and Agricultural Organisation [FAO], 2018). According to FAO (2018), world cassava production was 278 million tonnes. The total production in sub-Saharan Africa (SSA) is about 161 million tonnes in the same period, which is about 2% higher than that of 2017. Nigeria produced 59 million tonnes in 2017 (FAO, 2018). Despite being the largest producer of cassava in the world, more than 90% of cassava produced in Nigeria are consumed locally (Denton et al., 2004). World cassava market is worth multibillion dollars where cassava products are sold in different forms. China alone imports more than 80% of the total world cassava products processed into pellets and starch. Despite the available huge opportunities at the international cassava market (International Fund for Agricultural Development [IFAD] and FAO, 2000; and Prakash, 2008), most countries in the SSA play insignificant role participating at that level. At best, cassava remains a major subsistence crop of the majority of the small-scale farmers in SSA.

Evidence from FAOSTAT revealed that, as at 2017, Indonesia, Thailand and India are among topmost cassava producing countries in the world with very high output per hectare (Table 1). Indonesia made the most tremendous improvement in terms of output per hectare between the period, 1970 – 2017. This is closely followed by Viet Nam, Ghana and Benin. Whereas during this period, Nigeria performed poorly as its output per hectare dipped by 31512 (Hg/ha). However, during this period, cassava production in Nigeria has soared by 49,279,947 tonnes. Thailand (30,973,292 tonnes), Indonesia (19,046 000 tonnes) and Ghana (18,470,762 tonnes) followed Nigeria in terms of production (output). Between the period, 1970 – 2017, cassava output growth in Thailand and Ghana are most striking after Nigeria's output. The values of compound Growth Rate (CGR) for production of cassava in Ghana, Benin and Viet Nam are 15% 13% and 11% respectively (Table 1). The corresponding CGR values for yield are 5%, 6% and 5%. Regrettably, Africa's share in total world export is far less than 10% while Thailand and Viet-Nam/Indonesia contribute about 80% and 10% respectively to the world cassava export (International Fund for Agricultural Development [IFAD] and FAO, 2000; and Prakash, 2008). The world now recognizes that growing high yield cassava is a catalyst for development (Hershey, Henry, Best, Kawano, Howeler and Iglesias, 2001). This is one of the challenges most countries in SSA have been trying to solve for four decades with a view to increasing their participation at the world cassava market.

Table 1: Yield and Production of Cassava by Major Contributing Countries to World Cassava Market

	Yield (Hg/ha)			Production (tonnes)			CGR	
	1970 (A)	2017 (B)	(A) - (B)	1970 (A)	2017 (B)	(A) - (B)	Yield	Production
Angola	35556	116130	80574	1600000	11747938	10147938		
Benin	44000	155541	111541	510000	4341848	3831848	0.056	0.129
Ghana	75000	191305	116305	1550000	18470762	16920762	0.051	0.148
India	147876	209598	61722	5214100	4171000	-1043100	0.040	0.010
Indonesia	74948	244493	169545	10478310	19046000	8567690	0.055	0.038
Thailand	153170	230731	77561	3431000	30973292	27542292	0.026	0.075
Viet Nam	72137	192818	120681	945000	10267568	9322568	0.054	0.108
Nigeria	119090	87578	-31512	10206000	59485947	49279947		

Source: Author's computation from FAOSTAT, 2018

The increasing importance of cassava (*Manihot esculenta*) among crops grown in Nigeria is not unconnected to the increasing demand for it as food but also as food security. Nwokoro, Orheruata and Ordiah (2002) opine that well above two-thirds of the total production of cassava is used as food, while only little is left to be shared as feed for animal and also for industrial purposes. However, the demand scope has expanded as cassava is now being used as a substitute for cereal flours in bakery products; as energy source in animal feed rations; as starch for industrial use; and other products used in processed food (Tonunkari, 2004; and FAO, 2018). Recent statistics on global demand for starch and ethanol sourced from cassava shows it a multibillion dollar business across the world (FAO, 2018). Therefore, meeting the future demand can be a herculean task if the current production pattern is not rejigged for enhanced productivity. Thus, increasing cassava output by increasing land allocation for its production is not sustainable. Therefore, food insecurity becomes a source of concern when productivity is sacrificed in food production.

Cassava is a dietary staple food in Nigeria and other countries in SSA. According to Njoku and Muoneke, (2008), 7 in every 10 Nigerians consume, at least, a product of cassava once in a day. Besides its rich carbohydrate content, cassava also contained calcium, vitamins B and C, and other essential minerals. However, the quantity of nutrients in cassava is dependent on the varieties, age at the harvest time, soil conditions, climate and other environmental factors (Cock, 1982; and IITA, 2017). Evidence from recent research break-throughs has shown a blend of some of its products fortified with missing micronutrients (Okwulehie, Opara and Onimawo, 2014). The deployment of clear cut technologies in producing different varieties and processing of cassava products has indescribably increased the satisfaction attributes of cassava. In view of these, cassava products which used to be

associated with the poor have become more acceptable to more consumers across income groups. The implication of this therefore is, if supply of cassava does not grow at the same rate as demand, the cassava market equilibrium will be frequently altered, and in response, prices of cassava products fluctuate accordingly.

Cassava production is very popular in Nigeria because it constitutes a dominant content of household food baskets (FAO and IFAD, 2005). The major cassava producing states in Nigeria are: Anambra, Delta, Edo, Benue, Cross Rivers, Imo, Oyo and Rivers. Experts have argued that the cassava production is one of the well-developed agricultural crops in Nigeria because of its relatively well established and processing techniques. Cassava can be processed into varieties of products – e.g food and starch for industrial use. According to IITA, cultivating cassava comes with a lot of convenience. Some of which include: its ability to do well in poor soils, its labour requirements are low, it can be inter-cropped with other crops, it matures within a period of 6 months – 3 years after planting. Above all. cassava is highly tolerant to erratic weather condition (Burrell, 2003).

Evidence across states in Nigeria shows that government investments and intervention to enhance cassava production have resulted to increased output and also stimulated the rural economy. Local processing of cassava has created jobs for many rural women and the local fabricators and thus, has significantly stimulated the rural economy in SSA. Similarly, it has also influenced the agricultural input supply market. Therefore, it contributes to capital formation and securing markets for the agro-industry at large in Nigeria. However, whether or not, the present cassava production (supply) can meet the increasing demand for cassava as food and industrial use remains a serious concern. Cassava, the cheapest and most accessible food for the poor, looks set to be pulled away by the cassava allied-industry if nothing is done to sustain or increase per capita production in Nigeria.

Other parts of this paper are organized as follows: Section Two: Cassava Development in Nigeria; Section Three: Methodology and Analytical Techniques; Section Four: Results and Discussion; and Section Five: Summary, Conclusion and Recommendation.

2.0 Cassava Development in Nigeria

Cassava products are increasingly becoming popular in Nigerian food and agricultural markets. Thus, it provides a strong incentive for more economic agents to be involved in the cassava market. According to FAO (2018), cassava is a choice crop for rural development, poverty alleviation, economic growth and ultimately, food security. It is in view of the above that critical stakeholders have continued to contribute immensely to shaping the development of cassava sub-sector in Nigeria. Eke-Okoro and Njoku (2012) captured the phases in efforts to improve cassava production in Nigeria as: the emergent stage that spread from 1940 to 1953; primitive stage that stretched from 1970 to 1990 and the anticipatory stage that spanned from 1995 to date. Other phases of cassava development are also found in the literature.

2.1 Remarkable Interventions in Nigeria Cassava History.

However, for the purpose of this study, two periodic phases in cassava development are chosen to systematically analyze the compound growth rate (CGR) and the contributions of yield and area to the highly celebrated cassava production output in Nigeria: "Pre – Implementation Period of Medium Term Research Plan (MTRM) of the National Agricultural Research Strategy Plan (NARSP) (1970 - 1995)" [Period I] and the "Implementation and Post Implementation Period of Medium Term Research Plan (MTRM) of the National Agricultural Research Strategy Plan (NARSP) (1996 - 2010)" [Period II]

Pre – Implementation Period of Medium Term Research Plan (MTRM) of the National Agricultural Research Strategy Plan (NARSP) (1970 - 1995) – PERIOD I

This period coincided with the marked collaboration between national and international institutions for the development of cassava in Nigeria. One of the most striking event around this period is the development of some improved cassava varieties. This international collaboration was championed by International Institute of Tropical Agriculture (IITA). This collaboration was timely because it heralded the development of highly resistant cassava varieties to withstand the virulence of cassava bacterial blight (CBB), cassava mosaic virus disease (CMD), cassava anthracnose disease (CAD), cassava mealybug (CMB) and cassava green mite (Akoroda et al., 1985). Besides, IITA, Ibadan also developed some cassava varieties with attributes of high yield with minimal cyanide content which include – "TMS 4(2)1425 and TMS 30001". The National Root Crops Research Institute, Umudike, in the late 1980 also developed five cyanide-free cassava varieties (Sweet cassava varieties) namely: "NR 84175, NR 84292, NR 84104, NR 8959 and NR 8421" (Eke-Okoro and Njoku, 2012). Unfortunately, one of the sore points of the period is that the negative production pressures of the new strains of cassava mosaic virus could not be resolved.

Implementation and Post Implementation Period of Medium Term Research Plan (MTRM) of the National Agricultural Research Strategy Plan (NARSP) (1996 - 2017) – PERIOD II

This period is heralded by pre-emptive - CMD cassava development period. The first assignment in this period was to address the threats against sustainable production of cassava. One of such threats was the negative production pressure. To mitigate against this pressure, Nationally Co-Ordinated Research Programme (NCRP)

was approved for cassava in 1996. This decision was indeed strategic to the implementation of policy strategies to improve cassava production in during this period. According to Eke-Okoro and Njoku (2008), notable among the achievements at this period are: "a) successful development of cassava varieties that are not only suitable for intercropping but are also resistant to virulent pests and diseases; b) well-developed techniques for long preservation of cassava stems; and c) increase the number of well-trained extension agents with adequate knowledge on the art of rapid multiplication of cassava. The NCRP also had break-through in cutting edge technology that tremendously increased cassava production from 23.3 million tonnes/annum in 1994 to 45.6 million tonnes/annum in 2010. Sequel to these efforts, the annual production of cassava in Nigeria has sustained the rating of the highest producer of cassava globally (FAO, 2004; and FAO, 2018).

2.2 Rationale and Justification for the Study

Since the fixed agricultural land in Nigeria is consistently under threat from increasing demand for expanded infrastructure to cater for the rapidly growing population, relying on improved cassava production through expansion of cultivated area is definitely not sustainable. Nigeria, being an oil dependent economy, has gone through some unfavourable cycles in the recent time as a result of instability in oil prices It is expected that government, in attempt to diversify the economy, would also be making efforts to encourage the development of cassava sub-sector. Cassava market is an emerging market in the world and the future looks economically promising with a view to accrue some foreign earnings. Although the current statistics shows that despite the huge cassava production in Nigeria, the value of exports is still significantly low (FAO, 2018). It simply indicates that despite huge level of cassava production; it is not significantly beyond domestic demand in Nigeria. This makes it appealing to policy makers. It is therefore not surprising that cassava producers are part of the beneficiaries of Anchor Borrowers Programme (ABP) launched by the Central Bank of Nigeria (CBN) in 2015 to encourage the supply of products to the processing sector. However, recent statistics showed that the implementation of ABP made rice more lucrative to cultivate than cassava. This is expected to have effect in the cassava output and even its yield. Similarly, the CBN also reviewed the Commercial Agricultural Credit Scheme (CACS) in 2018 with a view to increasing access to credit for farmers. However, experts have argued that these efforts should not replace the quest to develop high yield performing cassava.

The performance of cassava sub-sector is largely dictated by the low output per hectare that characterize agriculture in Nigeria and other countries in SSA (Fakayode Babatunde and Ajao, 2012). Inadequate adoption of contemporary innovations and technology have constrained cassava productive efficiency to less than 60% in most countries in sub-Saharan Africa including Nigeria (Ajibefun, 2015; and Federal Department of Agriculture [FDA], 1995). The call to address this seemingly difficult challenge has again come to the fore as the demand for cassava is increasingly gaining momentum among various consumers. Besides, in the last two decades, government agricultural policies have been favourable to production of cassava with a view to using it as one of the pods to drive the country's economic growth. Some of these policies mandated bakers to include 10% cassava in their flour mix for bread production and flour mills to pre-mix cassava flour with wheat flour before supplying same to bakeries and confectioneries (Technical for Agricultural and Rural Cooperation [CTA], 2005). However, there are concerns that cassava production is not immured to production instability. Increasing number of authors have argued that production instability often exposes the economy to food price fluctuations that are capable of distorting consumption habit and compromising consumers' welfare (Moledina, Roe and Shane, 2004; Krohner, 2014; Sulewski and Kłoczko-Gajewska, 2014; Sehkar, Roy and Bhatt, 2017; and Ikuemonisan and Akinbola, 2019). The literature seems to be silent on cassava production instability in Nigeria.

There is no doubt that cassava output has increased tremendously from 7,384,000 tonnes in 1961 to 59,485,947 tonnes in 2017 making Nigeria the highest producer of cassava in the world (FAO, 2018). However, the literature seems scarce on the trend of cassava production in Nigeria with clear calibration for the trends in cassava production and contributions of harvested area and yield in the increasing cassava production in Nigeria. Therefore, this study questions the propelling factors for cassava production with the intention to ascertain factors that substantially influence growth in the sub-sector. The import of this question becomes real as the associated challenges with expanding development infrastructure and increasing industrial drive pose a serious threat against achieving agricultural growth only through expansion of cultivated/harvested instead of high yield cassava stems. The land is fixed and agricultural land is even under threat as infrastructure expands to cater for the rapidly increasing population. Besides, the fact that most cassava producers are smallholders who cannot afford machines for intensive cultivation sets snags on the path of cassava revolution in Nigeria. To put it more pithily, expanding cultivation area to increase cassava output may not be sustainable in the long run because as industry grows, there will be higher demand for labour and land by the industrial sector expected to come from those working in agricultural sector and agricultural land respectively.

In view of the above, this paper attempts to: (i) analyze the trend and growth in area, production and yield of cassava; (ii) review the instability in the growth of area, yield and production of cassava; and (iii) contributions of area and yield to the growth of cassava production in Nigeria.

3.0 Data and Methodology

3.1 Data

The paper relied strongly on secondary (time series) data obtained on area, production, and yield of cassava in Nigeria for the period 1970 -2017 from FAOSTAT. However, the analysis spanned across three periods: Period I (1970 - 1995); Period II (1996 - 2010) and period III [the pool – combination of the two distinct periods] (1970 – 2017).

3.2 Analysis of Data

3.2.1 Compound Growth Rate

The compound growth rate (CGR) was preferred to linear growth rate (LGR) in analyzing the growth rate in area, production and yield of cassava because according to (Dandekar, 1980), the LGR is not convenient for comparing two periods. The compound growth function was specified as follows:

$lnY = a + bt + e$ …… (1)

Y = area (ha)/production (1000 tonnes) /yield (kg/ha)

a = Intercept

t = Year

b = 1 + r (The slope coefficient 'b' measures the instantaneous relative change in Y for a given absolute change in the value of explanatory variable 't') – instantaneous growth rate.

r = Growth rate

However, when the relative change in Y is multiplied by 100, the percentage change or growth rate in Y for an absolute change in variable 't' is obtained while the slope coefficient 'b' measures the instantaneous rate of growth. Therefore, the compound growth rate is then estimated using the following equation:

CGR = [antilog b – 1] * 100---------- (2)

Equation (1) was estimated using Ordinary Least Square (OLS) method hence the t- test was applied to test the significance of 'b'. The underlining assumption in this estimation is that a change in cassava output in a given year would depend upon the output in the proceeding year (Deosthali and Chandrehekhar, 2004).

Since analyzing the growth rate in area, production and yield of cassava does not account for the relative contributions of area and yield towards the total output change, this paper adapted component/decomposition analysis model to achieve same. The literature is replete with evidence of how this model has been used to estimate relative growth performance of individual output in agricultural production (Taher and Shadmerhi, 2008; and Rehman, Saeed & Salam, 2011; Devi, Arivelarasan and Kapngaihlian, 2017).

3.2.2 Instability in Cassava Production

Production instability signals unpredictable phenomenon which effects can be hurtful to people whose livelihood depend on this line of production. Put more succinctly, it connotes inefficiency and undermines sustainability of production growth. When this affects food production and distribution in developing or low income countries, the effects on the preponderance of the low income farmers can be devastating. In Nigeria, the huge population of participants in cassava market is an evidence of its importance as a source of income and food for almost all. Therefore, experts have deployed different methods to estimate instability (Popcock's instability index) in agricultural production. Ahmed and Joshi (2013) used the trend free measure of variability which is a close approximation of the average year to year percentage variation adjusted by trend (Kaur and Singhal, 1988). Besides, modified coefficient of variation have also been used to estimate production instability (Singh, Dikshit, Reddy and Kuthe, 2014). Several other studies have also measured the magnitude of instability by an index developed by Parthasarathy (1984). Another index that has been used to measure production instability is Cuddy Della Valle Index (Cuddy and Della Valle, 1978).

Although, in the literature, standard deviation and coefficient of variation have been prominently used to measure risk and instability in agricultural production however, they have been widely criticized because it over estimates instability. Thus, this study deployed Popcock's instability index (PII) to measure instability in cassava production in Nigeria simply because of its advantages as highlighted above. The indexes of Popcock's instability measures (PII) are compared to those obtained from coefficient of variation (CoV).

$\text{CoV} = \frac{Standard\ Deviation}{Mean}$ ……..(3)

Popcock's instability Index (PCII) $= \left(antilog\ \sqrt{Vlog} - 1\right) * 100$ ……..(4)

$Vlog = \frac{1}{N-1}\sum [logX_{t+1} - logX_t - M]^2$ ……(5)

$M = \frac{1}{N-1}\sum [logX_{t+1} - logX_t]$ ……...(6)

Where X is the time series variable under consideration (production/area/yield)

3.2.3 Decomposition Analysis

The decomposition analysis was performed using the equation below:

$\Delta P = A_b * \Delta Y + Y_b * \Delta A + \Delta A * \Delta Y$ ……..(7)

(Yield effect) (Area Effect) (Interaction effect)

Where,

$\Delta P = P_C - P_B$

$\Delta Y = Y_C - Y_B$

$\Delta A = A_C - A_B$

A_B,P_B and Y_B are the area, production and yield of cassava for the base year.

A_C, P_B and Y_B are the area, production and yield of cassava for the current year.

The analysis is done for 3 periods i.e. 1970-1995, 1996-2017 and 1970-2017.

Thus, the total change in cassava production is attributed to area and yield using a model that decomposes production output into three effects viz; yield, area and interaction effects.

4.0 Results and Discussion

4.1 Trend in Area, Yield and Production of Cassava in Nigeria

The triennium ending figures for area, yield and production of cassava in Nigeria were determined from data obtained from FAOSTAT and presented on figure I.

In TE 1972, Nigeria produced an average of about 9,649,000 tonnes from 905,666 ha with an output per hectare of 10.69 tonnes/ha. The area under the cultivation of cassava showed an increasing steeply trend from TE 1987 (1,152,666 ha) to TE 1993 (2,716,666 ha). At this period, output per hectare declined between 11.11 tonnes/ha and 10.46 tonnes/ha respectively. The decline in output per hectare coincided with the period when cassava in Nigeria was prevalently infested with virulent cassava bacterial blight (CBB), cassava mosaic virus disease (CMD), cassava anthracnose disease (CAD), cassava mealybug (CMB) and cassava green mite. Soon after this period, in 1996, National Co-Ordinated Research Programme (NCRP) was approved. Hence, the collaboration between IITA, Ibadan and National Root Crops Research Institute, (NRCRI), Umudike resulted into some high yielding and low cyanide cassava varieties. This led to a decreasing increasing yield from 10.46 tonnes/ha in TE 1993 to 10.70 tonnes/ha in 1999. At this period, cassava output continued to increase as a result of expanded area of cultivation. Between TE 1999 and TE 2002, there was steep decline in output per hectare from 10.74 tonnes/ha to 9.73 tonnes/ha. This decline was linked to the pressure of the new strain of cassava mosaic disease (CMD). Respite soon came when IITA, Ibadan in collaboration with NRCRI, Umudike released new cassava varieties to check this disease. These efforts manifested in the increased yield between TE 2002 (9.73 tonnes/ha) and TE 2011 (11.73 tonnes/ha). This increasing trend in output per hectare continued till TE 2011 until it surged down drastically from 11.73 tonnes/ha to 7.90 tonnes/ha (TE 2014). In TE 2014, the total cassava output harvested from 6533910 ha was 51561000 tonnes, However, consequent on the various cassava improvement programmes and research on the best scientific approach to optimize cassava production in Nigeria, production and output per hectare increased to 58,898,000 tonnes and 9.24 tonnes/ha in TE 2017. The Anchor Borrower Programme (ABP) launched in 2015 could have also contributed to the increased yield in TE 2017 after the shortfall in TE 2014.

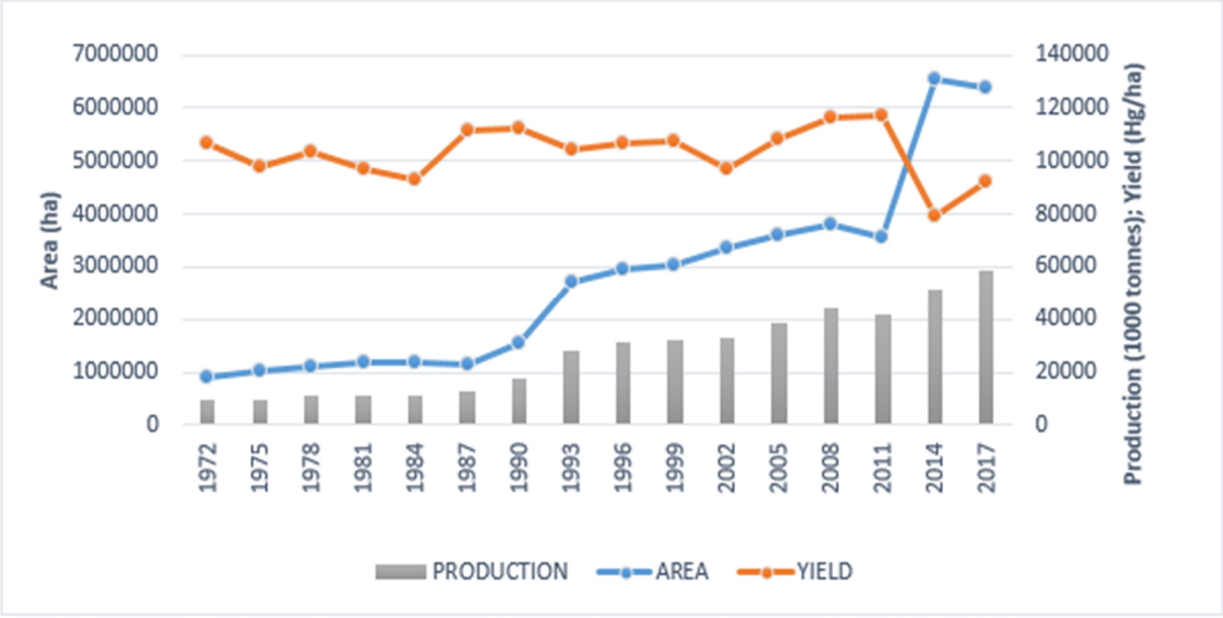

Fig. 1: Trend in TE of Area, Production and Yield of Cassava in Nigeria (1970 – 2017), 2019

4.2 Instability in Area, Yield and Production of Cassava

The instability index for area, yield and production of cassava in Nigeria is presented in Table 2. The study adopted both the simple coefficient of variation (CoV) and PopPock's Instability Index (PII) as measures for instability in cassava production. Measuring the instability in cassava production becomes imperative in view of widespread assertions in the literature that food production risk as well as food price volatility is high in the sub-region (Krohner, 2014; Sulewski and Kłoczko-Gajewska, 2014). More importantly, the welfare implications of these on the mass of poor farmers in the sub-region (Sassi, 2014; Sehkar, Roy and Bhatt, 2017; and Ikuemonisan and Akinbola, 2019). Firstly, the difference between the index of instability measured by CoV and PII are too wide apart hence, confirming the submission that in most cases, standard deviation and coefficient of variation hypes the risk (instability, volatility) in time series. Therefore, this study interprets only the PII. The results of the measures of instability show that in the instability of land put under the cultivation and yield of cassava are more pronounced in Period II [TB1996- TE2017] (12.2% and 11.2% respectively). However, instability in cassava output declined from 9.5% in Period 1 (TB1970 – TE1995) to 7.6%% in Period 2 (1996 – 2017). During Period III, which is the combination of the periods I & II, area allocated to the production of cassava (11.8%) is the most uncertain and closely followed by productivity per ha (9.9%) and output (8.7%). Since instability/uncertainty is an indication of unpredictable future outcome (area that can be allocated for cassava production, yield of cassava and cassava output), it thus implies that future market and prices are also uncertain. This demand pressure can further be hyped with increasing number of high volume of cassava demanding ethanol (biofuel) and starch firms. There is evidence that both local and international markets for ethanol fuel and starch are expanding, and Nigeria is not excluded.

Table 2: Instability Index for Area, Yield and Production

		Area (ha)	Yield Kg/ha	Production(1000 tonnes)
Period I (TB1970 - TE1995)	CoV	48.30	7.37	50.47
	PII	11.24	8.33	9.45
Period II (TB1996- TE2017)	CoV	33.71	13.11	23.57
	PII	12.22	11.26	7.59
Period III (TB1970 - TE2017)	CoV	65.51	10.50	59.11
	PII	11.81	9.89	8.76

Data Analysis 2019.

4.2 Compound Growth Rate of Area, Yield and Production of Cassava in Nigeria

The CGR of area, yield and production of cassava in Nigeria between 1970 – 2017 is presented on Table 3. During the period I, TB1970 – TE1995, CGR for area (10.8%), yield (0.7%) and production (11.5%) are positive and instantaneous growth rate is significant at 1%, 10% and 1% respectively. Thus, it implies that changes in area yield and output per hectare are significantly influenced by time trend during this period.

During the period II, TB1996 – TE2017, CGR and instantaneous growth rate for area (9.5%) and production (7.5%) for cassava are positive and statistically significant accordingly at 1% apiece. In this period, both CGR and instantaneous growth rate for yield are negative and not statistically significant. It means that time trend is significant in the growth of area and production of cassava during the period II (TB1996 - TE2017).

The results from the analysis of the pooled data (TB1970 – TE2017) show that CGR and instantaneous growth rate for area (10.9%) and production (10.6%) of cassava are positive and significant at 1% apiece. In this period, the growth in yield of cassava is not influenced by time trend during the period of review. When compared to the values of compound Growth Rate (CGR) for yield and production of cassava in Ghana (5.1%; 14.8%), Benin (5.6%; 12.9%) and Viet Nam (5.4%; 10.8%), Nigeria's rate of performance for yield and production (-0.2%; 10.6%) within the period under review is ridiculously low while that of production comes after that of Viet Nam. This paints a gloomy and relatively poor performance of cassava sub-sector in Nigeria especially in the face of rapidly growing population and quest to diversify the economy. While Nigeria is still struggling to have an increased share in world cassava market, the growing output could be further jeopardized as agricultural land and farm labour decreases as a result of expanding industrial and other development infrastructure

Table 3: Compound Growth Rate of Area, Yield and Production of Cassava in Nigeria between 1970 – 2017

	Area	Yield	Production
Period I:	0.0444* (0.004) [0.108]	0.0028*** (0.002) [0.007]	0.0473* (0.005) {0.115]
Period II:	0.0394* (0.004) [0.095]	-0.0081^{NS} (0.004) [-0.019]	0.0312* (0.002) [0.075]
Period III:	0.0445* (0.001) [0.109]	-0.0009 ^{NS} (0.001) [-0.002]	0.0437* (0.002) [0.106]

Data Analysis 2019. * significant at 1%; ** significant at 5%; * significant at 10%; NS: non-significant Figures in ( ) and [ ] are standard errors and CGR respectively.**

4.3 Decomposition of Production of Cassava in Nigeria

Table 4 reveals the Compound Growth Rate (CGR) and pattern of growth of area, yield and production of cassava in Nigeria. The table reveals the results of the analysis of contributions of area and yield to the growth of cassava production in Nigeria. This is necessary because figure 1 only presented the analysis of trend in the growth of area, yield and production of cassava and Table 3 shows the CGR for same between TB1970 – TE2017 but does not evaluate the contribution of area and yield to the production growth of cassava in Nigeria. To achieve the latter, changes in cassava is broken into three effects: yield effect, yield effect and interaction effect. The decomposition analysis was done for disaggregated data as follows: period I; period II and period III.

Figure 1 clearly indicates consistent increase in the output of cassava in Nigeria during the period under review. However, the decomposition analysis reveals that in the period, TB1970 – TE1995, only the area effect positively contributes to the increase in cassava production at this period. The 117% compensates for the negative yield effect (-5.02%) and interaction effect (-12.2s3%). The import of this is that increase in production of cassava over this period occurred as a result of expanded area of land cultivated. The scenario is significantly different during the period, TB1996 -TE2017. At this period, both yield and interaction effects are positive and contribute 43.51% and 56.8% respectively to increase in cassava production in Nigeria. This period coincided with the period when on-going cassava multiplication programmes for optimum production and high yield in cassava in Nigeria dominated cassava input market (Root and Tubers Expansion Programme [RTEP], 2002). The Anchor Borrower Programme (ABP) could have also contributed to the increased adoption of high yield cassava stems by farmers after it was launched in 2015.

However, in the period III, TB1970 -TE2017, the contribution of area effect was positive and very high (152%). During this period, the harvested area also compensates for the negative effects of the yield (-6%) and interaction between yield and area effects (-46%).

Table 4: Percentage decompositions of area, yield and their interaction towards increasing production of Cassava Production in Nigeria

Effect/Period	1970 – 2017	1970 – 1995	1996 – 2017
Yield Effect	-5.79	-5.02	43.51
Area Effect	151.63	117.25	-0.31
Interaction Effect	-45.83	-12.23	56.80

Data Analysis 2019

5.0 Summary, Conclusion and Recommendation

Cassava, once identified with the poor, is now in high demand in various forms like chips, pellets and starch. It is not only a major source of food but a choice crop for rural development, poverty alleviation, economic growth and ultimately, food security among the predominantly small-holder farmers in Nigeria. Cassava is widely grown in Nigeria because it tolerates poor soils and erratic weather conditions, and its labour requirement is very minimal. By 2017 estimates, the Nigeria's performance in cassava production (≈59 million tonnes) allowed Nigeria to maintain its lead as the largest cassava producer in the world. However, cassava production in Nigeria has been characterized by smallholders hence output per hectare is low.

Among the seven world current record cassava producers, only Nigeria experienced a huge dip in yield performance (-31512 Hg/ha) between the period, TB1970 – TE2017. This period was marked with various challenges and interventions through various collaborations. This study sectioned production period into three periods: period I [targeted at producing disease resistant cassava varieties] (1970 - TE1995); period II [targeted at producing high yield cassava with less cyanide content] (TB1970 - TE1995) to systematically analyze the compound growth rate (CGR) and the contributions of yield and area to cassava production output in Nigeria.

The study analyzed the trend and the decomposition of cassava output growth in Nigeria between the period, TB1970 – TE2017. The study reveals consistent growth both in harvested area and cassava production (output) in Nigeria but output per hectare was inconsistent through the period under review. In an attempt to assess the Compound Growth Rate of area, yield and production of cassava, the study finds that time trend significantly influences changes in harvested area and cassava production at 1% and the values of CGR are 10.9% and 10.6% accordingly between TB 1970 – TE 2017. However, CGR is negative for yield during the periods, TB1970 – TE2017 (-0.2%) and TB 1970 - TE1995 (-0.2%). This signaled the weakness in the output per hectare of cassava in Nigeria.

Following the revelation from the trend and growth rate of area, yield and production of cassava, the decomposition analysis further reveals that the marked and celebrated high cassava production in Nigeria during the periods, TB1970 – TE2017 and TB1970 – TE1995, is largely as a result of increased area under the cultivation of cassava (harvested area). In these periods, both the yield effect (-6%; -5%) and interaction effect (46%; 12%) contributed negatively to production of cassava in Nigeria, However, during the period II (1996 - 2010), the yield and interaction effects contribute largely to the observed increased cassava production. The high percentage yield (43.51%) and interaction effects (56.8%) conveniently compensated for the negative effect (-0.31%) of harvested area. This is the reflection (outcome) of the huge investment in the production of high yielding and disease resistant cassava stems developed through the collaborative efforts of stakeholders. The 44% yield effect is an evidence of the influence of improved cassava varieties on the increased production.

Consequent on the findings of the study, the following recommendations are made: (i) there should be deliberate efforts to train farmers on efficient soil management to increase the output of cassava per hectare; (ii) intensify (research) efforts to produce more high yield and disease resistant cassava varieties; (iii) government should help the farmers to take advantage of the large cassava international market in order to make foreign earnings. This can be achieved by increasing yield, production of cassava and more importantly, value addition to cassava becomes very essential by processing it into forms that are most acceptable to major demanders; and (iv) Since the hope for cassava market is high, it is essential that cutting edge scientific methods are courted to achieve optimization and precision in cassava production.

Therefore, for further studies, this study suggests the need to explore the value chain analysis of cassava with a view to identifying which activities are currently undertaken by the business folks and which can be provided by others. Besides, making a near precise forecast of the future demand and supply of cassava in Nigeria in the context of emerging cassava allied industry will be an area of interest.

References

Adeniji, A.A.; Ega, L.A.; Akoroda, M.O.; A.A. Adeniyi; B.O. Ugwu; A. de Balogun (2005). "Cassava Development in Nigeria". *Department of Agriculture Federal Ministry of Agriculture and Natural Resources Nigeria*. FAO. Retrieved 22 September 2013.

Ajibefun, Igbekele Amos (2015): Nigeria's Agricultural Policy, Productivity and Poverty: The Critical Nexus. (Unpublished Inaugural Lecture Series 69, The Federal University of Technology, Akure. pp1-6

Akoroda M. O., Gebremeshel I. and Oyinlola A. E. 1985. Impart of IITA Cassava varieties in Oyo State of Nigeria. IITA, Ibadan, Nigeria. p. 105.

Cock, J. H. (1982). Cassava: a basic energy source in the tropics. *Science*, *218*(4574), 755-762.

Dandekar (1980) Introduction, seminar on data and methodology for the study of growth rates in agriculture. India Journal of Agric. Econs, 35(2): 1-12

Deosthali, V. and Chandrahekkar (2004) Tice: Regionwise growth trends in Maharashtra. Economic and Political Weekly, 39(3): 240 – 242

Denning, G.; Kabambe, P.; Sanchez, P.; Malik, A.; Flor, R.; Harawa, R.; Nkhoma, P.; Zamba, C.; Banda, C.; Magombo, C.; Keating, M.; Wangila, J.; Sachs, J. Input subsidies to improve smallholder maize productivity in Malawi: Toward an African green revolution. PLoS Biol. 2009, 7, 2–10.

Denton F. T., Azogu I. I. and Ukoll M. K. 2004. Cassava based recipes for house hold utilization and income generation. AIDU, Federal Department of Agriculture, Abuja, Nigeria.

Devi, Y, L, Arivelarasan T. and Kapngaihlian, J (2017), Pulses Production in India: Trend and Decomposition Analysis. Economic Affairs, Vol. 62, No. 3, pp. 1-4.

Eke-Okoro, O. N., & Njoku, D. N. (2012). A review of cassava development in Nigeria from 1940-2010. *Journal of Agricultural and Biological Science*, *7*(1), 59-65.

Fakayode S.B, Babatunde R.O and Ajao.R (2008); Productivity analysis of cassava based production systems in guinea savannah.American-Eurasian Journal of Scientific Research 3 (1):33-39.2008

FAO. 2018 Food Outlook - Biannual Report on Global Food Markets – November 2018. Rome. 104 pp. Licence: CC BY-NC-SA 3.0 IGO.

FAO and FAO (2005). A review of cassava in Africa with country case studies on Nigeria, Ghana, the United Republic of Tanzania, Uganda and Benin. In *Proc. Valid. forum Glob. cassava Dev. Strateg.. Rome:*

International Fund for Agricultural Development/Food and Agriculture Organization of the United Nations.
FAO, 2004. Fact sheet No 5 on International Year of Rice http://www.rice2004.org/
Federal Department of Agriculture (FDA)., 1995. Federal Department of Agriculture; Federal Ministry of Agriculture Reports. Abuja, Nigeria
IFAD and FAO. (2000). The world cassava economy. Facts, trends and outlook. *Rome, IFAD, FAO*.
Ikuemonisan, E. S., & Akinbola, A. A. (2019). Welfare effects of transportation cost and food price volatility in the context of globalization in Nigeria.
International Institute for Tropical Agriculture (IITA): https://www.iita.org/cropsnew/cassava/
Juma, C. (2015). *The new harvest: agricultural innovation in Africa*. Oxford University Press.
Hershey, C., Henry, G., Best, R., Kawano, K., Howeler, R. H., & Iglesias, C. (2001). Cassava in Asia: Expanding the Competitive Edge in Diversified Markets. *A review of cassava in Asia with country case studies on Thailand and Vietnam*.
Kornher, L., (2014): Recent trends of food price volatility in developing and emerging economies - a comparison across measures Center for Development Research (ZEF), University of Bonn The rise of the emerging economies: Towards functioning agricultural markets and trade relations? 25-27 June 2014 | Halle (Saale), Germany June 26th, 2014.
Moledina AA, Roe TL, Shane M (2004). Measuring commodity price volatility and the welfare consequences of eliminating volatility. Paper presented at the AAEA Annual meeting on August 1-4, 2004 Denver Colorado
Mohammad Taher and Shadmehri, Ahmadi (2008). Estimating growth rates and decomposition analysis of agricultural production in Iran (1970-2000).
Njoku, D. N., & Muoneke, C. O. (2008). Effect of cowpea planting density on growth, yield and productivity of component crops in cowpea/cassava intercropping system. *Agro-Science*, *7*(2), 106-113.
Nwokoro, S. O., Orheruata, A. M., & Ordiah, P. I. (2002). Replacement of maize with cassava sievates in cockerel starter diets: effect on performance and carcass characteristics. *Tropical Animal Health and Production*, *34*(2), 163-167.
Okwulehie, F. C., Opara, H. C., & Onimawo, I. A. (2014). Nutrient content of soy fortified gari. *Nigerian Journal of Nutritional Sciences*, *35*(1), 60-64.
Oxford Poverty and Human Development Initiative (2017). "Nigeria Country Briefing", Multidimensional Poverty Index Data Bank. OPHI, University of Oxford. Available at: www.ophi.org.uk/multidimensional-poverty-index/mpi-country-briefings/
Paltasingh, K. R., & Goyari, P. (2013). Analyzing growth and instability in subsistence agriculture of Odisha: Evidence from major crops. *Agricultural Economics Research Review*, *26*(347-2016-17097), 67-78.
Parthasarathy, G. (1984), "Growth rates and fluctuations of agricultural production: A district-wise analysis in Andhra Pradesh", *Economic and Political Weekly*, 19 (26): A74 - A84.
Prakash, A. (2008). Competitive Commercial Agriculture in Sub-Saharan Africa (CCAA) Study.
Rehman, F. U., Saeed, I., & Salam, A. (2011). Estimating growth rates and decomposition analysis of agriculture production in Pakistan: pre and post sap analysis. *Sarhad Journal of Agriculture*, *27*(1), 125-131.
Root and Tubers Expansion Programme (RTEP), 2002. Root and Tubers Expansion Programme. Project Facilitation Team (PFT) Workshop Held in August, 2002.
Sassi, M. (2014). The Welfare Cost of Maize Price Volatility in Malawi. Bio-based and Applied
Economics 4(1): 77-100,
Sehkar, C.S.C, Roy, Devesh and Bhatt, Yogesh (2017): Food Inflation and Food Price Volatility
in India: Trends and Determinants. Markets, Trade and Institutions Division, International Food Policy Research Institute. IFPRI discussion paper 01640.
Stephen, K. O. (2017). Tropical root and tuber crops. *Advances in New Crops Relieved 26th July*.
Sulewski, P., & Kłoczko-Gajewska, A. (2014). Farmers' risk perception, risk aversion and
strategies to cope with production risk: an empirical study from Poland. *Studies in Agricultural Economics*, *116*(3), 140-147.
Tadele, Z., & Assefa, K. (2012). Increasing food production in Africa by boosting the productivity of understudied crops. *Agronomy*, *2*(4), 240-283.
Technical for Agricultural and Rural Cooperation (CTA), 2005. Cooperation for Agricultural Development in ACP Countries. SPORE 118. August, 2005.
Tonukari, N. J. (2004). Cassava and the future of starch. *Electronic journal of biotechnology*, *7*(1), 5-8.