Croatian Journal of Food Science and Technology
journal homepage: www.ptfos.unios.hr/cjfst/

Original scientific paper
DOI: 10.17508/CJFST.2019.11.2.12

# The effect of population growth on the agricultural production in Nigeria (1961-2013)

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ARTICLE INFO

*Article history:*
Received: May 16, 2017
Accepted: September 26, 2019

*Keywords*:
population
agricultural production
Granger causality
time series analysis

ABSTRACT

As of 2000, the total population estimate of Nigeria stood at about 124 million people, this number increased to 170 million in the year 2012, which shows a growth rate of 3.8% between 2000 and 2012. This figure provides an indication that the Nigerian population is among the fastest-growing populations in the world, on the other hand, food production increases marginally, at a rate lower than the population growth rate. This paper examined the effect of the Nigerian population on agricultural production over a period of 53 years. Descriptive analysis was used to analyse the pattern and the trend of agricultural production. Granger causality and Ordinary Least Squares were used to examine the relationship between agricultural production and population growth. It was recommended that there is a need for the government to support innovative ways for increasing agricultural production, to meet the demand of the increasing population of the country. There is a need for research bodies to improve production to match the country's increasing population, so sustainable development could be achieved. In order for agricultural production to meet the increasing population demand, there is a need for the development of improved high-yield, disease-resistant varieties coming from certified nurseries where the varieties can be traced. There is a need for innovative processes through which agricultural products and processing methods can be learned through extension services by the general population, so as to reduce malnutrition and poverty in the country.

## Introduction

The global population is projected to grow by about 65% within the next 50 years, Timm (2008). The current estimate of the world population is about 7 billion, with China having the total population of 1,330,045,000 people as of 2008, India being second with about 1,205,074,000 people, and the United State of America occupying the third position with the total population of 313,847,500 as of 2012. In Africa, the highest populated country is Nigeria and it was rated to be occupying the ninth position, with an estimated population of 170,074,000 people (Mundi index, 2012). Nigeria covers 924 000 km$^2$ on the west coast of Africa; vegetation ranges from tropical forest in the south to the Sahel savannah in the north. Prior to the discovery of oil in the 1970s, agriculture was the mainstay of the Nigerian economy, accounting for about two-thirds of the Gross Domestic Product (GDP). With the oil boom, agriculture's contribution to GDP declined to 25 per cent by 1980 and Nigeria moved from being a large exporter to a major importer of agricultural products. Since the mid-1980s, as a result of a decline in oil revenue and policy measures implemented under the Structural Adjustment Programme (SAP), agriculture's contribution to GDP has risen to about 40 per cent. The first two zones fall within the humid tropics, where the predominant soil types are the ferralitic soils which are rich in free iron but low in mineral

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reserves, and are consequently low in fertility. The central zone lies between the southern and the drier, northern agro-ecological zones, the soils are poor, due to leaching from heavy and intense rainfall, and limited fertility is therefore a constraint to agricultural production.

As of 2000, the total population estimate of Nigeria stood at 123,337,800 people, this number increased to 170,123,700 in the year 2012, which shows a growth rate of 3.8% between 2000 and 2012 (Mundi index, 2012). This figure provides an indication that the Nigerian population is among the fastest-growing populations in the world, on the other hand, food production increases marginally, at a rate lower than the population growth rate. Despite the fact that the rural communities have agriculture as their mainstay, FAO (2010) reported that 50% of hungry people are farm families in rural communities. It is argued that while poverty is the principal cause of hunger, hunger also causes poverty by bringing about poor health and low levels of energy, thereby impeding productivity and resulting in poverty (Omotesho K. F. et al., 2013). In Nigeria, agricultural production has still not met the population demand, leading to food insecurity, malnutrition, and a rise in poverty, especially in the rural areas (Oyebanji et al., 2003). Effective and innovative agricultural production line is a good prospect towards sustainable development in the country. The importance of agriculture in Nigeria cannot be overemphasised because it serves as the main source of livelihood in the country, especially amongst the poor populace. In a finding by Ayinde et al. (2009) there is a strong relationship between agricultural productivity growth and the reduction of poverty. In view of the renewed emphasis on agricultural production, processing, and utilization in Nigeria, it becomes necessary to assess the agricultural production and its prospects, especially in combating hunger and raising food security among vulnerable groups, including women and infants. Regarding the country's sustainable development, there is a rather increasing need for innovative measures to curtail the increasing poverty rate, inadequate healthcare, and food insecurity that roams the countries in Africa. In view of all these challenges, this study looks at the effect of the increasing population of Nigeria on agricultural production and will attempt to describe the pattern of change in the population of the country in the period of 53 years, examine the trend of agricultural production in the country over 53 years, and analyse the effect of the population on agricultural production in the study area.

Malthusian population theory states that the power of the population is superior to the power of the earth to produce subsistence for it, this means that supplies will run short at a point in time in the near future. Tverbeg (2012) highlighted that the doctrine of the population theory spelt out that the human race will grow on a geometric scale, while food production will remain at the subsistence level or arithmetic level, which will lead to hunger, poverty, squalor, and diseases, unless checked by wars, epidemics, and human vices. Production theory attempts to examine the relationship between resources and how they are transformed into output(s). In this context, it tries to uncover factors which are relevant in the production of given input(s) to output(s). Several definitions in production theory relate input(s) to output, (Doll and Orazem, 1978; Koutsoyianis, 1997; Lipsey, 1979; Whitehead, 1986). A production function is a technical relationship between inputs and outputs; that is a function that summarizes the process of conversion of factors into a particular commodity. It shows the maximum amount of the good that can be produced using alternative combinations of various inputs (Awoyinka, 2009). Although many studies have been done on the agricultural value chain, consumption production, and processing (Damardjati et al., 1994; Anga, 2005; Berry, 1993; Cenpuykdee et al., 1992 and Apata, 2013), little is known about the effects of population on the agricultural production of Nigeria, hence, the reason for this study. A number of statistical tools can be used, but Granger causality will be employed in this study.

Bivariate causality was employed by Kogid et al., (2011) to analyse the effect of import on the economic growth of Malaysia and it was discovered that economic growth is significantly influenced by import and vice versa. Onnwioduokit (2002) used the causality, regressing autoregressive distributed lag model of the ratio of fiscal deficit to the gross domestic product, level of fiscal deficit, and the inflation rate. Omoke and Uche (2010) used the causality and cointegration in finding the relationship between export, domestic demand, and economic growth in Nigeria. The major findings were that long term relationship was found not to exist between export, domestic demand, and economic growth. Ordinarily, regressions reflect "mere" correlations, but the Granger causality test provides additional evidence as to the causal of an effect between two variables, and in which direction the cause is. A number of statistical tools can be used, but Granger causality and Ordinary Least Square regression will be employed in this study.

## Materials and methods

*Scope of the study*

This study employed time series data of a period of 53 years, obtained from various sources spanning from 1961 - 2013. The data was obtained from various AGROSTAT bulletins, which includes the editions of the National Bureau of Statistics review of external trade, the National Bureau of Statistics summary and the annual abstract of statistics, the Central Bank of Nigeria's economic and financial review, and an online database maintained by the Food and Agricultural Organization (FAO).

*Analytical technique*

*Descriptive statistics*

Descriptive and inferential statistical techniques, such as graphs and charts, are used to show the trend and pattern of both the population and agricultural production. Granger causality and Ordinary Least Squares are used to analyse the effect of population on the agricultural production in the study

*Granger causality test*

Granger causality approach, as proposed by Granger (1996), is to see how much of the current Y can be explained by the past values of Y and then to see whether lagged values of X can improve the prediction of Y, or equivalent if the coefficients on the lagged X's are statistically significant. This test assumes that the information relevant to the prediction of the variables in question is contained solely in the time series data on these variables. The Granger causality analysis used in the study involves the estimation of the following pairs as adapted from Ayinde (2008); Ayinde et al. (2010),

$$Y_t = \sum \propto Y_{t-1} + \sum \beta i X_{t-1} + U_t \qquad (1)$$

$$Y_t = \sum \beta i X_{t-1} + U_t$$

$$Y = Y_t - Y_{t-1}$$

where it is assumed that the disturbance term $U_t$ is uncorrelated

$Y_t$ and $X_t$ are time series

$Y_t$ = agricultural production at time t

$X_t$ = population growth at time t

$U_t$ = error

$_{t-1}$ = lag variables

By this model, the variable that causes the other is identified. This leads to a bivariate regression model with lag variables:

$$Y = \beta_0 + \beta_1 + \beta_{2+}\beta_3 + \beta_4 + \beta_5 + U_t \qquad (2)$$

where the $Y_t$ = dependent variable identified by the causality model (Wt or $Z_t$)

$Y_{t-1}$ , $X_{t-1}$ = lagged dependent and independent variable

$U_t$ = disequilibrium term

According to Gujarati (2003), the regression of non-stationary time series on stationary time series data would produce a spurious result; thus, the non-stationary data is transformed by differencing as in equation (3)

$$\Delta Y_t = Y_t - Y_{t-1} \qquad (3)$$

*Unit root test*

The unit root test was done using the Augmented Dickey-Fuller (ADF) test (Dickey and Fuller, 1979). This is used to test for stationarity or non-stationarity. A stationary series will have a mean value which will not vary with the sampling period. A non-stationary series will exhibit a time varying mean (Juselius, 2006), and the rules are shown in Table 1.

## Results

*Descriptive statistics*

The analysis summary in Table 2 shows descriptive statistics, where mean, minimum, and maximum were analysed for data variables. The all-time maximum population of Nigeria is 173615000 people in 2013, with the mean value of 95084000 people, agricultural production having an all-time maximum production of 54000000 tonnes and an all-time minimum of 7384000 in 1961, while the standard deviation of population and agricultural production is 37401000 and 14764000 for the 53 years considered in this research.

*The pattern of change in population of Nigeria*

A visual plot of the data is usually the first step in the analysis of any time series. From figure 1, the population growth pattern can be described thus: the population increase wasn't on a straight line, the growth in population started in 1961, from the graph where there were little bends through 1970. The little deviation from the straight-line increase from 1975 to 1985 was on an upward curved position, which signifies a more than proportionate increase in population around that time. From 1990 up to 2013, the curve took a more drastic increase towards the vertical point, indicating a drastic increase in the population of Nigeria, which coincides with the report of Sajini (2011). Although the population

growth over the years has not been at a 100% increase rate, the population of the country has never decreased or fell below that of the prior years, this can be explained by the rate of birth, which is much higher than the mortality rate, improved nutrition, sanitation, and medical care (Carolyn, 2015). In Nigeria, the increase in population has also led to an increase in food insecurity, more records of malnutrition, and increased poverty, because over 50% of the population is in the rural areas (Enefiok and Ekong 2014).

*Trend of agricultural production*

The trend of agricultural production from the result in Fig. 2 can be described thus: The lowest point on the graph was in 1961. Agricultural production increased a at a very low rate from 1961 to 1969, production increased drastically and fell between 1969 and 1971, there was a rather constant line of production with little falls and rises at an increasing rate between 1971 and 1983. From 1985 up to 2006, there was drastic increase in production which compensates for the increase in population, although there were different changes in production between 1997 and 2001. The 2008-2010 world price spike resulted in the decreased agricultural production in the country. From 2001, there were different levels of increases and decreases, with the highest production level in 2013, probably because of increasing population, consumption, and the awareness of individuals and the government to the possibilities and opportunities in agricultural production.

**Table 1.** Unit root table

| Explanatory variable | Dependent variable | Estimation Method |
|---|---|---|
| Stationary | Stationary | OLS |
| Non-Stationary | Non-Stationary | Co-integration |
| Stationary | Non-Stationary | Logically Inconsistent |
| Non-Stationary | Stationary | Logically Inconsistent |

Source: Gujarati (2003)

**Table 2.** Summary of statistics for dependent and explanatory variables

| | N | MINIMUM | MAXIMUM | MEAN | STD. DEVIATION |
|---|---|---|---|---|---|
| **POPULATION** | 53 | 46144000 | 173615000 | 95084000 | 37401000 |
| **AGR. PROD.** | 53 | 7384000 | 54000000 | 22588000 | 14764000 |

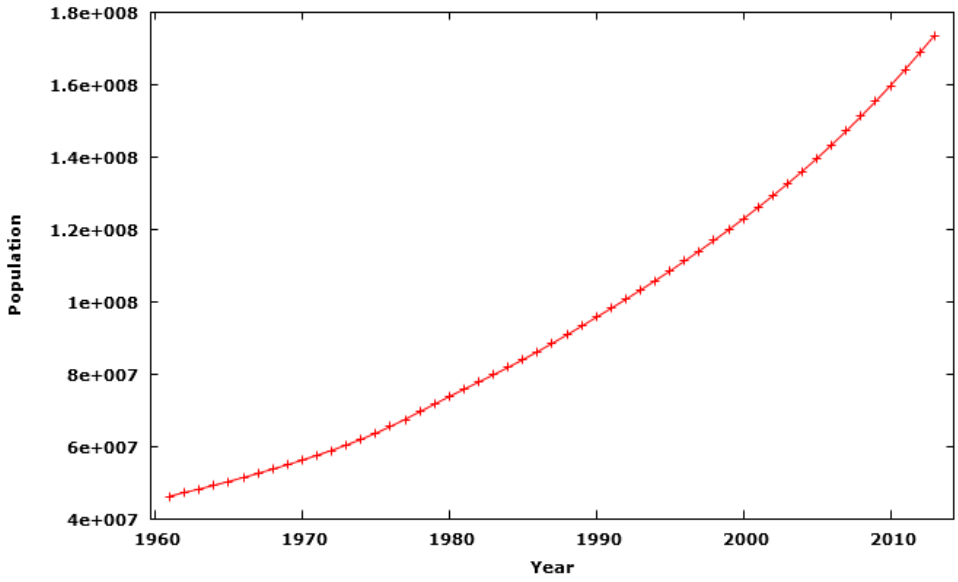


**Fig. 1.** Pattern of population

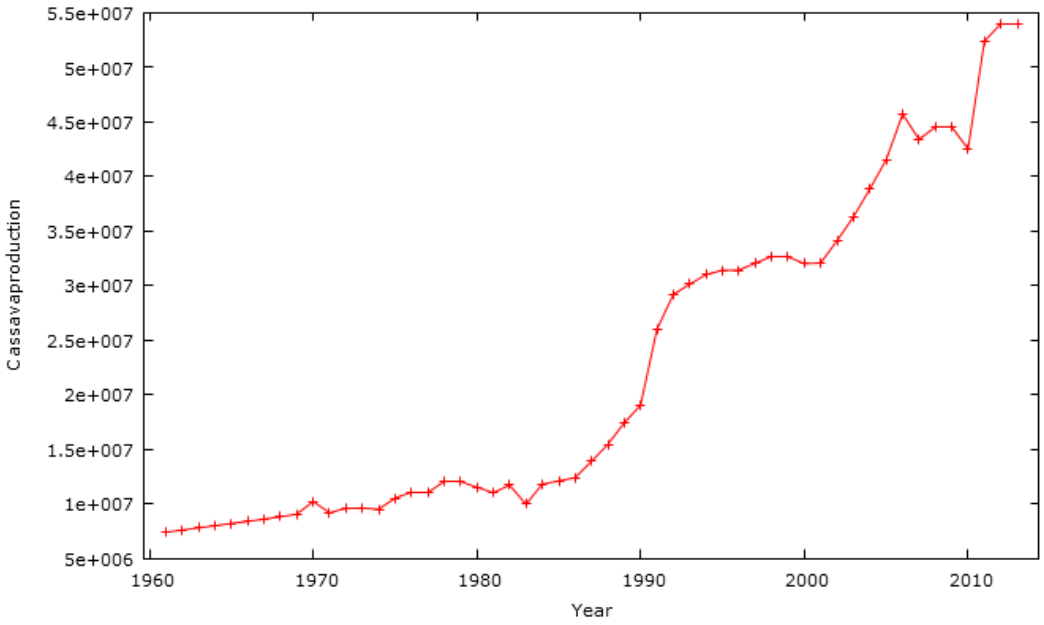


**Fig. 2.** Trend of agricultural production in Nigeria

*Result of the Granger causality test*

The analysis result from Table 3 showed that the relationship existing between the population and the agricultural production is a unidirectional one. The hypothesis which says that lagged production (4 lagged) does cause population increase was rejected because the probability value was more than 5%, while the lagged population (4 lagged) causing agricultural production was accepted with a probability value of 3.08%. From the result, the increase in the population of Nigeria has an effect on the agricultural production in Nigeria.

**Table 3**. Granger causality Wald tests

| Null hypothesis | F- statistics | optimum lag | Probability | Decision |
|---|---|---|---|---|
| **Production does cause population** | 0.81328 | 4 | 0.5242 | Reject |
| **Population does cause production** | 2.96840 | 4 | 0.0308 | Accept |

Granger causality Wald tests. Sample 1961 – 2013

**Table 4.** Ordinary Least Squares analysis output

| | Coefficient | Std. Error | t-ratio | p-value |
|---|---|---|---|---|
| **Const** | −1.39947e+07 | 1.26259e+06 | −11.0841 | <0.0001*** |
| **Population** | 0.384744 | 0.0123727 | 31.0961 | <0.0001*** |
| **Mean dependent var** | 22588389 | | **S.D. dependent var** | 14764302 |
| **Sum squared resid** | 5.68e+14 | | **S.E. of regression** | 3336935 |
| **R-squared** | 0.949900 | | **Adjusted R-squared** | 0.948918 |
| **F(1, 51)** | 966.9668 | | **P-value(F)** | 7.99e-35 |
| **Log-likelihood** | −870.2742 | | **Akaike criterion** | 1744.548 |
| **Schwarz criterion** | 1748.489 | | **Hannan-Quinn** | 1746.064 |
| **Rho** | 0.829811 | | **Durbin-Watson** | 0.318904 |

OLS, using observations 1961-2013 (T = 53) Dependent variable: Agricultural Production

Table 4 shows the results of the Ordinary Least Square (OLS) test with 53 observations. Population was significant at least at the 99% level, with a P value less than 0.01. An adjusted R-squared value of 0.95 indicates that the population explains about 95% of the variation in agricultural production and the Durbin-Watson value of 0.32. A decrease in population has a negative effect on agricultural production according to the OLS result.

## Conclusion

According to Joyce and Idisi (2014), agricultural employment remains the primary source of livelihood

for about 38% of the population in developing countries, but is underperforming for a number of reasons. Nigerian private investors do not have the incentive to invest in agricultural research and development because of the lack of patent protection, although there is an increase in population which corresponds with the findings of FAO (2002). Constraints in agricultural production include a wide range of technical, institutional, and socioeconomic factors. These include pests and diseases, agronomic problems, land degradation, shortage of planting materials, food policy changes, access to markets, limited processing options, and inefficient/ ineffective extension delivery systems.

From the empirical analysis result, it is evident that decreasing population has a negative effect on agricultural production. In Nigeria, the agricultural production rate still does not match the need of the increasing population; this eventually leads to a more food-insecure economy, increased poverty, and bad healthcare; this is in line with the findings of Omotesho K. F. et al. (2013), who reported that increased population at a different rate from agricultural production will impede productivity and result in poverty.

In line with the results of the analysis, the following recommendations are necessary. There is a need for the government to support innovative ways for increasing agricultural production, in order to meet the demand of the increasing population of the country. There is a need for research bodies to improve production to match the country's increasing population, so sustainable development could be achieved. In addition, if agricultural production is to meet the increasing population demand, there is a need to promote innovation towards the development of improved high-yield, disease-resistant varieties coming from certified nurseries where the varieties can be traced. There is a need for innovative processes through which agricultural products and processing methods can be learned through extension services by the general population, so as to reduce malnutrition and poverty in the country.

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