

Economic Analysis of Tomato Production in Nigeria (1981-2017)

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ABSTRACT

Improving tomato production is one of the important greatest challenges facing Nigeria government today. Since tomato is an important fruit crop for the country and for individual households, it has important implications for livelihood of rural people. In order to achieve this, several interventions in the sector were done in an attempt to improve production. The study analyzes the tomato production from year 1981-2017. The study was carried out to examine the trend in tomato production and importation, the determinant of tomato production and the effect of tomato import on it producer in Nigeria. Secondary data obtained from Central Bank of Nigeria Statistics and Food and Agricultural Organization were used for the study. Dickey-Fuller unit root test and Co-integration test were employed to analyze the data collected. The result showed that the time series used for the study are all stationary at first difference. The result of co-integration test in the short-run Error Correction Model (ECM) estimation at 1 lag length shows that Agricultural labour, local tomato price and rainfall are significant to tomato production. The result of the long-run ECM estimation shows that Agricultural labour, local tomato price and rainfall are significant to tomato production. The result of the trend local tomato price showed it was stationary at first difference and also positively significant to tomato production at both short-run and long-run ECM estimation which indicates that local tomato price time trend has being favourable for tomato production. Result of the trend of agriculture labour showed that it was stationary at first difference and positively significant in the short-run and positively in the long-run ECM estimation to tomato production which indicates that agricultural labour time trend is inversely related to tomato production. All this can be due to the country not depending on importation of agricultural produce, food production through agriculture to the masses by the government within the country, implying that the government support production and more exportation resulting in an government increasing revenue. It is therefore concluded that more agricultural produce should be produce in the country to control importation.

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Introduction

The word "tomato" comes from the Nahuatl word tomato, literally known as "the swelling fruit" (Online Etymology Dictionary). Tomato belongs to the Solanaceae family. Tomato (*Solanum lycopersicum* L) is one of the most important vegetables worldwide. As it is a relatively short duration crop and gives a high yield, it is economically attractive. Tomatoes contribute to a healthy, well-balanced diet, as they are rich in minerals, vitamins, essential amino acids, sugars, dietary fibres, vitamin B and C, iron and phosphorus. It can be processed into different products including: Ketchup, puree, powder and juice.

Nigeria ranks as the 16th largest tomato producing nation in the world and has the comparative advantage and potential to lead the world in tomato production and exports. The production of tomatoes in Nigeria in 2010 was about 1.8 million metric tonnes, which accounts for about 68.4% of West Africa, 10.8% of Africa's total output and 1.28% of world output. Unfortunately, the country still experiences deficiency in critical inputs, lack of improved technology, low yield and productivity, high postharvest losses and lack of processing and marketing infrastructure. The demand for

tomato and its by-products far outweighs the supply. With a population of over 170 million people, an estimated national population growth rate of 5.7% per annum, and an average economic growth rate of 3.5% per annum in the past five years, Nigeria has a large market for processed tomato products. Apart from the Nigerian market, the advantage of the trade liberalization in the West African market could be used to enhance the sale of processed tomato products in this region. At present, a significant percentage of processed tomato products used in Nigeria are imported, resulting in unnecessary pressure on foreign exchange reserve. It is therefore necessary to study the entire value chain for Nigerian tomato to improve its production and processing.

Nigeria's agricultural productivity is declining. Productions of tomatoes remain low compared to increase in inhabitants of most nations and since for food – especially in soups where it is used for thickening – is on the increase, it is proper to observe how the production of this all important commodity can be improved upon. As part of crop improvement, it is the use of soils that have optimum nutrients that is used for tomato production. High cost and scarcity of chemical fertilizers to provide the much needed

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nutrients (NPK) for plant growth means that alternatives have to be explored and hence this study to explore composts from different sources. The study carried out in this work was to meet high demand of tomatoes throughout the year using compost treatment and increase the use of cost effective organic fertilizers e.g. composts or animal droppings.

Tomato marketing is poorly developed in Nigeria. It is characterized mainly by the problem of seasonality and perishability amongst others. Worst still, in the past, the government paid more attention to production with little attention to the marketing of vegetables such as tomato, pepper, onions, garden eggs, okra and leafy vegetables despite the fact that they need spatial marketing facilities (Idachaba, 2000). Consequently, losses of 40-50 percent occur for many vegetables mainly due to spoilage, inadequate transportation, sorting, improper packaging and handling and lack of storage facilities. Also, another problem with tomato marketing is in the area of standard weights and measurements. These leave the consumer to their luck and hagglng abilities in securing a good deal. Thus, this study describes the marketing functions and structure, estimates costs and returns to tomato marketing and determines the factors influencing net returns of tomato marketers.

The failure of tomato farms to meet demand in Nigeria has raised concern over the ability of these farms to increase tomato output. In view of the growing demand for tomato in Nigeria, improving the efficiency of resource use would be the key to increased tomato production in the Country. Thus, for the Nation to thrive in tomato production, it needs to achieve a high level of efficiency which is essential for competitiveness and profitability. It is against this background that this study intends to carry out the technical efficiency of resource use among tomato farmers as well as the factors influencing the output of tomato in Nigeria. Specifically, this study was designed to: examine the trend in tomato production and tomato importation in Nigeria, examine the determinant of tomato production in Nigeria and highlight the effect of tomato import on it produce in Nigeria. The hypothesis was stated in null form H_0 : Tomato production is not profitable in Nigeria.

Worldwide production of fruits and vegetables has been increasing over the years, partly in response to population growth but also due to rising living standards in most countries and active encouragement to consume fruits and vegetables by government health agencies (Wills, 2007). The tomato is commercially important worldwide both for fresh fruit market and processed food industries. Because of its commercial importance, millions of dollars are now spent on imparting and improving desirable characteristics, either through classical breeding programs or by genetic manipulation (Opiyo, 2005). The tomato (*Lycopersicon esculentum* M.) is one of the most commonly grown fresh market vegetables despite being highly perishable. Due to poor handling and inadequate infrastructure, postharvest losses in horticultural crops (including tomato) are estimated to be in the tune of 25 to 40% which is a major setback in expansion of the industry. Postharvest losses in tomato are a prime factor affecting the quantity and quality of tomato fruits in the market (Meaza et al., 2007). 5 Options to avert these losses are limited, and thus there is need to design research studies that are geared to developing such strategies. All year round availability of tomato in the market is very important for farmers as well as consumers because the tomato is a vegetable par excellence; it is found in every meal

and can be eaten raw as salad. This is now even more critical as more and more producers adopt greenhouse technology where tomato is the crop of choice. The manipulation of field practices such as proper watering might reduce field losses and enhance the quality of the tomato, and may also result in higher yield. Good storage and packaging might also influence the fruit quality and its shelf life. Tomato subjected to different levels of water regimes can behave differently in terms of postharvest qualities. The losses observed from harvesting time to consumption may therefore be reduced depending on the water regimes adopted

The main objective of this article as stated above is to asserting whether or not is economical to produce tomato in Nigeria, paying particular attention to farmers response to various government policy instruments during the period under study. Various past researchers works were reviewed to capture the objective which guides this research. These include issues about regional tomato production and marketing trend in Nigeria, importance of tomato production to developing countries and factors affecting production and the empirical models commonly used to study production behavior and farmer's response to policy incentives.

The Impact and Factors Affecting Tomato Production in Nigeria

Tomato is widely cultivated across Nigeria. Smallholder farmers planting on between 0.5 and 4 hectares of land account for 90% of production, with the balance contributed by commercial producers (Sahel research, 2015). Nigeria has the largest area harvested for fresh tomato in Africa with 541,800ha followed by Egypt with 214,016ha (Faostat, 2014). However, Nigerian farmers on average generate the lowest yields for tomatoes in Africa at 4.0MT/Ha which is significantly lower than Egypt with 38.7mt/ha and South Africa with yields of 78.7mt/haa in 2014 (Faostat, 2014). Yields are low because of the poor production practices including usage of old varieties, low soil fertility, inadequate pest and weed control and the high post-harvest losses due to the poor handling and distribution system. In effect, 40- 50% of tomato produced in Nigeria is lost due to the poor handling, processing and preservation practices in Nigeria (Sahel research, 2015). In 2016, GAIN has developed the Postharvest Loss Alliance for Nutrition (PLAN) to bring together the multitude of public and private sector actors addressing this issue to collectively reduce loss and waste of nutritious foods.

The Post-harvest Alliance for Nutrition (PLAN) is currently exploring models that allow smallholder farmers lease returnable plastic crates (RPC's) at affordable prices for tomato packaging in place of the handmade weaved raffia baskets commonly used by tomato farmers in 2016. Tomato; *Lycopersicon esculatum* belongs to the family *Lycopersicon*. Though the site of domestication is uncertain, Peralta and Spooner, (2007), suggested that the south west coast of the tropical South America may be ascribed to be the origin of the crop. This crop has become widely grown around the world because of its importance and value (Adepoju, 2014). Tomatoes are grown both in most home gardens and commercially as one of the words most popular vegetables. It is America's most popular home grown vegetable, produced by most homes – at least more than 90% of home grow the crop (Peralta, and Spooner, 2007; Gao, et, al., 2010). The per capital consumption of tomatoes in the United States is believed to have more than tripled in the last 50 years (Gilber et. al., 2000). Its malleability when frozen has played a major

role in the rapid and widespread adoption as an important feed commodity. *Lycopersicon esculatum* is thought to be the direct ancestor of cultivated tomato based on its wide presence in South America. The flowers have been classified into five botanical varieties namely commune (common tomato), *cercisiforme* (cherry tomato), *periforme* (pear tomato), *garandiforme* (potato leaf tomato) and *validum* (upright tomato), (Musa, et. al.,; 2009).

Tomatoes are first raised in nurseries before transplanting to the field. The input supplies required include seeds, fertilizer, pesticides, nursery supplies, greenhouse, ancillary equipment, etc. Most of the inputs are not produced in Nigeria, making them a little more expensive than what the farmers can afford. The difficulty in accessing inputs and technology makes it impossible for farmers to maximise production. Most of them have very small holdings, making commercial production impossible. Tomato grows in most parts of Nigeria, however the best area is the Savannah agro-ecological zone, where diseases and pests affecting tomatoes are less common. Major producing areas lie between latitude 7.5°N and 13°N and within a temperature range of 25°C-34°C. These areas include states in the northern parts namely Bauchi, Benue, Borno, Kano, Kaduna, Plateau, Jigawa and some southern states like Delta, Kwara and Oyo. Tomatoes are warm season crop and are sensitive to high humidity / rain. Thus, increases in yield are experienced in well drained, sandy loam, and rich in humus soils.

The planting season is between August and September. However, where irrigation farming is practiced, the best time for planting is during the dry season. The trend in tomato production in Nigeria from the year 2000 to 2010. The highest yield was recorded in year 2010 and the lowest in 2006. Total yield in 2010 was 1,860,600 metric tonnes valued at \$687,610,000. Most tomatoes produced are destined for domestic market and yet they are scarce during off season. The national demand for fresh tomatoes is about 2 – 3 million metric tonnes annually, leading to demand gap of about 500,000 metric tonnes. Between the year 2009 and 2010, a total of 105,000 metric tonnes of tomato paste valued at over #16 billion was imported to bridge the deficit gap. This point out the great opportunity to develop the value chain with improvement in productivity and competitiveness of all actors.

According to a press release by the Central Bank of Nigeria in 2013, an annual total area of one million hectares is reportedly used for tomato cultivation in Nigeria while it makes up about 18 percent of the average daily consumption of vegetables in homes. Nigeria is ranked second largest producer of tomato in Africa and fourteenth largest in the world, producing 1.51 million metric tonnes of tomato annually valued at #87 billion at an average of 25-30 tonnes per hectare under rainfall production, Central Bank of Nigeria. Tomato is grown and eaten all over the world. It is used in diverse ways, including raw in salads, and processed into tomato soup. Unripe green tomatoes can also be breaded and fried. Tomato juice is sold as a drink. The fruit is preserved by drying, often in the sun, and sold either in bags, baskets or in jars with oil. Tomato is rich in vitamins, minerals and lycopene, an excellent antioxidant that helps to reduce the risk of prostate and breast cancer. Tomato production requires a high level of management, large labour and capital inputs and close attention to detail. Tomato production is subject to the variations that occur in weather, which may result in severe crop damage and losses.

Labour requirements for production, harvesting, grading, packaging and transporting are very intense. Erdogan confirms that tomato production is labour intensive and bulk of production is mostly supported by small family farm. Major tomato producers in Nigeria are small scale farmers who could hardly produce enough to meet the demand of consumers. Tomato produced in the State is done mostly during the dry season, that is, October to May. The period between July to September is severe tomato scarce period because of high incidence of pests and disease associated with growing tomato; general crop management and shifting of tomato producers to production of grain crops. These critical supply elements drive high demand for fresh tomatoes, causes inflation of fresh tomato price, opens market for unhygienic sun-dried tomato as well as clearance for imported fresh tomatoes from neighboring States. The failure of tomato farms to meet demand in Nigeria has raised concern over the ability of these farms to increase tomato output. In view of the growing demand for tomato in Nigeria, improving the efficiency of resource use would be the key to increased tomato production in the State. Thus, for the State to thrive in tomato production, it needs to achieve a high level of efficiency which is essential for competitiveness and profitability. It is against this background that this study intends to know the analysis of tomato production use among tomato farmers as well as the factors influencing the output of tomato in Nigeria.

Tomato is a very widely used and important vegetable in Nigeria (Ric et. al.,; 2001), about 25,000 tons of fresh tomato are produced annually. It is grown for its fruit and is used in varieties of ways for the production of puree pastes, juices, and canned fruit or mixed in chilli sauces. Tomato fruit is found to have high amount of vitamin C. The seed contains 22- 29% crude fat; 15 - 28% crude fibre; 5 - 10% ash content and 23 - 34% crude protein It has been reported that water deficit stress increases the flower abortion, thus affects the fruits settings. The low marketable fruit yield obtained for some tomato varieties might be due to non-development of flowers. It was observed that only 50% of the flowers produced developed into fruits, thus sink size was a limiting factor to fruit production in tomato (Olaniyi et al., 2010).

The production constraints identified include: use of poor agricultural practices; unwillingness of communities to give out land to interested investors to go into commercial production; lack of good quality seeds and over application of other insecticides by farmers. Other constraints include: high cost of critical production inputs such as irrigation equipment, greenhouse, machinery, fertilizer and pesticide, lack of experienced technical manpower in tomato production and management, infrastructure and basic amenities such as electricity, roads and water. The lack of good adoption of Good Agricultural Practice (GAP) result in poor yields and low productivity. For example, the average on practices is about 10 tons per hectare. With improved seed varieties and GAP, yields as high as 60 tons per hectare can be obtained, transport facilities, for example the conditions of the roads linking the farm areas to the markets are poor and they are sometimes inaccessible. To farmers, it leads to losses, as their produce will not be accessible and high transportation cost reduces the profit. The breakdown of vehicles and basket containing tomato lead to losses and high marketing cost for wholesalers, retailers and consumers

Methodology

This study was carried out in Nigeria. Nigeria is the most populous African country south of the Sahara (FOS, 1992). It is a geo-political and sovereign entity that is composed of 36 states and the Federal Capital Territory (FCT-Abuja). Nigeria is situated along the coast of West Africa between latitudes 4° and 14° N and longitudes 3° and 15° E. It shares a common boundary with Benin Republic in the west Niger Sc Chad in the North Cameroon in the East Gulf or Atlantic oceans in the South. Nigeria occupies a land area of 98.3 million hectares, of which only about 34.2 million hectares are actually being cultivated and less than one percent of the arable land is irrigated (NBS, 2008). Its terrain ranges from southern coastal swamps to tropical forest, open woodlands, grasslands and semi-desert in the far north. The country enjoys an annual rainfall ranging from 381cm along the coast to 64cm or less in the far north. Rainfall, as one of the important climatic factors influencing agriculture in the country, it is characterized by an alternation of wet and dry seasons of varying duration. In the south, rainfall lasts from May to October with a peak in September while in the north; rainfall lasts from May to September with a peak in August. The mean annual temperature ranges from 28° – 31° C in the south.

Secondary were obtained for the purpose of this study. for this study time series data were collected, Data on tomato output, area, yield, price, labour, equipment, land, fertilizer and produce will obtained from the International Tomato Research Institute (ITRI); the United State Development Agency (USDA) version will be chosen over the Food and Agricultural Organization (FAO) version contained in the statistics because it was better updated, comprehensive and consistent for the targeted time interval (1980-2017). Supplementary data on the price and non-price variables were obtained from the International Institute of Tropical Agriculture (IITA), publications of development finance and research department of the CBN. Also documents of the National Bureau of Statistics (NBS), National Planning Commission (NPC), and other official sources. The features of data will include: Price of Tomato, Tomato Yield, Labour used, Land used, Value of Tomato Import and International Price of Tomato.

Augmented Dickey Fuller Test (ADF)

Any of the forms of this test presumes the existence of white noise errors in the regression. If that is implausible, the test will lose significant power. To cope with this issue, an ADF test is employed in which a number of lags of the dependent variables are added to the regression to whiten errors. The ADF test is based on the regression equation with the inclusion of a constant and a trend of the form.

Engle and Granger (1987) provided appropriate tests for stationary of individual series specifically the test procedure includes the estimation of Dickey-Fuller (DF) and the Augmented Dickey Fuller (ADF) statistics. The DF and ADF is test for the null hypothesis that the variable of interest is non-stationary. Thus

H_0 ; The variables are not stationary at their levels, i.e; $I(1)$

H_a ; The variables are stationary at their levels, i.e; $I(0)$

The test procedure is usually indicated in the following type of equation:

For DF test, $\Delta X_t = \alpha_0 + \Delta X_{t-1} + e_t \dots \dots \dots (1)$

For ADF test,

$\Delta X_t = \alpha_0 + \delta X_{t-1} + \sum_{i=1}^k \Delta X_{t-i} + e_t \dots \dots \dots (2)$

H_0 is rejected if t- statistic on δ is negative and statistically significant when compared to the appropriate critical values established for stationary tests.

A basic test for the order of integration is the Dickey-Fuller test. Assume that x_t is random walk process, $x_t = x_{t-1} + \epsilon_t$, then the regression model becomes $x_{t-1} = \rho x_{t-1} + \epsilon_t$. Subtract x_{t-1} from both sides of the equation, $\Delta x_t = \pi x_{t-1} + \epsilon_t$, (1) where $\pi = (1 - \rho)$. In this model we know, under the null, that $\hat{\pi}$ is biased downwards. Because of this, the significance of π is tested as a one-sided "ttest". The problem is that the test statistics associated with $\hat{\pi}$ is non-standard. If x_t is a stationary variable $\hat{\pi}$ would asymptotically follow a normal distribution, and standard tests would be possible. It can be shown that if x_t is a random walk, that the distribution of $\hat{\pi}$ is skewed under the null. Dickey and Fuller simulated the correct test statistics for $H_0 : \hat{\pi} = 0$, under the assumption of a random walk process. Instead of using standard t-tables, to perform the "ttest", we use the non-standard Dickey-Fuller distribution instead. (Notice that the Dickey-Fuller distribution changes depending on how the test equation is set up.) The Dickey-Fuller test can be set up in three ways, depending on what we want the alternative hypothesis to be. The null is always that x_t is a random walk without drift. The alternative can be that x_t is stationary $I(0)$, or that x_t is driven by a deterministic trend (t), alternatively that x_t is driven by a deterministic quadratic trend (t²). For each model the empirical distribution of $t\hat{\beta}$ is different, and tabulated in separate tables. Notice that Dickey originally developed F-tests for testing the joint significance of π and constants. These tests does not offer any advantage over the t-tests presented here, due to the downward bias that motivates one sided testing.

Testing for Unit Roots and Co-integration

The empirical distribution is always simulated under the assumption a random walk with white noise residuals, $\epsilon \sim iid(0, \sigma^2)$. In general, this is not the case, Δx_t is likely to be having an ARMA representation. In this situation the autoregressive structure can be dealt with by augmenting the regression equation with lagged Δx_t variables, such that $\hat{\epsilon}_t$ in the regression model becomes white noise and the Dickey-Fuller distributions are valid. If Δx_t contains a moving average process the situation is more complex. The augmentation is now at best viewed as an approximation. A solution is offered by Phillips and Perron (1988), who finds a non-parametric way of adjusting the estimated variance so that the tabulated distribution is valid. If x_t contains seasonal deterministic factors they can be added to the model as seasonal dummies without affecting the asymptotic distribution of the test statistics. Impulse dummies that remove extreme values can be added to the models without affecting the asymptotic distribution of the test statistics. Shifts in a deterministic trend components of x_t affects the distribution, however. Step dummies that capture changes in deterministic growth cannot be included in the model without changing the distribution.45 Furthermore, the test is sensitive to large negative MA processes in the series. An alternative, might be that the variable is near integrated, with an MA(1) process close to minus one. In the following we look at the three ways of setting up an Augmented Dickey-Fuller (ADF) test.

Restricted ADF Model:

$\Delta x_t = \pi x_{t-1} + \epsilon_t$ The Dickey-Fuller "t-statistics" for the significance of $\hat{\pi}$ is based on the estimated Dickey-Fuller (DF) model $\Delta x_t = \pi x_{t-1} + \epsilon_t$. Alternatively, in the case of

autocorrelation in the observed series, estimate the Augmented Dickey-Fuller (ADF) model: $\Delta x_t = \pi x_{t-1} + \sum_{i=1}^k \gamma_i \Delta x_{t-i} + \epsilon_t$. The null hypothesis is that $x_t = x_{t-1} + \epsilon_t$ where $\epsilon_t \sim NID(0, \sigma^2)$. The augmentation ($k > 0$) will not affect the asymptotic distribution of the test statistic. The test can also be performed on variables in first differences as a test for I(2)-ness. 6. Under the null $\hat{\pi}$ will be negatively biased in a limited sample, thus unless x_t is explosive, only a one sided test is necessary for determining $H_0 : \pi = 0 (x_t \sim I(1))$ against $H_a : \pi < 0 (x_t \sim I(0))$. The alternative hypothesis of segmented deterministic trends is discussed by Perron (1989), see also Enders (1994). A test procedure is offered by Banerjee, Lumsdaine and Stock (1992). 5 Notice that if you on a priori grounds identify segmented trends (shifts in the constant) and introduces these into the model, the outcome is that the empirical distribution of $t\hat{\beta}$ is driven from the Dickey-Fuller distribution towards the normal distribution. Thus, if you continue testing for unit root using the Dickey-Fuller test you will not over-reject the null of having an integrated variable, and you can avoid spurious regression results in a following regression model. 6 These comments also applies to the ADF models with constants, trend, and seasonal. Testing for Unit Roots and Cointegration model, there is alternative hypothesis for explaining an observed non-stationary process. A significant positive value implies an explosive process, which can be a very difficult alternative hypothesis to handle. The critical value at 5% and 25 observations is -1.95. 1.3.2 ADF model: $\Delta x_t = \alpha + \pi x_{t-1} + \epsilon_t$ The Dickey-Fuller "t-statistics" for the significance of ρ is based on the estimated model $\Delta x_t = \alpha + \pi x_{t-1} + \epsilon_t$. Alternatively, in the case of autocorrelation in the observed series, estimate the augmented Dickey-Fuller model: $\Delta x_t = \alpha + \pi x_{t-1} + \sum_{i=1}^k \gamma_i \Delta x_{t-i} + \epsilon_t$. The null hypothesis is that $x_t = x_{t-1} + \epsilon_t$ where $\epsilon_t \sim NID(0, \sigma^2)$. Under the null $\hat{\pi}$ will be negatively biased in a limited sample, thus only a one sided test is necessary for determining $H_0 : \pi = 0 (x_t \sim I(1))$ against $H_a : \pi < 0 (x_t \sim I(0))$. This model is less restricted, because it allows a deterministic trend as $x_t = \alpha t + \pi x_{t-1} + \epsilon_t$. The critical values are tabulated in Fuller (1976).

Graphical Analysis, Unit Root test and Regression Analysis were used as tools of Analysis in this study. The Graphical Analysis was used to examine the trend in the movement of selected macro-economic variables while Regression Analysis was used to examine the relationship between selected independent variables and the dependent variable. The hypothesized structural relationship for the study specified as follows:

$$Y = f(a, X_1, X_2, X_3, X_4, X_5, X_6, \mu)$$

Where;

Y = Tomato production, X_1 = Exchange Rate, X_2 = Imported Price, X_3 = Local price, X_4 = Rainfall, X_5 = Agric. Labour, X_6 = Agric. Land and μ = Error term

The following production functions were explicitly fitted to the model:

$$\text{Linear function: } Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6 + \mu$$

The presence of the error term (μ) will take care of other variables that have an influence on rice importation but are not stated in the model specified.

Result and Discussion

Tomato production in Nigeria from year 1981-2017

The trend in Tomato production was presented in figure 1. The graph shows that in year 1981 tomato production was too low but gradually increases from year 2000 and continue

to rise till 2017. The highest yield was recorded in year 2017 and the lowest in 1981. Total yield in 2017 was 400,000 metric tons. Most tomato produced was destined for domestic market and yet they are scarce during off season. The national demand for fresh tomato is 2-3 million metric tons annually, leading to demand gap of about 2,500,000 metric tons.

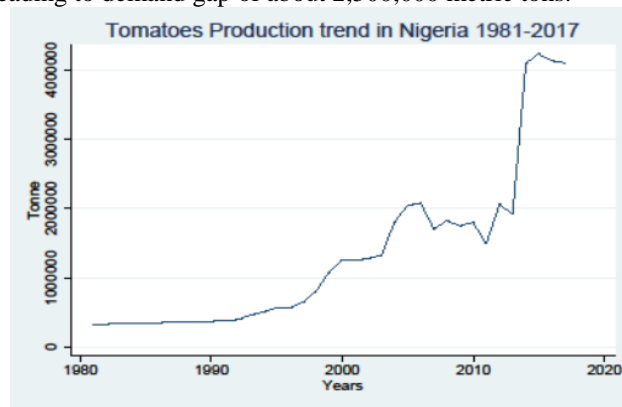


Figure 1. Tomato production in Nigeria 1981to 2017

Tomato importation graph (fig.2) shows that from year 1981 to 1998 importation was not stable there is a slight decrease from year 2000 and it continues to rise and fall continually. Over the last decade, the production of fresh tomatoes in Nigeria has grown by 25% from 1.8 million tons to an estimate 2.3million tons. Hence the country continues to rely on tomato paste importation to meet the existing gap.

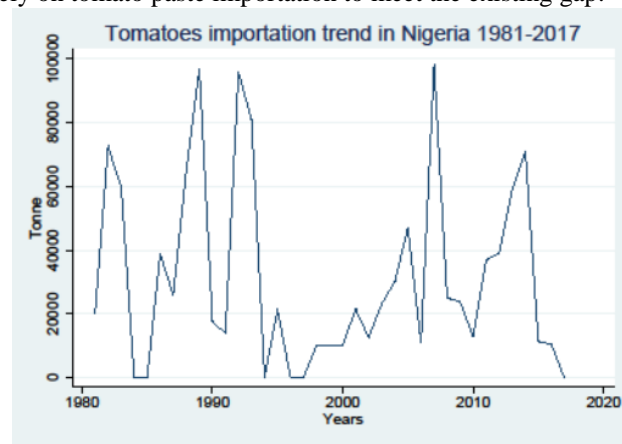


Figure 2. Tomato importation in Nigeria 1981to 2017.

Tomato price in US Dollars per ton from 1981-2017. The local price of tomato shows the price of a metric ton of tomato per US Dollars in Nigeria and this varies depending on the exchange rate. Local tomato price as shown in the graph (fig. 3) shows that year1981 tomato price is very low and it continue to rise gradually from 1990 to 2010 and it decrease slightly only to increase sharply and falls gradually.

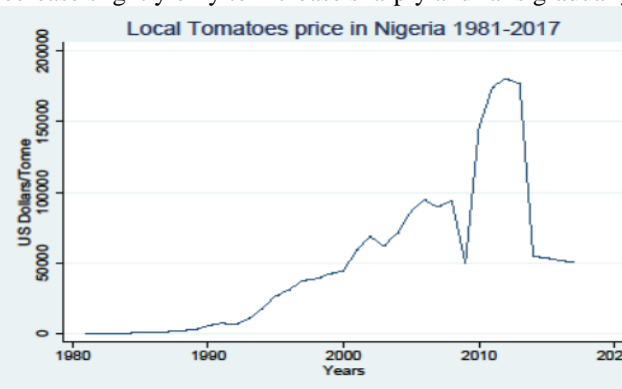


Figure 3. Price of local tomato in Nigeria 1981to 2017.

Exchange rate of Naira (#) to US Dollars (\$) in Nigeria between the year 1991-2017

A foreign exchange rate is the relative value between two currencies. The exchange rate is defined by how much money or the amount of foreign currency that you can buy with one US dollars. The exchange rate defines how many Naira you can get for one US dollar. Exchange rate graph (fig 4) reveals that there is a regular flow in the exchange rate from year 1981 to 2017 and it gradually increases from 1995 to 2012 while an increase at an increasing rate was from 2014 to 2017.



Figure 4. Exchange of Naira to Dollar 1981to 2017.

Source; Data Analysis, 2019

Rainfall in Nigeria from 1981-2017

Rainfall is the quantity of rain falling within a given area in a given time. All plants needs at least some water to survive, therefore rain (being the most effective means of watering) is important to agriculture, while a regular rain pattern is usually vital to healthy plant, too much or too little rainfall can be harmful, even devastating to crops. The graph shows the amount of rainfall from year 1981 to 2017. The graph shows that there is no steady increase or decrease in the rainfall, it increases and decreases (unstable). The highest rainfall was in 1994 while the lowest was 1987.

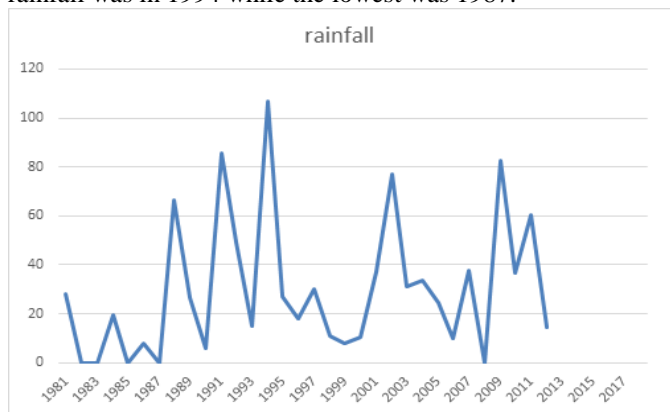


Figure 5. Rainfall in Nigeria between 1981 and 2017

Source; Data Analysis, 2019

Unit root test

The results presented in table 1 showed the stationary (Unit root) test conducted for all the variables. The properties of each tomato production were analyzed first in order to determine the effect of tomato production. Augmented Dickey Fuller was used to ensure that serial correlation is absent using Akaike’s Information Criterion (AIC).The ADF estimation is based on ordinary Least Square (OLS). The series of tomato production were first difference since further tests showed that non-stationarity was the case and the test

was re-conducted. When all the tomato production was differenced once, the result of the unit root test indicated that the null hypothesis of non- stationary was rejected and therefore, the alternative was accepted. This implies that all the tomato production under consideration was generated by similar stochastic processes and they exhibit the possibility of how moving together in the long-run (Mafimisebi 2007). The table shows the criteria value at 1%, 5% and 10%, we need to note that if the absolute value of the ADF test is lower than 5% critical ADF statistics, the null hypothesis of non-stationary is rejected.

Table 1. Dickey Fuller Unit Root Test.

Variable	DF Test	Critical Value at 5%	Order of Integration
Tomato prod	3.151	-2.969	Significance and 1 st difference
Tomato imp	-3.764	-2.969	Significance and 1 st difference
Ex rate	-2.993	-2.969	Significance and 1 st difference
Rainfall	-3.146	-2.969	Significant and 1 st difference
Local import	-3,263	-2.969	Significant and 1 st difference
Agric Labour	-7.346	-2.969	Significant and 1 st difference

Source Author Computation, 2019

Table 2 below shows the short run ECM model estimation of tomato production in Nigeria. Tomato production is the dependent variable while import, exchange rate, rainfall, Agricultural labour, Agricultural land are independent variables. The results showed that Agricultural labour is significant at1%, local tomato price and rainfall are significant at 5% while tomato importation, Exchange rate and Agricultural land are not significant.

Local tomato price is positively related to tomato production indicating that an increase in local tomato price will lead to increase in tomato production by 0.1669946 unit. Tomato importation price is negatively related to tomato production indicating that a decrease in tomato price will lead to decrease in tomato production by -0.1036528 unit.

Exchange rate is positively related to tomato production indicating that an increase in exchange rate will lead to increase in tomato production by 0.0009704 unit. Rainfall is negatively related to tomato production indicating that decrease in rainfall will lead to decrease in tomato production by -0.0025471 unit. Agricultural labour is positively related to tomato production indicating that an increase in agricultural labour will lead to increase in tomato production by 7.515371 unit.

Agricultural land is positively related to tomato production indicating that an increase in agricultural land will lead to an increase in tomato production by 7.91e-06 unit.

Engle-Granger 1st step Regression at short run.

Table 2: Short-run Engel-Granger ECM estimation

Production	Coeff.	Std. Err.	t	P>/t/
Local Tomato Price	0.1669946	0.0801953	2.08	0.046
Import Tomato Price	-0.1036528	0.1205694	-0.86	0.397
Exchange rate	0.0009704	0.0014459	0.67	0.507
Rainfall	-0.0025471	0.0010897	-2.34	0.026
Agric labour	7.515371	1.11394	6.75	0.000
Agric land	7.91e-06	0.0000151	0.52	0.605
Constant	-67.99005	11.82466	-5.75	0.000

Source; Data Analysis, 2019

Also, in Table 3, it was shown that the long run ECM model estimation of tomato production in Nigeria. Tomato production is the dependent variable while import, exchange rate, rainfall, Agricultural labour, Agricultural land are independent variable. The results showed that Agricultural labour is significant at 1%, local tomato price and rainfall are significant at 5%.

Table 3: Engle-Granger 2-step ECM at long run (Long-run Engel-Granger ECM estimation)

D Production	Coef	Std. Err.	t	P>/t/
Local Tomato Price	0.0001451	0.0000217	6.69	0.000
Import Tomato Price	0.1202091	0.170917	0.70	0.488
Exchange rate	-0.0020669	0.0022667	-0.91	0.370
Rainfall	0.0006589	0.0008345	0.79	0.437
Agric labour	0.0051291	0.0019469	2.63	0.013
Agric land	-0.0000581	0.00002	-2.90	0.007
Constant	0.800909	0.2285225	3.50	0.001

Source; Data Analysis, 2019

Local tomato price is positively related to tomato production indicating that an increase in local tomato price will lead to increase in tomato production by 0.0001451 unit.

Agricultural labour is positively related to tomato production indicating that an increase in agricultural labour will lead to increase in tomato production by 0.0051291 unit.

Agricultural land is negatively related to tomato production indicating that a decrease in agric land will lead to a decrease in tomato production by -0.0000581 unit.

Summary

Tomato (*Solanum lycopersicum* L) is one of the most important vegetables worldwide. The demand for tomato and its by-products far outweighs the supply. The study was carried out to access tomato production Nigeria. The broad objective of the study was to examine the economic analysis of tomato production in Nigeria using annual time series data from 1980-2017 with specific objectives like examine the trend in tomato production and importation, the determinant of tomato production and the effect of tomato import on it producer in Nigeria. The use of secondary data was employed for this study; they were obtained from the Food and Agricultural Organization (FAO) website, (AGROSTAT), the central bank of Nigeria (CBN) statistical bulletin, World Bank Department indicators were used for this study. Time series data for tomato variables were collected from this sources the variables include agricultural land, agricultural labour, exchange rate, tomato production, tomato importation, rainfall. The results show that Agricultural labour, local tomato price and rainfall are significant to tomato production. The failure of tomato farms to meet demand in Nigeria has raised concern over the ability of these farms to increase tomato output. In view of the growing demand for tomato in Nigeria, improving the efficiency of resource use would be the key to increased tomato production in the Country. Thus, for the Nation to thrive in tomato production, it needs to achieve a high level of efficiency which is essential for competitiveness and profitability.

Conclusion

In conclusion, the study shows that there is low yield and productivity due to lack of good adoption of Good Agricultural Practice [GAP], unwillingness of communities to give out land to interested investors to go into commercial production, lack of good quality seeds and over application of

other insecticides by farmers. Provision of enabling environment by government in form of regulatory measures for marketing and prices will go a long way to facilitate increased tomato production.

On the basis of findings of this study, factors which could contribute to successful tomato production in Nigeria are application of appropriate soil nutrient replenishment. Pest and disease management and varieties well suited to local conditions, by the government, guaranteed producer prices and output market, high input credit recovery rates, and well organized village level association, provision of inputs and extension services to tomato farmers.

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