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Assessment of the Growth Rate of Cotton (*Gossypium Spp*) Production in West Africa: Evidence from Nigeria's Pre – SAP, SAP and Post – SAP Periods (1960 - 2014)

Ibitoye S.J[1], Shaibu U.M[1*], Omole B.O[1]
Department of Agricultural Economics and Extension, Kogi State University Anyigba, Nigeria

***Corresponding Author:**
Shaibu U.M
Email: brave.monday@yahoo.com

Abstract: This study assessed the growth rates of cotton production in West Africa under Nigeria's different policy periods. Time series data for a period of fifty five years (1960-2014) was collected from secondary sources and the analytical tools used were descriptive statistics, Ordinary Least Square regression model, t-test, and Exponential Growth Rate Model. Findings showed that the instantaneous growth rates of cotton production in Nigeria are – 4.5%, 8.9%, -1.7%, and 1.5 % for pre – SAP, SAP, post – SAP, and the entire periods respectively and the compound rates of growth of cotton production in Nigeria are – 4.4 %, 9.3%, -1.7%, and 1.5% for the pre – SAP, SAP, post – SAP, and the entire periods respectively. The compound rate of growth of cotton production in the SAP era was found to be higher than that of the pre – SAP and post – SAP periods in Nigeria. By implication, the policy reforms in the SAP period were more effective in ensuring increased growth of cotton production in the country over that of other periods. Hence, the Structural Adjustment Programmes (SAP) was beneficial to cotton farmers with its multiplier effect on increased production in Nigeria.
Keywords: Cotton, Growth Rate Model, Nigeria, Production, SAP

INTRODUCTION

Cotton (Gossypium, spp) has played an important part in the economic development of a number of West African countries and has remained a key source of livelihood for many. Cotton has been grown in West Africa for more than a hundred years and a significant traditional textile industry has existed in the region for more than 50 years [1]. Cotton as a major cash crop is of considerable social and economic importance to Nigeria. Cotton/textile activities are widespread in the country. Cotton production in Nigeria dates back to 1903 with the British Cotton Growers Association taking the lead until 1974, when it was disbanded and replaced by the Cot ton Marketing Board to develop, gin and market the produce. Following the deregulation of the Nigerian economy in 1986, the Board was abolished vis-à-vis the economic activities rendered by it.

The contribution of cotton to national GDP varies according to country. It provide 3 to 5% of GDP in Benin, Burkina Faso, Mali, Chad and Togo and less than 2% for other cotton producers, such as Nigeria with 0.2% [2]. Indicatively, cotton exports generate significant resources for national economies in many West African countries such as Burkina Faso, Benin, Chad, Mali and Togo. On the other hand, Nigeria, Côte d'Ivoire and Cameroon have economies that are more dependent on petrol and less dependent on cotton. The challenges faced by the cotton sub-sector in Africa are, however, complex. Some of the key factors include sustained increases in cotton production worldwide, increasingly strong competition from synthetics, advances in technology, improved pest management techniques, the rapidly growing application of biotechnology in cotton production by Northern producers in Asia and even in South Africa [3].

In her effort to increase food production and be self food sufficient, the Nigeria government over the years, have put in place several policy reforms and one of such policy reforms in time past is the Structural Adjustment Programme (SAP) introduced in July 1986. The SAP aimed at facilitating economic growth as a means of jump-starting the economy towards sustainable economic growth and development. The objectives of the programme as pointed out by Mesike [4], included reconstructing and diversifying the productive base of the economy, by reducing the dependence on oil and imports, laying a basis for sustaining noninflationary growth, making substantial progress towards fiscal and balance of payment viability, improving efficiency of the private sector's contribution to economic growth, through liberalized trade and privatization of public sector enterprises, devaluing the naira and reducing government deficits

and these translated into specific policy measures in the agricultural sector such as abolition of commodity boards, privatization and commercialization of agricultural and agro-industrial enterprises. Others include removal of all government subsidies on food and other agricultural products, promotion of the production and export of non-traditional agricultural products, import restrictive measures on food and other locally produced agriculturally based raw materials, increase of the budgetary allocation to the system of agricultural development projects as a major instrument for agricultural development [5].

Previous studies that considered trend of agricultural production in Nigeria are vast with paucity of empirical evidence on cotton production (see for example: Rahman and Damisa [6]; Rahman [7]; Onyenweaku and Okoye [8]; Udom [9]; Anyaegbunam *et al*. [10]; Ojiako *et al*. [11], Ifeanyi, Ojiako, and Olayode, [12]). Available empirical evidence on cotton production basically dwelt on the use of primary data with focus on its economics (see for example; Ben and Sani, [5]; Fortucci [13]; Aliyu and Kutama [14]; Sabo, Daniel, and Adeniji [15]; Daniel, Gwandi, *et al*. [16]; Adzawla, *et al*. [17]; Alam, *et al*. [18]. The general objective of Nigeria's SAP was to restructure and diversify the productive base of the economy in such a way as to reduce dependency on the oil sector and imports. The policy reforms in existence prior to the introduction of SAP (pre-SAP) and after the SAP period (post-SAP) differs and therefore, the growth in cotton production vis-à-vis agricultural production is expected to vary in the Pre –SAP, SAP and Post – SAP periods in Nigeria. In view of the foregoing, this study was designed to provide an empirical information on the growth rates of cotton production in Nigeria in the Pre – SAP, SAP and Post – SAP periods which would be relevant for policy recommendations in the country and other West African countries.

Model Specification

The trend equation is given as:

$Y_t = a + bt + e$ ……..(1)

Where

Y = Cotton Output

a = intercept

b = slope/coefficient

e = error term

t = time

The exponential form (left-side semi-log) of equation (1) is:

$Y_t = Y_0 (1+r)^t$ …….(2)

Taking the natural log of both sides;

$\ln Y_t = \ln Y_0 + t\ln(1+r)$

Where $\ln Y_0 = a$ and $b = \ln(1+r)$, equation (2) can be written as:

$\ln Y_t = a + bt$ …….(3)

Adding disturbance term to equation (3), the explicit form of the model employed was derived as:

$\ln Y_t = a + bt + e_i$ …….. (4)

Where:

Y_t = Output of Cotton (‘000 tonnes)

METHODOLOGY

The study area is Nigeria. It is located between latitude 07° to 14°N and longitude 03° and 15°E. Nigeria, which spans an area of 924,000 square kilometers, is bordered by the Gulf of Guinea, Cameroon, Benin, Niger, and Chad. The topography ranges from mangrove swampland along the coast to tropical rain forest and savannah to the north [19]. Nigeria is generously endowed with abundant natural resources. With its reserves of human and natural resources, Nigeria has the potential to build a prosperous economy and provide for the basic needs of the population. This enormous resource base if well managed could support a vibrant agricultural sector capable of ensuring the supply of raw materials for the industrial sector as well as providing gainful employment for the teeming population [20].

Time series data on cotton production, yield, land area harvested, and time were collected for a period of fifty five years (1960-2014).Secondary data were used for the study. The data were mainly sourced from the United State Department of Agriculture, (USDA) extending from 1960 to 1985 (Pre – SAP period), 1986 to 1998 (SAP period) and 1999 to 2014 (Post – SAP period).

The model employed in this study for the estimation of growth trend in cotton output in Nigeria was adopted from Gujarati, [21] and used by Mustafa *et al*. [22] and Nwosu [8]. This model is a semi log model whose regressand is in logarithm form and the regressor is time variable which can take values from one, two, three to infinity. For descriptive purposes, the growth rate model is called a log – lin model and the slope coefficient of the model measures the constant proportional or relative change in the regressand for a given absolute change in the value of the regressor.

t = Time trend (1960 to 1985, 1986 to 1998 and 1999 to 2014)
a = constant term
b_1 = Coefficient of time variable
e_i = Random term
The annual exponential or compound growth rate (G) used is as given:

$$G = (e_i^b - 1)100\% \quad \text{.....(5)}$$

Where e_i = Euler's exponential constant of 2.71828
b = coefficient of time (t)
The test of means (t-test) was used in testing the differences in the growth rate among the policy periods as given below:

$$t = \frac{Y_1 - Y_2}{\sqrt{\frac{\delta_1^2}{P_1} + \frac{\delta_2^2}{p_2}}}$$

Where: Y_1= mean value of the first sample
Y_2 = mean value of the second sample
δ_1^2 = standard error of the first sample
δ_2^2 = standard error of the second sample
p_1 = sample size of the first sample
p_2 = sample size of the second sample.

RESULTS AND DISCUSSION

Cotton Production Trend in Nigeria (1960 – 2014)

The graph of cotton produced in Nigeria from 1960 – 2014 is presented in Figure 1.

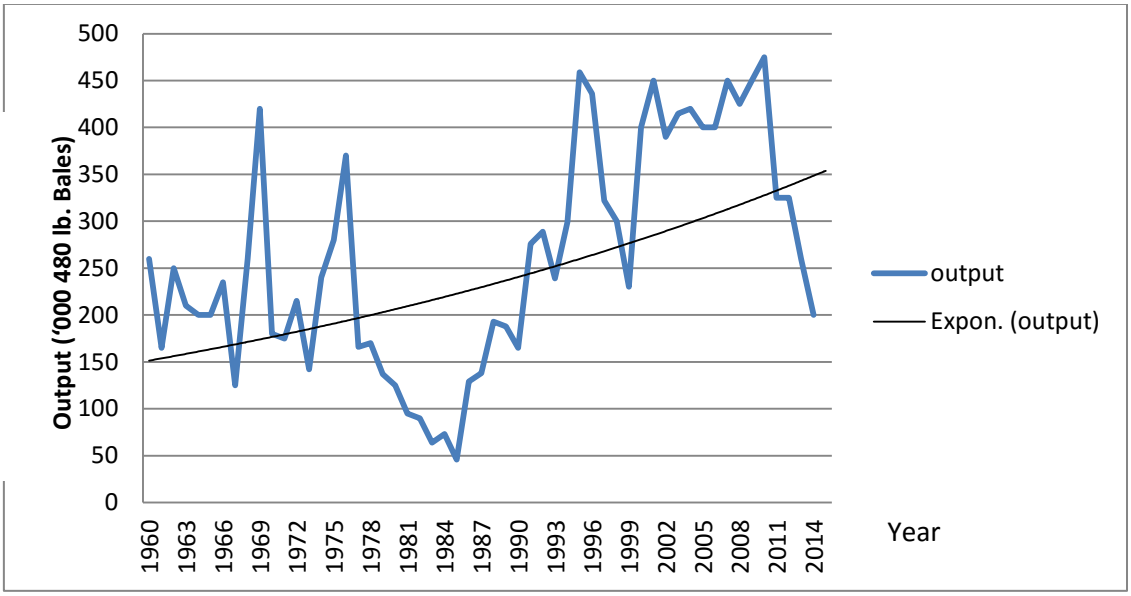

Fig-1: Graph of Cotton Production in Nigeria from 1960 – 2014
Source: Author's Computation Using USDA, [23] Data

The figure shows that cotton production in the country has generally followed an upward trend. Peak production period was observed in 1969, 1995, 2001, 2007, 2009, and 2010. Factors which could contribute to successful cotton production as pointed out by [15] are; application of appropriate soil nutrient replenishment; pest management and seed varieties well-suited to local conditions; the provision, by the government and cotton companies, of support services and infrastructure; guaranteed producer prices and output markets; high input-credit recovery rates; and well organised village-level associations.

Output was however very low in 1985 which was the end of pre-SAP era and 1999 (the end of SAP). By and large, cotton production in Nigeria gained significant increase during the Structural Adjustment Programme (SAP) period (1986 – 1998). Production in recent time has being on a continuous decline. It could be that output decreased precisely due to the decrease in area cultivated and other factors of production which might have remained largely unchanged – particularly labour and capital. Additionally, in 2002, the price of cotton dropped below production costs level with which producers found nearly impossible to compete, given

that they receive little protection from such price volatility.

Comparison of Cotton Production under Different Policy Periods

The mean outputs of cotton production in Nigeria under different policy periods are presented in Table 1. The result indicated that the pre-SAP era (1960 – 1985) had the least mean output, while the SAP and post-SAP era had the highest mean output of 264.08 and 375.94 respectively. Further tests of significance between the output of the respective periods and that of the entire period (1960 – 2014) indicated that the mean output of the aggregate period (1960 – 2014) and that of the SAP period was insignificant at the level of measurement ($p<0.05$), while the mean output of the entire periods and the pre-SAP and post-SAP periods was significant at 1% each.

Table-1: Comparison of Mean Outputs of Cotton Production between pre-SAP, SAP, and post SAP policy period and entire period

Years	Policy Period	Mean ('000 480 lb. Bales)	Std. Error	t-value
1960 – 1985 1960 – 2014	Pre-SAP	188.19 260.75	17.42 16.22	53.35***
1986 – 1998 1960 – 2014	SAP	264.08 260.75	28.82 16.22	-1.640
1999 – 2014 1960 2014	Post-SAP	375.94 260.75	20.91 16.22	68.57***

Source: Author's Computation from USDA Data *** = coefficient sig. @ 1%

Estimated Trend Equation for Cotton Production in Nigeria

Results of the estimated trend equation presented in Table 2 for the policy period under study shows a low coefficient of determination (R^2) of 9.4% for the post SAP period. By implication, only 9.4% of the output variation in cotton production during this period was explained by the time variation. The value of R^2 was however 43%, 75%, and 21% for the pre-SAP, SAP, and entire periods respectively. The result in Table 2 further shows that time variable was significant in influencing output of cotton at 1% in the pre-SAP, SAP and entire periods and was insignificant in the post – SAP period. In the estimated growth rate model, the slope coefficients of -0.045, 0.089, -0.017 and 0.015 for pre – SAP period, SAP period, post – SAP period, and the entire periods respectively measures relative change in output of cotton for a given change in the value of time trend. By multiplying the relative change in cotton output for pre – SAP period, SAP period, post – SAP period, and the entire periods by hundred, gives the percentage change or the growth rate in cotton output for an absolute change in time.

Table-2: Estimated Regression of Growth Rate of Cotton Production in Nigeria (1960 – 2014)

Variables	Coefficient	Std. Error	t-value
	PRE-SAP PERIOD		
Constant (β_0)	94.330	20.931	4.507***
Time (β_1)	-0.045	0.011	-4.262***
R^2	0.43		
Adj. R^2	0.41		
	SAP PERIOD		
Constant (β_0)	-172.715	31.203	-5.535***
Time (β_1)	0.089	0.016	5.712***
R^2	0.75		
Adj. R^2	0.73		
	POST-SAP PERIOD		
Constant (β_0)	39.325	27.783	1.415
Time (β_1)	-0.017	0.014	-1.203
R^2	0.094		
Adj. R^2	0.029		
	ENTIRE PERIODS		
Constant (β_0)	-25.231	8.278	-3.048***
Time (β_1)	0.015	0.004	3.705***
R^2	0.21		
Adj. R^2	0.19		

Source: Author's Computation from USDA Data *** P < 0.01

Pre – SAP period
Growth rate = relative change ×100; Growth rate = -0.045 ×100; Growth rate = - 4.5%
SAP Period
Growth rate = relative change ×100; Growth rate = 0.089 ×100; Growth rate = 8.9%
Post – SAP Period
Growth rate = relative change ×100; Growth rate = -0.017 ×100; Growth rate = -1.7%
Entire periods
Growth rate = relative change ×100; Growth rate = 0.015 ×100; Growth rate = 1.5%

Compound Growth Rates

The growth rates of – 4.5%, 8.9%, -1.7%, and 1.5 % for pre – SAP period, SAP period, post – SAP periods, and the entire periods respectively implies that over the period, 1960 – 1985, 1986 – 1998, 1999 – 2014, and 1960 – 2014, the output of cotton in Nigeria increased at the rate of – 4.5%, 8.9%, -1.7%, and 1.5% per annum. However the growth rate worked out above are an instantaneous (at a point in time) rate of growth and not the compound (over period of time) rate of growth.

Table-3: Estimated Exponential Growth Rate

Period	Coefficient	$G = (e_i^{\beta} - 1)100\%$
1960 – 1985 (n=26)	-0.045 (-4.262)	-4.40
1986 – 1998 (n=13)	0.089 (5.712)	9.31
1999 – 2014 (n=16)	-0.017 (-1.203)	-1.69
1960 – 2014 (n=55)	0.015 (3.705)	1.51

Source: Author's Computation from USDA Data; Figures in parenthesis are t-values

Compound growth rates (G) were estimated from the exponential growth rate as presented in Table 3. By implication, the rate of growth of cotton output in Nigeria per year during the pre – SAP period, SAP period, post – SAP period, and the entire periods (instantaneous rates of growth) are– 4.5%, 8.9%, -1.7%, and 1.5% and the rate of growth of cotton output in Nigeria over the periods 1960 – 1985, 1986 – 1998, 1999 – 2014, and 1960 – 2014 (compound rates of growth) are – 4.4 %, 9.3%, -1.7%, and 1.5% respectively.

It was observed from the results that the compounded growth rate of cotton output in Nigeria during the SAP era was higher than the pre –SAP and post – SAP eras. Indicatively, there was a slight increase in the compound growth rate of 0.4 to the instantaneous growth rate during the SAP period. This increase could be attributed to the compounding effect. In essence, the growth rate of cotton being higher in the SAP era as compared to the pre – SAP era and post – SAP era is that the policy reform of the SAP era was favourable in ensuring increased cotton production in Nigeria. In essence, the general perception that SAP was a complete failure could be misleading. This situation was also affirmed by Oyakhilomen and Emmanuel [24] in their study on the growth rates of maize production in Nigeria.

CONCLUSION

The instantaneous growth rates of cotton production in Nigeria are – 4.5%, 8.9%, -1.7%, and 1.5 % for pre – SAP, SAP, post – SAP, and the entire periods respectively and the compound rates of growth of cotton production in Nigeria are – 4.4 %, 9.3%, -1.7%, and 1.5% for the pre – SAP, SAP, post – SAP, and the entire periods respectively. The compound rate of growth of cotton production in the SAP era was found to be higher than that of the pre – SAP and post – SAP periods in Nigeria. From the findings of this study, it is suffice to say that the policy reforms in the SAP period was effective in achieving increased cotton production as compared to other reforms in the pre – SAP and post – SAP periods.

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