Output Projections for Maize in Nigeria (2015 - 2030), Implication on its Importation

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Abstract
This study analyzed the trend of maize output in Nigeria, in order to make estimates and forecast for future production. Time series data for a period of twenty years (1995-2014) were collected from secondary sources and the analytical tools used were descriptive statistics, Ordinary Least Square regression model, and Simple Growth Rate Supply Model. Results indicate that there was a general rise in maize output in Nigeria from 2001-2006 after which a sharp decrease was recorded in 2007. The period, 2008-2011 witnessed another general rise in the quantity of maize supply. The trend in maize production in Nigeria had been on the increase but at a very slow pace. Producer price of maize and per capital supply of maize in the previous year were positively signed and significant at 10%. The supply projection indicates that the quantity of maize supply in Nigeria will increase from 7748 thousand metric tones in 2015 to 11043 thousand metric tones in 2030. However, there was a decline in the growth rate. This projected figure calls for policies that would encourage maize farmers to increase the area of land put under maize cultivation and improve their productivity. Foreign and local investors should capitalize on the suitable land and readily available market by investing massively in maize production and its industrial value addition in Nigeria.

1. Introduction
Nigeria is primarily an agrarian economy with high population density, where food security remains a major concern. Agriculture, having contributed 34.7 percent of the country’s Gross Domestic Product (GDP) in 2011, National Bureau of Statistics, (NBS) (2012)[1], plays a great role in the creation of rural employment and generation of income in Nigeria and is therefore considered a lifeline of the Nigerian economy. Nigeria was self-sufficient in food production and was a key exporter of several agricultural commodities, notably, cocoa, oil palm products, rubber, and groundnuts before the oil booms of the 1970s and 1980s. Agriculture has been the provider of food for the teeming population, the largest employer of labour force in the country [2] and also helps to generate foreign exchange.

Maize (Zea mays) is a member of the grass family (gramineaceae). It is the most important cereal crop in Sub-Saharan Africa (SSA). Along with rice and wheat, maize is one of the three most important cereal crops in the world. Over 50 species of maize exist and consists of different colours, textures, grains, shapes and sizes [3]. Yellow, white and red species are the most common types but most people prefer the yellow and white species [4]. Maize was introduced into Africa in more than 150 decades ago and has since become one of the dominant food crops in Africa. It originated from South and Central America and was introduced to West Africa by the Portuguese in the 10th century [5].

Maize is the largest producer of maize in the world and the largest producer in Africa [5]. The North central region is the main producing area in Nigeria. The region accounted for about 31% of the total national production in the years 2006 and 2007, 58% in 2008 and 44% in 2009 [13]. In Nigeria, the estimated corn production in 2010 was about 8,800 metric tons with growth rate of 1.68%, in 2012, it rose to about 9,410 metric tons for which the growth rate was 1.73% [14].

According to James (2003), global cereal demand in 2020 is estimated at 2.1 billion MT and will, for the first time, show a major shift in favour of maize with demand estimated at 852 million MT compared with 760 million MT for wheat and 503 million MT for rice. Thus, global demand for maize in 2020 will increase by 45% (compared with 30% for wheat and 32% for rice). The substantial increased demand for maize is a challenge to developing countries because imports, which have typically supplied about 10% of developing country needs, are not expected to change significantly [15].
It is on the basis of the above that this study seeks to analyse the output and trend of maize as well as projection of maize commodity in Nigeria.

Despite Nigeria’s significant progress in agriculture, especially with respect to maize production and yields, the demand for maize still outstrips domestic production, and the country remains an importer of maize [5]. With an expanding population, planning for future cereal production and demand is crucial to meeting the food security challenges in Nigeria. To facilitate this planning, projections of future supply for cereals are critical. This study is an attempt at carrying out such future projections. Toward this end, models of supply was developed using the latest available data, which are then used to project supply for the years 2015, 2020, 2025, and 2030 under various scenarios in order to formulate an effective policy for the growth and development of maize production in the country. It is in the light of the above that this study intends to project the output of maize in Nigeria (2015-2030). Specifically, the study:

(i) Examined the trend of maize production in Nigeria;
(ii) Compare maize consumption and importation in Nigeria;
(iii) Find out the trend in growth for maize in the country;
(iv) Project the quantity of maize produce and the corresponding yield for the year 2030 in Nigeria.

2. Methodology

2.1 Analytical Framework

In the 1960s, the Food and Agriculture Organization of the United Nations (FAO) made public its first “agricultural commodity projection” based on single-equation model methodology [16]. In the projection, various types of mathematical functions were carefully selected for each country and commodity in order to reproduce patterns of past trends. The U.S. Department of Agriculture (USDA) made several attempts to build multi-equation models in which supply-demand gaps were cleared automatically by a change in prices (USDA 1985). However, the form of the equations was rather simple and the structure of the models was comparatively static, whereby single point of the future was compared with the starting point. Thus, the results of the projections were not very persuasive.

In order to assess the mutual impact among various economic sectors, computable general equilibrium (CGE) models were adopted. The GTAP (Global Trade Analysis Project) model is a typical model of this kind and was widely used for agricultural trade issues [17]. Since the commodity classification is not as detailed as in the partial equilibrium models, it is not a very powerful tool for future projection [18]. In this study, however, the standard Ordinary Least Square (OLS) model was used for estimations, while the Simple Growth Rate Model for supply as used by Dastagiri [19] (2004) in India were adopted to project the future supply of maize in Nigeria. This model was adopted because it fits the Nigerian scenario of a developing country with agriculture as one of her major activities, and also that projections in this study were limited to the small scale production (supply) of maize only. The system equation of log linear model was specified as:

\[ \log Y_i = a + b_i \log m_s + c_j \log P_j + u \]

Where: \( Y_i \) is the quantity produced of the ith commodity, \( P_i \) is producer prices and \( C_j \) are price coefficients.

2.2 The study area

The study area is Nigeria. Nigeria has an area of 923,769 square kilometers (made up of 909,890 square kilometers of land area and 13,879 square kilometers of water area), and is located between 3° and 14° East Longitude and 4° and 14° North Latitude (NBS, 2011). The country is bordered on the west by the Republics of Benin and Niger; on the east by the Republic of Cameroon; on the north by Niger and Chad Republics and on the south by the Gulf of Guinea. The coast of Nigeria is a belt of mangrove swamps traversed by a network of creeks and rivers and the great Niger Delta. The climate is tropical in nature, characterized by high humidity and substantial rainfall. There are two seasons – the wet and dry seasons. The wet season lasts from April to October, while the dry season lasts from November through March.

2.3 Sampling Procedure and Data Collection

Time series data on maize production, rainfall, per capita income (GDP in agric sector), price of maize, producer prices of maize, maize yield, land area harvested, and price of other food items were collected for a period of twenty years (1995-2014).

Secondly data were used for the study. The data were sourced from Central Bank of Nigeria (CBN) 2013 statistical bulletin, the Nigeria Meteorological Agency (NIMET), and United States Department of Agriculture (USDA) 2015 data base [20].

2.4 Method of Data Analysis and Model Specification

Data were statistically analyzed using regression method and simple growth rate model for supply. The supply projections were made using simple growth rate model for supply based on per capita production of maize in the base year, growth rate in nominal prices of maize commodity, price elasticity of supply for maize, and projected land size for the projected year. The equations were estimated using OLS multiple regression method. The estimated response functions incorporated the price lags of one year.

The statistical analyses used include regression model as stated in Joseph [1998] and Elasticity model [19].

The supply equation was used to determine the effects of the below stated explanatory variables on the supply of maize in Nigeria. The double-log functional form was adopted as the best functional form for supply estimations. The model is given below as:

\[ \log Y_{it} = \beta_0 + \beta_1 \log P_{g_{it}} + \beta_2 \log R_{a_{it}} + \beta_3 \log P_{m_{it}} + \beta_4 \log L_{n_{it}} + \beta_5 \log T_{im_{it}} + \epsilon_{it} \]

Where:

- \( Y_{it} \) = quantity of maize supplied
- \( P_{g_{it}} \) = producer prices of maize
- \( R_{a_{it}} \) = rainfall (proxied by weather variables)
- \( P_{m_{it}} \) = price index of other food items (lagged)
- \( L_{n_{it}} \) = Land Area Harvested (lagged)
- \( T_{im_{it}} \) = technological change (proxied by time trend)
- \( \beta_0 - \beta_5 \) = estimated parameters
- \( \epsilon_{it} \) = random variables

**Elasticity**

The elasticity model is specified as:

\[ \text{ep} = \beta \times p/q \]

Where:

- \( \beta \) = coefficient of price of maize
- \( p \) = price of maize
- \( q \) = quantity of maize supplied

**Projection Model**

The supply projections for years 2015-2030 were made using Simple Growth Model as adopted by Dastagiri [19] (2004) to determine demand and supply model to project the future demand and supply for livestock products in India.

The Simple Growth Rate Model for Supply is specified as:

\[ S_{it} = S_{0} + (1 + P_{g}) 	imes (1 + P_{m}) + P_{t} \]

Where:

- \( S_{it} \) = supply projection for maize in year t
- \( S_{0} \) = per capita production of maize in the base year
- \( P_{g} \) = growth rate in producer prices of maize
- \( P_{m} \) = price elasticity of supply for maize
- \( N_{t} \) = projected land size in year t

3. Results and Discussion

3.1 Trend of maize production in Nigeria

The trend of maize production in Nigeria is presented in figure 1. Figure 1 showed that maize production in Nigeria was on a decreasing rate from 1996 to 1998. This decreasing rate can be attributed to the removal of ban on imports in 1995. A sharp decrease was experienced in the year 2000, after which there was a relatively steady increase in maize production from 2001 to 2006. This increase in output is due to increase in the area of land used for maize production. This is in line with the works of many authors. [10,21-23]. There was a sharp decrease in maize production in the country in 2007 after which a steady increase in maize production has been maintained from 2008 to 2011. However, the rate of maize production in the country is on the decreasing rate in recent years (2012-2014). This could be due to decrease in the area of land used for maize production, pest infestation or lack of adequate storage facilities.
3.2 Maize Consumption and Importation

The trend of maize consumption in Nigeria in figure 2 shows that maize consumption in the country had been on the increase over the years though there was a decrease in the consumption level in 2000 after which a steady increase was maintained till 2011. There is a gradual decrease in the consumption level in 2012 and 2014. This decrease in consumption may be attributed to an increase in the producer price of maize.

Figure 2 also shows that the trend of maize importation was very low over the years; it started increasing from 2008 and maintained a steady increase up to 2014. The high level of import in recent years indicates that the country could not meet the high level of demand for maize and has to opt for import so as to bridge the demand-supply gap. This agrees with James [15], who reported a global cereal demand which will shift in favour of maize. However, the quantity imported can still be met locally if there is an aggressive approach towards increasing maize output in years to come. If all attention is not paid to this new development, Nigeria may have to depend on importation to meet the current increase in demand for maize in the country.

3.3 Growth Rate in Maize Production

The growth rate in maize production as shown in figure 3 reveal that maize production had been fluctuating over the years. There had not been a steady continuous growth in maize production over the years. The growth rate was negative in the years 1996, 1997, 2000, 2007, 2010, 2012 and 2014. The peak period of maize production in the country were 2001, 2004 and 2008, while the period of low but positive growth rate was in the years 1995, 1998, 1999, 2002, 2003, 2005, 2006, 2009, 2011 and 2013. This implies that maize production still need a lot of attention from policy makers to design a good policy that will stimulate improvement in the steady growth of maize production in the country.
3.4 Supply Estimation

The estimates of the supply equation for maize production in Nigeria are presented in Table 1. Results of the estimates reveal an adjusted R-squared value of 0.827 which indicates that 83% of the independent variables explained the quantity of maize commodity supplied in the country.

3.5 Producer price (lagged)

Table 1 indicates that the producer price of maize had a positive effect on the supply of maize in Nigeria and this relationship was significant at 10%. By implication, the higher the producer price, the higher the quantity of maize that would be supplied in the country. Increased producer price will encourage farmers in the country to produce more maize and also cover their production cost.

3.6 Rainfall

The volume of rainfall had a positive relationship with maize supply in Nigeria. The relationship was not significant. This implies that the higher the volume of rainfall the higher the quantity of maize supply. However, excessive and erratic rainfall can reduce maize supply in the country. This finding agrees with Ojoko, et al [21], who reported that the volume of rainfall determine the quantity of rice commodity that would be available in Nigeria at a particular point in time.

3.7 Per capita supply (lagged)

Per capita supply of maize was positively signed. The relationship was significant at 10%. By implication, the higher the per capita supply of maize in the previous year, the higher the quantity of maize supply in the current year. Hence, the quantity of maize supplied in the previous year play significant role in determining the quantity of maize that would be available in Nigeria at a particular time.

3.8 Time

Time trend was positively signed. The relationship was however not significant at any level. Awareness and adoption of innovation like the use of modern farming implements; high yielding varieties of maize; recommended rate of fertilizer, insecticide, and pesticides, application; and Integrated Pest Management (IPM) system; will enhance the production of higher quantity of maize in Nigeria and farmers will enjoy economies of scale.

Table 2 showed the supply projection of maize in Nigeria. The average growth rate for the total maize supply in the country is likely to grow by 3.3% and 2.7% in 2015 and 2016 respectively from the base year. There is reduction in growth rate to 2.0% in 2020 from 2016, 2.1% in both 2025 and 2030 from 2020 and 2025 respectively. This decline in maize supply could be attributed to reduction in the area of land put under maize cultivation, pest infestation, price fluctuation and poor storage facilities. This implies a deficiency in maize supply with respect to the quantity that will be demanded in the nearest future if no measure such as increase in the area of land is taken to improve maize production in Nigeria. Aliyu [24] in 2009 reported an annual instantaneous growth rate of 2.6% in maize yield over the period, 1990-2011. Ojoko et al [21] found a decline in the domestic supply of local rice commodity in Nigeria and attributed the decline to geometric rate of population growth, as compared with the slow growth (arithmetic rate) in rice production. Rosegrant et al [25] in 2001 reported a production growth rate for maize of 4.1% in China, 2.2% in India, 3.6% in East Asia. Pingali and Heisey [26] in 1999 reported a growth rate of 2.26% for maize production in South Africa.

4. Conclusion

Maize supply in Nigeria had been increasing at an arithmetical rate. If this continues, with reduction in the area of land put under maize cultivation while population is moving in a geometric rate, in the near future, demand for maize commodity will far surpass its supply, which will pose a challenge to the citizens of Nigeria. Based on the findings, the following recommendations are made:

1. The Nigeria government should implement agricultural policies that would encourage local farmers to improve their productivity.
2. Foreign investors should utilize the very suitable and readily made local demand for maize by investing massively in maize production in the country.
3. Suitable production environment such as provision of inputs should be created for individuals, organizations, and private investors to invest in maize production.
4. The Federal Ministry of Agriculture in collaboration with States Ministry of Agriculture and the Agricultural Development Project (ADP) should lay emphasis on increase output per unit area of land via promotion of more productive dry season maize production, the use of fertilizer, tractors, modern implements, provision of credit facilities for maize farmers, and improved varieties of maize seeds for the small scale farmers.
References


