

# TREND ANALYSIS OF AREA AND PRODUCTIVITY OF SORGHUM IN SOKOTO STATE, NIGERIA, 1993-2012

*M., A. Maikasuwa, PhD*

*A.L. Ala, Professor*

Department of Agricultural Economics, Faculty of Agriculture, Usmanu Danfodiyo University, Sokoto, Sokoto State, Nigeria

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## Abstract

The study was carried out to examine trends in area and productivity of sorghum in Sokoto state, Nigeria from the period 1993-2012. Secondary data collected from the State Agricultural Development Programmes (ADPs) for the period 1993-2012 were used for the study. Exponential trend equations were fitted to area and productivity to examine their patterns of growth. The computed growth trend for area was negative (-0.015) and significant ( $P < 0.05$ ). The computed growth trend for productivity was positive (0.035) and significant ( $P < 0.01$ ). However, The quadratic time term indicated a stagnated growth in area and an accelerated growth in productivity. It was suggested that the process of decline in area should be reversed through expansion of area devoted to sorghum cultivation and the process of growth in productivity could be enhanced through increased use of advisory services and provision of input supports to the farmers engaged in the cultivation of sorghum

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**Keywords:** Area, Productivity, Growth Trend, Sorghum, Sokoto State, Nigeira

## Introduction

Sorghum is the fourth most important world cereals crop following wheat, rice, and maize. It is a staple food in the drier part of Africa, china and India. It is the most widely cultivated crop in the northern guinea savannah zone of Nigeria. The largest growers of sorghum are India (16 million hectares), America (11 million hectares), Nigeria (6 million hectares) and Sudan (2.5 million hectares) (Idrissa, 2005). Total sorghum production in the world exceeds 50 million tonnes, a third of which is from a small area in the developed countries. Average yields are very high on the American continent ( $> 3.0$  t/ha), while they are low ( $< 1.0$  t/ha) in India and Africa.

Africa accounts only for a quarter of the world's sorghum production. Nigeria and Sudan contribute nearly half of the sorghum production in Africa. (Idrissa, 2005).

About 50% of the total area devoted to cereal crops in Nigeria is occupied by sorghum. The area estimated at 6.8 million hectares extends northwards from latitude 8<sup>0</sup>N to latitude 14<sup>0</sup>N. In 1978; the total sorghum production in Nigeria was estimated at 4.8 million tones. This figure has risen to about 7.0 million tonnes annually. Consequently, Nigeria becomes the highest sorghum producer in West African sub-region, accounting for 71% of the regional sorghum production for human consumption and has risen from its fifth position in 1995 to the third largest producer of sorghum in the world after USA and India where more than 90% of their sorghum harvest is used for animal feed (Okpeke, 2006).

Despite the fact that Sokoto state is one of the major producers of sorghum in Nigeria, the pattern of growth in the production of the crop in the State is not defined (Dalton and Zereyesus, 2012). For instance, Dalton and zereyesus, (2012) and Ibrahim *et.al.* (2010) identified accelerated growth in sugarcane between 1983 to 2003 and Tanko *et.al* (2010) identified decelerative growth in area, production and productivity of rice. Such pattern of growth in area and productivity of sorghum is still not clear. This study is therefore, designed to shade some light on the growth trend in area and productivity of sorghum in Sokoto State, Nigeria.

### **Methodology**

The study was conducted in Sokoto state. The state is located between latitude 11° 3<sup>1</sup> to 13° 5<sup>1</sup> N and 4° to 5°E. The climatic condition of the state is semi-arid with two distinct seasons; the raining season lasting for 3-4months from mid- May to mid-September and the dry season from October to early May (Mamman *et. al.*, 2000). The State has a mean annual temperature of 34.9°C.

Farming is the major occupation of the people in the State. The major crops grown include millet, cowpea, sorghum, maize, rice and other vegetables such as amaranthus and spinach. The major livestock reared are cattle, sheep and goats.

The study was based on a time series data on area and productivity of sorghum collected from the State Agricultural Development Programmes (ADPs) for the period 1993-2012. Basic statistics such as mean, standard deviation and coefficient of variability were computed. In modelling time trend for this study, the exponential trend or log-linear as employed by Ahmed *et. al.* (2005), Udom (2006), Diebold (2007), Ojiako *et. al.* (2007), Ojiako *et. al.* (2008) and Nmadu (2009) was used.

The exponential trend equation for sorghum production was specified as follows;

$$Y_t = e^{\beta_0 + \beta_1 t + u_t} \quad \text{-----} \quad 1$$

By taking the natural logarithm of both sides, the linear form of the equation was obtained making it amenable to OLS as;

$$\text{Log} Y_t = \beta_0 + \beta_1 t_i + u_t \quad \text{-----} \quad 2$$

Where:

Y= Area or Productivity

t= time trend variable

$\beta_0$ =Intercept of the trend equation

$\beta_1$ = trend coefficient

$u_t$ =error term

From equation (2) the compound growth rate was computed as follows;

$$r = (e^{\beta_1} - 1) * 100 \text{-----} \quad 3$$

Where:

R = compound growth rate

$\beta_1$ = estimated coefficient from equation (2)

e = eular’s exponential constant (=2.71828) (Sawant, 1983)

The time it will take to double the rate of growth was then computed as follows:

$$D_T = 69/r \text{-----} \quad 4 \quad (\text{Nmadu, 2009})$$

Where:

$D_T$  = Doubling time

r = compound rate of growth as in equation (3)

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

$$\text{Log} Y_t = \beta_0 + \beta_1 t_i + \beta_2 t_i^2 + u_t \text{-----} \quad 5$$

All variables as previously defined,  $\beta_0$ ,  $\beta_1$  and  $\beta_2$  are parameters to be estimated. In the specification of equation 5, the linear and quadratic time terms indicate the circular path in the dependent variable ( $Y_t$ ). The quadratic time variable ( $t^2$ ) allows for the possibility of determining whether there was acceleration, deceleration or stagnation in sorghum production during the period 1993-2012 (sawant, 1983; Oyenweanku and Okeye, 2005). In determining the pattern of growth, our main concern is on  $\beta_2$  (i.e. coefficient of  $t_i^2$ ) which reveals a measure of the growth pattern following Oyenweanku (2004); Oyenweanku and Okeye, (2005)

If  $\beta_2 > 0$  and statistically significant, then there is acceleration in growth,

If  $\beta_2 < 0$  and statistically significant, then there is deceleration in growth,

If  $\beta_2$  is positive or negative but not statistically significant, then there is stagnation in growth (Oyenweanku, 2004; Oyeaweanku and Okeye, 2005)

### **Results and Discussion**

Results in table 1 indicated that an average of 236,000ha was devoted to sorghum production with a mean productivity of .86ton/ha. This means that farmers obtained an average of 860kg/ha from the 236,000ha of land used for the production of sorghum. However, results from the variability showed that there were 2.31% and 37.79% variability in the area and productivity of sorghum, respectively. This suggested instability in area and productivity even though, the level of instability in productivity was high compared to the instability in area. Similar instability was detected in the production sugarcane by Ibrahim *et.al.* (2010).

Analysis of the growth trend in area and productivity of sorghum was done using the estimated regression coefficients of the time trend variable as in equation 2. The  $R^2$  values were 0.304 and 0.399 for area and productivity, respectively. This implies that time trend as a variable was very important accounting for 30.4% and 39.9% of the variations noticed in area and productivity of sorghum, respectively.

The coefficient of area (-0.015) was negative and significant ( $P < 0.05$ ) suggesting that there has been a 1.5% per annum decrease in the area devoted to sorghum cultivation for the period 1993-2012. The coefficient of productivity (0.035) was positive and significant ( $P < 0.01$ ) suggesting a 3.5% per annum increase in productivity. The growth rate explained by the coefficients of area and productivity were instantaneous (at a point in time).

The compound growth rates for area and productivity of sorghum were -1.49% and 3.56%, respectively. This implies a relatively slow process of decline in area and a slow process of growth in productivity of sorghum particularly during the period 1993-2012. This calls for concerted effort to reverse the process of decline and increase the process of growth in productivity. The process of decline in area could be reversed through expansion of area devoted to sorghum production by making use of land that is put to fallow. The slow process of growth in productivity of the crop could be enhanced by the use of improved advisory services and provision of input supports to the farmers engaged in the cultivation of sorghum.

The doubling time computed for the compound growth rates in years for area and productivity were 46.31years and 19.38years, respectively. This implies that given the present trend, the rate of decrease in area put to sorghum cultivation would doubled in the next 46.31%years. Similarly, it would take 19.38 years to double the rate of growth in productivity based on the current trend. It therefore means that, the current negative trend in area must be reversed if land area used for sorghum production is to be maintained. This could be done through sensitization and mobilization of

local farmers in the study area on the need to engage more farmlands for the cultivation of sorghum. Similarly, the productivity growth trend needs to be improved in order to reduce its doubling time. This could be done through capacity building of the local farmers on new technologies at the same time increasing their accessibility to farm inputs. Ibrahim *et.al.* (2010) obtained a doubling time of 32 years for output of sugarcane for the 1983-2003 production period.

In order to investigate for the existence of acceleration, deceleration or stagnation in the growth of area or productivity of sorghum cultivation, the quadratic equation in time trend variable was fitted as in equation 5. The quadratic term ( $t^2$ ) allows for the possibility of acceleration, deceleration or stagnation in the area and productivity growth processes. Results in Table 2 showed that the value of the coefficient of  $t^2$  for area (0.003) was not significant implying a stagnated growth in the area devoted to sorghum cultivation. The value of the coefficient of  $t^2$  for productivity (0.017) was significant ( $P < 0.01$ ) confirming an accelerated growth in productivity of sorghum. Tanko *et.al* (2010) observed a decelerative growth in area, production and productivity of rice for the period 1985-2006, Ibrahim *et.al.* (2010) realized accelerated growth in rice for the period 1983-2003 while Onyenweaku (2004) discovered a stagnated growth in the Nigerian agricultural production for the period 1970-2000.

### **Conclusion and Recommendations**

Based on the results of the study, it was concluded that there was a significant decrease in area devoted to sorghum cultivation per annum and a significant increase in productivity per annum for the crop for the period 1993-2004. Both the processes of decrease in area and increase in productivity were slow. However, the rate of decline in area would be doubled by the next 46.3 years from 2004 and the rate of increase in productivity would be doubled in the next 19.38 years would be doubled beginning from 2004.

It was suggested that the process of decline in area should be reversed through expansion of area devoted to sorghum cultivation. This could be achieved through increased sensitization and mobilization of the local farmer on the need to bring back use such land area that were put to fallow. The process of increase in productivity should be enhanced through increased use of advisory services and provision of input supports to the farmers engaged in the cultivation of sorghum.

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