ANALYSIS OF RICE PRODUCTION GROWTH IN THE NORTH EAST AND THE NORTH WEST, NIGERIA: PRE- AND POST- ATA POLICY

Supported by tetfund TERTIARY EDUCATION TRUST FUND

A. Tijjani[1]* and S. Amin[2]
[1]Department of Agricultural Economics & Extension, Modibbo Adama University of Technology, Yola, Nigeria
[2]Department of Agricultural Economics & Extension, Bayero University, Kano, Nigeria
*Corresponding author: tijjadam@gmail.com

Received: March 9, 2021 **Accepted:** July 13, 2021

Abstract: This study analyzed growth rates in rice production, area and productivity in the North East and the North West regions in Nigeria from 1999 to 2018. The period was divided into two: Period I (1999-2010) and period II (2011-2018). Period I represented the era before the implementation of the Agricultural Transformation Agenda (ATA) policy, while period II represented the era during the ATA. This was to estimate and compare the growth rates before and during the ATA, and also to identify the sources of rice output growth in both regions. Data was obtained from the Agricultural Performance Survey Reports and analyzed using Compound Growth Rate, Coefficient of Variation, Instability Index and Hazell Decomposition Analysis. It was found that in period II both regions recorded a significant growth in volume of production (North East = 12.50, North West = 13.17) and in area (NE =9.39, NW =9.00), but no significant growth in productivity (NE =1.3^{s}, NW = 5.98). During the ATA, variability in volume of production was the highest in both the NE (31.1%) and the NW (29.4%). Generally, it was a change in the mean area that accounted for total change in rice output in both regions (NE = 71.6%, NW = 61.8%). Therefore, it is concluded that rice farmers increase their production through land expansion. Hence, it is recommended that efforts should be directed toward increasing production through increase in productivity rather than through land expansion, because land supply is limited and can be exhausted in the long-run.

Keywords: Growth rate, North East, North West, production, rice

Introduction

Nigeria is endowed with both human and natural resources enshrined with so many potentials for rice production. Because of the resource availability, rice is virtually cultivated in all the agro-ecological Zones in Nigeria. Out of the estimated 70 million hectares of arable land available in Nigeria, 3.7 million hectares, which is about 10% of the 35 million hectares of total arable land cultivated, were devoted to rice production (Munonye, 2016). It was revealed that about 77% of the land area under rice production was rain-fed, of which 47% and 30% were low land and up land respectively (Munonye, 2016). The main areas of rice cultivation in the country include: Benue, Kaduna, Niger, Taraba, Enugu, Cross River and Ebonyi States. Kaduna is the main producing State, followed by Niger, Benue, Ebonyi, Taraba, Kano and Borno States (NBS, 2010 in Munonye, 2016).

As such, Nigeria became a leading producer of rice in African (Foods and Agriculture Organization, FAO, 2019). Available data from Index Mundi (2018) revealed that in 1990 milled rice production was estimated at 1.5 million Metric tonnes. Subsequently, production rose to 1.956 million Mt in 1992 and drop to 1.456 million Mt in 1994. Thereafter, it rose to 1.979 Mt in the year 2000. From 2001 to 2017, rice production kept on increasing to a point that a total of 3.654 million Mt was recorded in 2017.

However, even in the face of recorded increase in rice production in the country, the demand for the commodity outpaced its production. Many factors accounted for the observed difference between the quantity produced and demanded. Some of the reasons could be attributed to population explosion, farmers' inefficiency, inadequate inputs, instability in government policies and many others.

Recently, in a bid to reform the agricultural sector, the Nigerian Government implemented the Agricultural Transformation Agenda (ATA) strategy. It started in 2011, the Government built on the principle that agriculture is a business and therefore policy should be about supporting it. The main priority of the policy was to **"restart the clock"** and reintroduce the Nigerian economy to sustainable agriculture centered on business-like attitude driven by the private sector (Federal Ministry of Agriculture and Rural Development, FMARD, 2016). After critical observation of the achievements and shortfalls of the ATA, the current Government designed another policy termed Agricultural Promotion Policy (APP). The main objective of the APP is to build on the ATA legacy and as well tackle its shortcomings (FMARD, 2016). Both policies aimed at increasing production of staple food especially rice so as to increase food security in the country.

On the average, growth rate of rice production in Nigeria seemed to be increasing annually. Farmers keep on expanding land area for rice cultivation nationwide. Also, farm technologies in form of high yielding varieties, agro-chemicals, machinery, improved practices are increasingly developing over the years. Therefore, to relate the observed increased in country's rice production to policy changes remains an unverified issue. This is simply because Nigeria's agricultural policies are quite unstable and inconsistent (Munonye, 2016).

Consequently, researchers applied different methodologies in studying growth rate in rice production in the country so as to delineate the trend as well as the effect of policies on the output growth. For example, Onu *et al.* (2015) used aggregate data and studied rice growth rate in relation to trade policy. Such studies, however, ignores regional specific characteristics. Therefore, this paper analyzed rice growth rate in relation to ATA and APP of 2010 and 2015, respectively, because these policies are the most recent policies on rice production in the country. This is to ascertain whether the policies have significant contribution to output growth or not. In addition, only data for the North East and the North West Zones were used in this study so as to capture the specific characteristics that are more peculiar to the Zones. The Zones are comparatively the major suppliers of paddy rice in the country.

Therefore, the specific objectives of this paper are to: estimate the rice growth rate in the North East and the North West Zones of Nigeria from 1999 to 2018; compare the growth rate before and after the implementation of the ATA; and identify

the sources of the rice output growth in the two regions. The result of the study will give a foresight on the effect of Government policies on the growth of agricultural production in Nigeria. Both policy makers as well as farmers would find the result useful in decision formulation.

Materials and Methods

This study used secondary data collected from the Agricultural Performance Survey Reports prepared by the National Agricultural Extension and Research Liaison Services (NAERLS) and Federal Department of Agricultural Extension (FDAE). The data covered the period from 1999 to 2018. Data on the quantity of paddy rice produced, land area devoted to rice production and yield per hectare of rice in the North East and the North West Zones were analyzed using Compound Growth Rate (CGR), coefficient of variation (CV), Instability Index (ID), Student t-test and Hazel Decomposition Analysis.

The data was divided into two: from 1999 to 2010 and from 2011 to 2018. This was to enable the analysis to capture significant difference, if any, between outputs growth rate before and after the implementation of the Agricultural Transformation Agenda (ATA) policy. Here, the period before implementation of the policy was specified as Period I (from 1999 – 2010) while during the implementation as Period II (from 2011 – 2018).

Instability analysis was carried out in order to study the nature of variability in production, area planted and productivity of rice. This was done by computing the coefficient of variation (CV) and the instability index (ID) as follows:

$$CV = \frac{Standard\ diviation}{Mean} \times 100 \quad \ldots\ldots\ldots\ldots\ldots\ldots (1)$$

And the instability index as:

$$ID = CV \times \sqrt{1 - R^2} \quad \ldots\ldots\ldots\ldots\ldots (2)$$

Where: R^2 = coefficient of determination

It follows that the high degree of instability index signifies violent variation.

For growth rate analysis, the choice of CGR in this study was informed for its relevance in the comparison of different data series and also for its ability of taking into consideration the compounding effect of a variable (Annesha, 2017). In this model, a multiplicative error term is assumed which allowed for the transformation of the model into a linear form using logarithmic transformation, and the growth rate r is derived through the following steps:

$$Y_t = A(1+r)^t \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (3)$$

Where: Y= the area (to determine the GR in area devoted to rice production); or = output (to determine the GR in quantity of rice produced); or = yield (to determine the GR in yield of rice production); t = time in years; a = intercept; b = parameter to be estimated; and r = rate of growth in percentage.

Taking log on both sides of equation (3)

Log Yt = log A + t log (1+r)

Putting Log Yt =Y, log A = a and log (1+r) = b

$$Y = a + bt \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (4)$$

$$1+r = \exp^b$$

Finally, the compound growth rate is estimated by the following equation:

$$r = (\exp^b - 1) \times 100 \quad \ldots\ldots\ldots\ldots\ldots\ldots (5)$$

To test for the significance of compound growth rate, t-test was employed as used by Sharma (2015). Thus, $t = \frac{r}{SE(r)}$ with (n - 2) degree of freedom, where r is CGR per cent and n is the number of observations (years) and $SE(r) = \frac{100\,.\,b\,.\,SE(logb)}{0.4343}$

The rule of thumb: 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

Student t-test was also used to statistically ascertain the existence or otherwise of the significant difference between outputs realized in the two periods, in which computer software, IBM SPSS Statistics version 20 was used in running the test.

Also, decomposition analysis was carried out with the aim to partition the changes in expected values of production and the variability in production to its constituent parts taking the values of the variables in the initial period as base. This study adopted the decomposition model used by Hazel (1982) in which he specified four sources of changes in average production as follows:

$$\Delta E(Q) = \bar{A}_I \Delta \bar{Y} + \bar{Y}_I \boldsymbol{\Delta} \bar{A} + \boldsymbol{\Delta} \bar{A} \boldsymbol{\Delta} \bar{Y} + \boldsymbol{\Delta}\mathrm{Cov(A,Y)} \quad \ldots\ldots\ldots (6)$$

Where: $\Delta E(Q)$ = change in average production, $\bar{A}_I \Delta \bar{Y}$ = change in mean yield, $\bar{Y}_I \boldsymbol{\Delta} \bar{A}$ = change in mean area, $\boldsymbol{\Delta} \bar{A} \boldsymbol{\Delta} \bar{Y}$ = interaction between mean area and mean yield and $\boldsymbol{\Delta}$Cov(A,Y) = change in area-yield covariance. The first and the second terms are known as pure effect, while the third and the fourth terms as the interaction and the variability effects, respectively.

Results and Discussion

Growth Rate of Rice Production, Area and Productivity

Trend in rice production, hectare and productivity in the North East and the North West Zones of Nigeria was analyzed over the period of 1999 – 2018.

Compound growth rate result presented on Table 1 show that in the North east region, both production and area variables have not shown any significant growth before the implementation of the ATA policy (period I). However, during implementation of the ATA, growth rate in production and area was highly significant (1% level of significance).

Table 1: Compound Growth Rate of rice production, area and productivity in the North East and the North West Zones (1999 -2018)

Zone	Period	Production	Area	Yield
North East	Period I	0.83^{NS}	0.24^{NS}	1.05^{**}
		[0.2707]	[0.7890]	[0.0138]
	Period II	12.50^{***}	9.39^{***}	1.33^{NS}
		[0.0092]	[0.0013]	[0.7246]
North West	Period I	9.37^{***}	30.60^{**}	1.79^{NS}
		[0.0039]	[0.0305]	[0.1075]
	Period II	13.17^{***}	9.00^{***}	5.98^{NS}
		[0.0018]	[0.0002]	[0.1370]

Source: Author's computation from agricultural performance survey data report, NAERLS and FDAE (2019). Note: values in parenthesis are p-values

In case of the North West, there was a significant growth rate with regard to both production and area before and during the ATA, but yield per hectare did not show any significant growth neither in period I nor in period II.

From the above findings, there is evidence to claim that growth rate in area and production in the North East was influenced, to some extent, by ATA policies. In the North West, though a significant growth rate in area and production was recorded before the implementation of the policies, but growth rates recorded during the ATA were comparatively higher. Therefore, it could be said that the policy has reasonably impacted on rice production growth in the regions.

Table 2: Coefficient of Variation and Instability Index in Rice Production, Area Harvested and Productivity in the North East and the North West zones

Zone	Period	Production			Area Harvested			Productivity		
		Mean	CV	I index	Mean	CV	I index	Mean	CV	I index
North East	Period I	688.8	8.7	8.168	433	**13.8**	**11.59**	10.1	10.6	10.54
	Period II	1184.9	**31.1**	17.89	630.9	24.5	9.73	11.5	23	**22.84**
North West	Period I	508.1	**46.02**	**28.41**	1164.5	16.2	12.58	11.4	13.4	11.7
	Period II	1594.8	**29.4**	11.48	2031.9	25.2	6.981	14.2	22.4	**21.79**

Source: Author's computation from agricultural performance survey data report, NAERLS and FDAE (2019). Note: CV= coefficient of variation in percentage, I index = Instability Index

Instability in rice production, area and yield

Table 2 presented results of the mean of production, coefficient of variation and instability index of area, volume of production and yield for both North east and North west regions, before (period I) and during (period II) the ATA policy implementation.

Before the implementation of the ATA (period I)

The result in Table 2 revealed that in the North East region, during period I, variability in area (13.8%) is higher than variability in both production and yield whose values are 8.7 and 10.6%, respectively. Similarly, the instability in area (11.59) is shown to be higher than instability in production (8.17) and in yield (10.54) per hectare. These suggested that before the implementation of ATA policies in the North East region, area devoted to rice cultivation kept on changing year in year out. That is to say, farmers in the North East change their land size in accordance with the prevailing exogenous and endogenous factors of rice production. Most of the changes observed in the output growth before the implementation of the ATA could be, therefore, attributed to changes in area rather than changes in productivity.

However, in the North West, during period I, a different scenario was reported. It can be seen from Table 2 that production variable has the highest values of both coefficient of variation (46%) and instability index (28.4). Here, variability in production is more pronounced compared with variability in area and in yield per hectare. One could arguably assert that, changes in rice output growth witnessed in the North West before the implementation of the ATA policy was as a result of increase in production.

During the ATA (period II)

As indicated on Table 2, variability in rice production for the North East during period II was 31.1%, while variability in area and productivity was 24.5 and 23%, respectively. In addition, the instability in production, area and productivity of rice were depicted on Table 2 as 17.9, 9.7 and 22.8, respectively. These results showed that during the ATA, variability in production was higher than variability in both area and productivity, and productivity has the highest instability index. Meaning that yield per hectare in the North East region fluctuates more in comparison with what is observed in area and production.

Similar results were obtained in the North West as indicated on Table 2 where variability in production (29.4%) was shown to have higher values than that of area and productivity, and instability index of productivity (21.8) was higher than that of area and production.

From the above findings it is reasonable to conclude that, area expansion was the main source of rice output growth in both regions before and during the ATA policy implementation. A scenario which showed that ATA policies have, to some extent, impacted positively on rice production growth in the regions. This is insured by encouraging farmers to open more land for rice cultivation as contained in one of the objectives of the ATA policies. These findings corroborate with the results reported by Fasihur Rehman *et al*. (2011) on growth rates and decomposition analysis of agriculture production in Pakistan: pre (1972-1988) and post (1989-2009) SAP analysis. They found that area was the main source of rice growth rate in post adjustment period in Pakistan. Similarly, in Gujurat, India Narendra *et al*. (2014) reported an increase in area under rice crop from 1982 to 2012.

Table 3: Average North East and North West rice production (Period I: 1999-2010, Period II: 2011-2018)

Region	Average production ('000)			
	Period I (tons)	Period II (tons)	Change	
			Tons	%
North east	688.9	1,184.9	496.0	72.09
North west	508.1	1,594.8	1,086.7	213.88
Total	1,197.0	2,779.7	1,582.7	132.22

Source: Author's computation from agricultural performance survey data report, NAERLS and FDAE (2019)

Average production in the North East and the North West

Change in average production recorded in the North West was higher than that of the North East (Table 3). Table 3 showed that there was an average increase of more than one million metric tons of rice in the North West translating to more than 200% increase after the introduction of the ATA policy. Whereas, 72% increase in average rice production was recorded for the North East region during the same period.

Generally, both regions have increased significantly their production by 132.2%. Changes in production were decomposed into its various components so as to appreciate their contributions to average production and the result is presented below.

Decomposition of change in average production

Production changes were dominated by changes in mean area which accounted for 72 and 62 percent of total change in the North East and North West respectively (Table 4). It follows that changes in production is mainly as a result of land expansion. Farmers in both regions increased their output by clearing more land area. This system is not reliable for sustainable growth of agricultural output as land exhaustion and scarcity may set in on the long run. Theoretically, land supply is limited and thus inelastic in nature. Therefore, this finding corroborates with the result presented by Muhammad Taher (2008) in which he reported that about 56.6 percent of growth in rice production in Iran was due to area expansion effect. Although, results obtained by Narendra *et al*. (2014) in Gujurat and Annesha (2017) in Assam both in India indicated that increase in rice production in those areas was mainly due to increase in yield than in area expansion.

Table 4: Components of change in the average North East and North West rice production (1999-2010 and 2011-2018)

Sources of Change	Symbol	North east	North west
Change in mean yield	$\bar{A}_I\Delta\bar{Y}$	21.6	20.7
Change in mean area	$\bar{Y}_I\boldsymbol{\Delta}\bar{A}$	71.6	61.8
Interaction between change in mean area and mean yield	$\boldsymbol{\Delta}\bar{A}\boldsymbol{\Delta}\bar{Y}$	9.9	15.4
Change in area – yield Covariance	$\boldsymbol{\Delta}$Cov(A,Y)	-3.1	2.1

Source: Author's computation from agricultural performance survey data report, NAERLS and FDAE (2019)

Again, Table 4 showed that the impact of yield effect in the North East and the North West region was 22 percent and 21 percent, respectively. An indication that yields effect seems to bring about the same change in rice production in both regions. One would find it reasonable to attribute the non-difference of yield effect between the two regions to efforts made by Governments in ensuring equal distribution of resources such as fertilizers, tractors and chemicals to various States in Nigeria.

Changes in the interaction effect – which occurred because of simultaneous changes in mean yield and mean area – accounted for about 10 and 15 percent in the North East and the North West, respectively. Changes in area-yield covariance between periods (before and during ATA implementation) were small and accounted for only two percent in the North West and negative in the North East (Production).

Conclusion and Recommendations

Since in the North East, a significant growth rate in rice production and area, not yield, was recorded during the ATA policy, the policy might have impacted on the rice total output in the region. In contrast, the policy may have had little or no impact on rice total output in the North West because the region has recorded a significant growth rate in production and area before and during the ATA. As for the source of output growth, land expansion was the main source before and during the ATA in both regions. Also, changes in average production from period I to period II was higher in the North West than in the North East. In terms of decomposition of change in output, area effect accounted for the larger percentage of output change, and then followed by yield effect. In addition, changes caused by interaction between area and yield were small, while changes in area-yield covariance was very small in both regions.

It is therefore, recommended that, since viable and sound policies have positive impact on rice output, additional and strategic policies that will ensure land intensification should be designed and implemented so as to encourage rice farmers to increase output without necessarily increasing land areas. The policies should be a sort of built-on on the existing policies to ensure continuation, not initiation. Farmers should learn and adopt how to increase their productivity instead of always clearing more lands to increase production.

Conflict of Interest

The authors declare that there is no conflict of interest reported in this work.

References

Annesha M 2017. An analysis of growth trend, instability and determinants of rice production in Assam. *Indian J. Agric. Res*., 51(4): 355-359.

FAO 2019. Nigeria at a Glance. Food and Agriculture Organization, Rome, October, 2019

Fasih ur Rehman, Ikram S & Abdul Salam 2011. Estimating growth rates and decomposition analysis of agriculture production in Pakistan: Pre and post SAP analysis. *Sarhad J. Agric.* 27(1).

FMARD 2016. Policy and Strategy Document. Federal Ministry of Agriculture and Rural Development, Nigeria.

Hazel PBR 1982. *Instability in Indian Foodgrain Production*. IFPRI Research Report No. 30, Washington, DC; Internation Food Policy Reasearch Institute.

Index Mundi 2018. Rice Production in Nigeria. Retrieved from www.indexmundi.com

Muhammad Taher AS 2008. Estimating growth rates and decomposition analysis of agricultural production in Iran (1970-2000). *Trends in Agriculture Economics*, 1(1): 14-26.

Munonye JO 2016. Nigeria rice imports in the last three decades under different trade and fiscal policies. *Unified J. Agric. and Food Sci.*, 2(1): 001- 008.

NAERLS & FDAE 2019. Agricultural Performance Survey of 1999-2018 Wet Season in Nigeria, NAERLS Press, Ahmadu Bello University Zaria.

Narendra S, Dikshit AK, Reddy BS & Surendra BK 2014. Instability in rice production in Gujarat: A decomposition analysis. *Asian J. Econ. and Empirical Res.*, 1(1): 6-9.

Onu DO, Obike KC, Ebe FE & Okpara BO 2015. Empirical assessment of the trend in rice production and imports in Nigeria (1980 – 2013). *Int. Res. J. Agric. Sci. and Soil Sci.* 5(6): 150-158.