academicresearchJournals

Vol. 5(7), pp. 236-252, November 2017
DOI: 10.14662/IJPSD2017.080

ISSN: 2360-784X
http://www.academicresearchjournals.org/IJPSD/Index.html

International Journal of Political Science and Development

Stochastic Time Series Analysis for Rice Production and Price in Nigeria Using Autoregressive Integrated Moving Average (ARIMA) Model

[1*]Binuomote, S. O., [1]Adesiyan, I. [1]Hassan, S. O., [1]Akindele, A. and [1]O. Taiwo

[1]Department of Agricultural Economics, Faculty of Agricultural Sciences, Ladoke Akintola University of Technology, PMB 4000, Ogbomoso, Oyo State, Nigeria. E-mail: sobinuomote@lautech.edu.ng

Accepted 8 November 2017

This study forecasted the production and producer price of local rice in Nigeria from the historical data sourced from the online Statistical database of the Food and Agricultural Organization of the United Nations using univariate autoregressive integrated moving average (ARIMA) models. The autoregressive (p) and moving average (q) parameters were identified based on the significant spikes in the plots of partial autocorrelation function (PACF) and autocorrelation function (ACF) of the different time series. ARIMA (1,1,0) model was found suitable for Nigeria rice production, while ARIMA (0,1,1) was best fitted for forecasting of the producer price of rice in Nigeria. Prediction was made for the immediate next 24 years (2017-2040) for rice production and 23 years(1961-2013) for producer price of rice using the best fitted ARIMA models based on minimum value of the selection criterion, that is, Akaike information criteria (AIC) and Schwarz-Bayesian information criteria (SBC) with the performances of models were validated by the necessary diagnostic tests. The results of the ARIMA models generated on R software show that local rice production and its price in Nigeria will continue to increase going into the future.

Keywords: ARIMA, Rice, Forecasting, Autocorrelation, Production, Nigeria

Cite this article as: Binuomote, S. O., Adesiyan, I., Hassan, S. O., Akindele, A. and O. Taiwo (2017). Stochastic Time Series Analysis for Rice Production and Price in Nigeria Using Autoregressive Integrated Moving Average (ARIMA) Model.. Int. J. Polit. Sci. Develop. 5(7) 236-252

INTRODUCTION

Rice has been adjudged a major staple food for about 2.6 billion people globally (Spore, 2005 and De Datta, 1981) and it is considered to be about the fastest growing commodity in Nigeria's food basket (Adejumo and Momoh, 2013). Rice production in Nigeria increased from 2.5 million tonnes in 1990 to about 4 million tonnes in 2008, accounting for about 37 percent rise in domestic production (FOSTAT (2010). With a population estimate of 174,507,539 persons and population growth rate of 2.54%, Nigeria happens to be not only the leading producer of rice in West Africa, but also among the leading importers of the commodity. Although endowed with a strong agricultural and natural resources base, as well as favorable climatic conditions for agricultural production, an amount of about ₦1 billion is spent daily by Nigeria on importation of rice (Abubakar, 2013). Hindered by inconsistent policies on rice, improper methods of production used by farmers, high costs and scarcity of viable inputs of production among other factors., local rice production for Nigeria has failed to catch up with the increasing pace of consumption. By estimates observed from the agricultural production database of FAO for Nigeria, the gap between domestic demand of rice for food (as against feed and other uses) has widened since the late 1990s. Treated with benign neglect prior to independence due to self-sufficiency, rice has become a strategic and political commodity in Nigeria, attracting much attention due to its increasing role in the diet of the populace and its daily drainage of foreign exchange through imports. Rice used to be classified as a luxury food item prior to independence; it however now holds the status of a staple food, replacing cassava and yam among others (Daramola, 2005).

The consumption of rice in spite of increasing prices induced through high tariff imposition has been increasing since the year 1976. Per capita consumption of rice in the country increased from as low as 3.4kg/year in 1976 to 20.9kg/year in 2009 (FAOSTAT, 2013), an increase of over 500%. Production has however failed to catch up with the increasing demand for rice, leading to widening of the gap between domestic production and demand, increasing the role of imported rice in diets of the Nigerian populace and making the country a net importer of the commodity in the process.

Various trade policies have been purposed on improving local rice production while various marketing systems have been adopted and applied by previous regimes to help reverse the net rice-importer status of the country. Among such measures are imposition of tariffs, quantitative restrictions on imports through the use of quota, and outright ban on imported rice (Daramola, 2005). In spite of past and present efforts, the demand-supply gap persists. Like other West African countries, besides the aforementioned trade policy measures adopted in bridging of the rice demand-supply gap in Nigeria, other measures that have been adopted include expansion of area for production as against intensification (purposed on improving productivity). With area harvested of rice having generally depicted an increasing trend between the years 1976 and 2009, output of rough rice has more or less stagnated between the years 1989 and 2007.

Given the status of rice as a major staple food with capacity for significant impacts on the economy of Nigeria, it is important to know about the future values of the production and price status of this crop. A proper forecast of the production and price of rice in Nigeria is of significance to the food security of the Nation. Critical analysis of production and market price of this important commodity is a prerequisite for proper knowledge base on the ecology and appropriate research/development efforts for harvesting maximum possible potential. An unexpected decrease in production of rice definitely reduces marketable surplus and income of the farmers which subsequently leads to price rise and most likely food insecurity. Similarly, an increase in production of rice can lead to a sharp decrease in prices which is expected to have adverse effect on farmers' incomes. As noted by Tripathi (2014), impact of price of an essential commodity has a significant role in determining the inflation rate, wages, salaries, and various policies in an economy.

Forecasting the yield and price of rice in Nigeria will help to see the future trend acts as an early warning signal which will be of great benefit and help the relevant policy makers to get insights of future production and prices and to manage the resources needed. It will afford the policy makers and all stakeholders in the Nigeria rice sector, the opportunity to develop various policy interventions which can significantly help to bridge the gap between the yield and consumption of rice in Nigeria. This will go a long way to prevent food insecurity and also prevent price stability. The proper forecast would also pave way for appropriate surplus and deficit management to stabilize the price and ensure profits for the farmers.

Though modelling and forecasting of phenomena has a long history, its application, especially in the field of agriculture become substantially visible during the latter half of the last century. It got further boost with the introduction of Box – Jenkins methodology. Badmus and Ariyo (2011) studied forecasting the cultivated area and production of maize in Nigeria using Autoregressive Integrated Moving Average (ARIMA) model utilizing time series data for the period of 1970-2005. They forecasted the maize production for the year 2020 to be about 9952.72 tons with upper and lower limits 6479.8 and 13425.64 thousand tons respectively. Iqbal *et al*. (2005) estimated ARIMA model and showed that the production of wheat would grow to 29.77 million tones in the year 2022 in Pakistan. The study concluded that the expected growth was low and that the scope for higher area and production laid in adequate government policies regarding wheat cultivation in the country. Sahu and Mishra (2013) studied forecasting the production, import –export (both in quantity and value) and trade balance of total spices in India and China alongwith world using Autoregressive Integrated Moving Average (ARIMA) model using time series data covering the period of 1961-2009 and forecasted for year 2020. Other researchers who have worked on forecasting of production and or price of food crops using the ARIMA Box- Jenkins(1976) approach include but not limited to Areepong(1999), Sahu *et al* (2015), Karim *et al*, (2012), Najeeb *et al* (2005)

This paper therefore employed Box – Jenkins Autoregressive Integrated Moving Average (ARIMA) model for forecasting the yield and price of in Nigeria. The remaining part of this paper is organized as follows: Section two is the methodology of the research work, section three deals with the presentation and discussion of obtained results while section four is the conclusion and policy recommendation from the study.

DATA AND METHODOLOGY

Data and Data Source

This study is based secondary data pertaining to annual production and producer price of rice for Nigeria. The rice production data from 1961 – 2016 and price data from 1961 to 2013 was obtained from Food and Agriculture

Organization of the United Nations online statistical database (FAOSTAT).

Analytical Techniques

Both inferential and descriptive statistics were used to analyze this study. While the descriptive statistics involved the use of graph to examine the trend in rice production and price in Nigeria, as well as some time series properties of the data, the Box- Jenkins ARIMA model was used to forecast the yield and price of rice in Nigeria.

ARIMA Modeling

This study applied ARIMA modelling also known as Box-Jenkins Methodology of forecasting to analyze rice production and price forecast in Nigeria. ARIMA is the method first introduced by Box and Jenkins (1976) and until now has become the most popular models for forecasting univariate time series data (Harris *et al*, 2012). The basic principle of methodology involves forecasting the future values of a particular variable using the past or lagged values of the same variable. The ideology is termed “let the data speak for themselves” (Gujarati, 2004). The various steps and procedure involved in ARIMA modeling is explained below. The Box-Jenkins ARIMA model has evolved from the combination of AR (Autoregressive) and MA (Moving Average), the ARMA models.

The methodology of Chandra (2012) as contained in Gathondu (2012) is specifically applied in this study. According to Gathondu (2012), let Y_t be a discrete time series variable which takes different variable over a period of time. the corresponding AR (p) model of *Yt* series, which is the generalizations of the autoregressive model, is expressed as;

$$AR(p); Y_t = \theta_0 + \theta_1 Y_{t-1} + \theta_2 Y_{t-2} + ... + \theta_p Y_{t-p} + \varepsilon_t \quad \dots \quad (1)$$

Where Y_t is the response variable at time t, Y_{t-1}, Y_{t-2}, Y_{t-p}, *are* the respective variables at different time lags; θ_0, θ_1, ... θ_p are the coefficients and ε_t is the error factor. Similarly, the MA(q) model which is the generalization of the moving average model is specified as;

$$MA(q); Y_t = \mu_t + \varepsilon_t + \sigma_1 \varepsilon_{t-1} + ...\sigma_q \varepsilon_{t-q} \qquad \varepsilon_t \sim WN(0, \sigma^2_t) \quad (2)$$

Where, μ_t is the constant mean of the, series, σ_1, σ_2, ... σ_q, *are* the coefficients of the estimated term and ε_t is the error term. When (Y_t) in the data is replaced with ($\Delta Y_t = Y_t - Y_{t-1}$), then the ARMA models become the **ARIMA (*p,d,q*)** models, where ***p*** is order of autocorrelation (indicates weighted moving average over past observations), ***d*** is order of integration (differencing) and ***q*** is order of moving averaging. By combining the models in (1) and (2), this resulting model is referred to as ARIMA model, which have the general form of;

$$Y_t = \theta_0 + \theta_1 Y_{t-1} + \theta_2 Y_{t-2} + ...\theta_p Y_{t-p} + \varepsilon_t + \sigma_1 \varepsilon_{t-1} + ... + \sigma_q \varepsilon_{t-q} \quad (3)$$

If Y_t is stationary at level or I(0) or at first difference I(1) then this determines the order of integration. To identify the order of p and q the ACF and PCF is applied.

Test of Stationarity of Time Series Data

ARIMA model is generally applied for stationary time series data. A time series is said to be stationary if both the mean and the variance are constant over time. A time plot of the data can suggests whether the time series needs any differencing before performing formal tests. Also, the stationarity and non-stationarity properties are checked by applying ADF. The ADF statistic is a negative number and the more negative it is, the stronger the rejection of the hypothesis that there *is* a unit root at some level of confidence i.e., the time series is non-stationary. If the time series is non-stationary, we do the first differencing or a higher order differencing till the time series becomes stationary. The times of differencing the series is indicated by the parameter *d* in the ARIMA(*p,d,q*) model.

ARIMA model Selection

The Box-Jenkins methodology employed a three stage method for selection of appropriate ARIMA model for the purpose of estimating and forecasting univariate time series. These include; i) Identification, ii) Model estimation, iii) Diagnostic Checking, iv) Forecasting Model evaluation. After these stages, the selected models can now be used for forecasting.

Model Identification

The first step of applying the model is to identify appropriate order of ARIMA (*p,d,q*) model. Identification of ARIMA model involves selection of order of AR(*p*), MA(*q*) and I(*d*). The order of *d* is estimated through I(I) or I(0) process.

The model specification and selection of order *p* and *q* involves plotting of ACF and partial PACF or correlogram of variable at different lag length after stationarity. The plotted ACF and PACF of the variable were observed to determine which correlations were statistically significant at 95% confidence interval. The principle of parsimony was adhered to, in which a model is expected to have as small parameters as possible yet still be capable of explaining the series, that is if two or three explanatory variables can explain the behavior of a model we do not need to add more variables.

Given a set of time series data, one can calculate the mean, variance, autocorrelation function (ACF), and partial autocorrelation function (PACF) of the time series. This calculation enables one to look at the estimated ACF and PACF which gives an idea about the correlation between observations, indicating the sub-group of models to be entertained. This process is done by looking at the cutoffs in the AC and PACF. At the identification stage, one would try to match the estimated ACF and PACF with the theoretical ACF and PACF as a guide for tentative model selection, but the final decision is made once the model is estimated and diagnosed

Model Estimation

Once the order of p, d and q are identified, the next step is to specify appropriate regression model and estimate. With the help of R software various orders of ARIMA model were estimated to arrive at the optimal model. For instance, by ARIMA (2, 1, 1), it means the series is stationary at first difference and follows AR (2) and MA (I) process. The estimated models are compared using AIC and BIC, the one with smallest AIC and BIC values is then selected.

Diagnostic Checking

After selecting an ARIMA model and having estimated its parameters, diagnostic check was done to assess whether the chosen model fits the data reasonably well.This was done by checking on the residual term obtained from ARIMA model by applying ACF and PACF functions, to know if residuals are not auto correlated and follow normal distribution. The Q statistic of Ljung-Box (1978) was used to test for auto-correlation.

Forecast in Model Evaluation

Models are evaluated according to the minimum values of Root Mean Square Error (RMSE), Mean Absolute Error (MAE), Mean Square Error (MSE) and Mean Absolute Percentage Error (MAPE)

Forecasting

After the Box-Jenkins three stage methodology of forecasting was carried out, then the selected model was used in forecasting the future values of the variable.

RESULTS AND DISCUSSIONS

This section looks at the analysis and extraction of information from the data collected and to make inferences based on this information to produce solid and sound conclusions and recommendations. The analysis employs Box-Jenkins method of analyzing time series data.

Descriptive Statistics

The fifty-six years data of the average yearly rice production and forty-eight years data of average yearly producer price of rice in Nigeria are purely secondary and was obtained from FAOSTAT database. The rice yield and price data spans from 1961 to 2016 while the data for the producer price of rice in Nigeria spans 1965-2013.

The descriptive statistics results show that the mean of the Nigeria rice production is 2232390 tonnes with maximum of 6256228 tonnes and minimum of 133000 tonnes in years 2015 and 1961 respectively. While the mean of the Nigeria rice price is 19057/tonne Naira with maximum of 75138/tonne Naira and the minimum of 110/tonne respectively. The time series data plot of rice production and rice price are shown in Figure 1 and 2 respectively. The two graphs show an increasing trend in the production and price of rice in Nigeria. While the production could be due to acreage use intensification rather than increase in yield, the increase in the prices of rice in Nigeria is largely due to demand push inflation and tariff on the imports of rice which was deliberately put in place by the government to encourage local production.

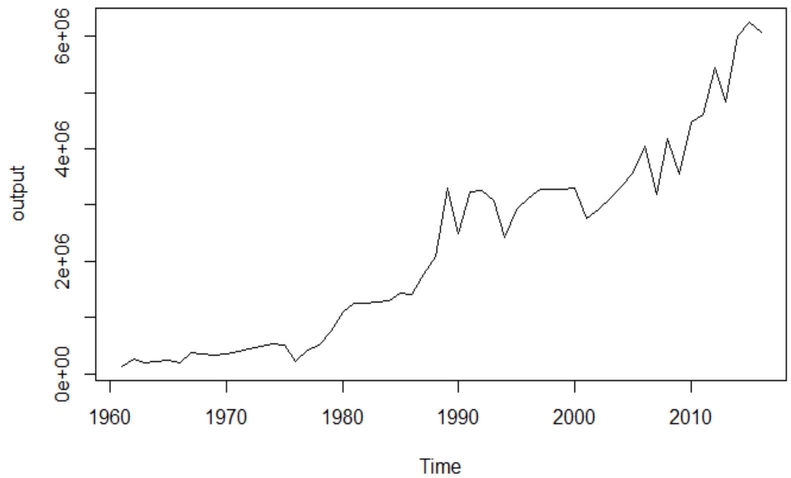

Figure 1: Time series plot of the Rice Production data

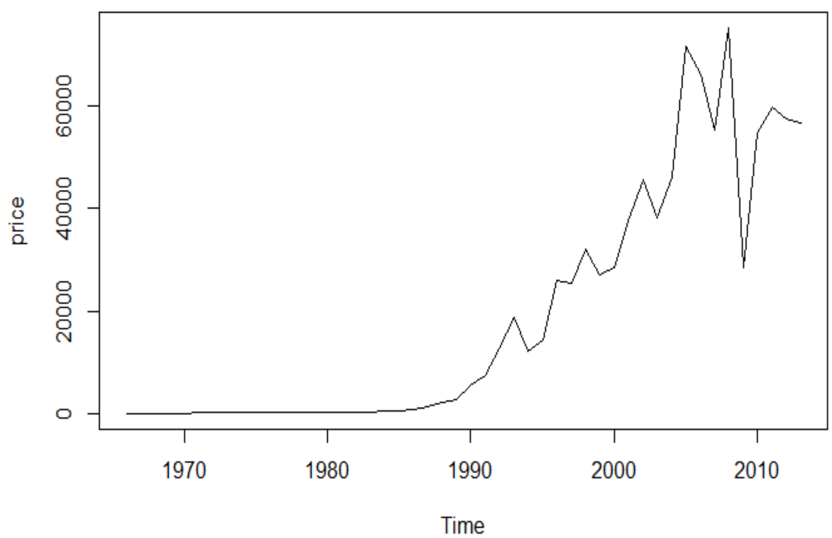

Figure 2: Time series plot of the Rice Price data

Forecasting of Rice Output and Producer Price in Nigeria

Box-Jenkins (ARIMA) Methodology

Model Identification

In this study, we employed Box Jenkins (1976) ARIMA modeling following the four steps which include identification, estimation, diagnostics checking and forecasting of time series data of rice production and rice price in Nigeria. The unit root test is conducted on the rice production and rice price data set by examining trend of the time plot of the dataset, plotting the Autocorrelation Function (ACF) and Partial Autocorrelation Function (PACF) and performing the Augmented Dickey-Fuller (ADF) test. The results show that the rice production and rice price exhibit a form of upward trend and depict that rice production and rice price dataset does not have a constant mean and variance over time. Therefore, there is need to difference them to form a stationary series, so that the values vary more or less uniformly about a fixed level over time. This can also be seen through the ACF plots of rice production and rice price data series which shows a slow decline as shown in Figure 3a and 4a respectively, their partial ACF plots has a significant spike at lag 1, shown in figure 3b and 4b.

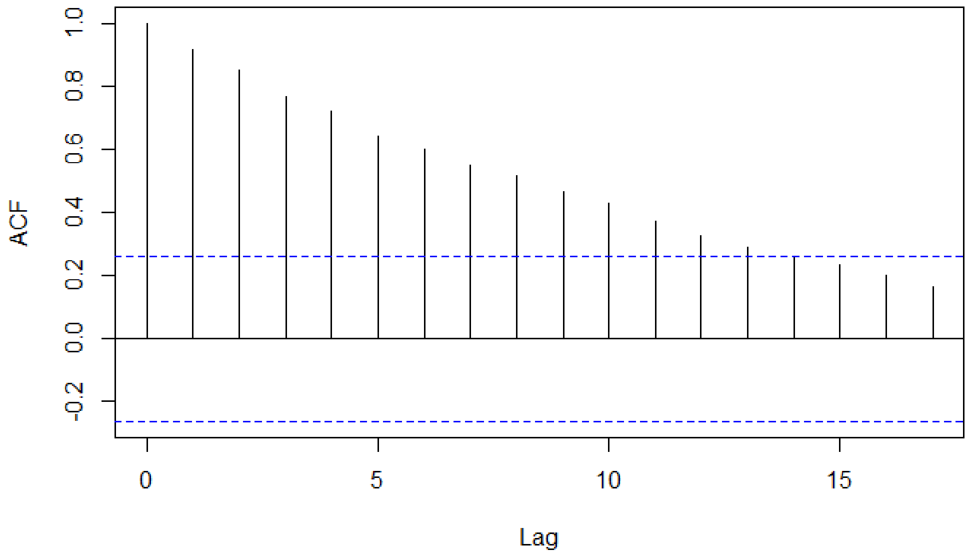

Figure 3a: ACF Plot of Rice Production

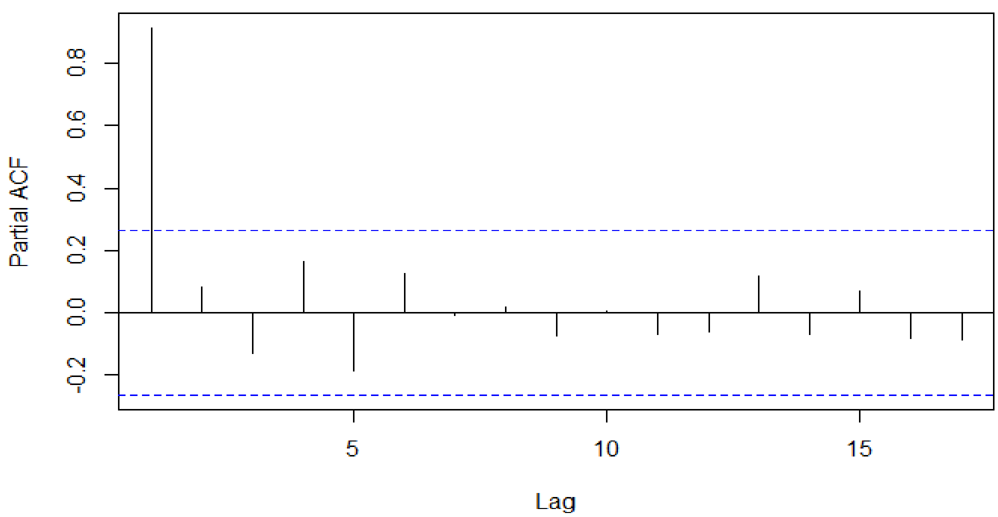

Figure 3b; PACF plot of Rice Production

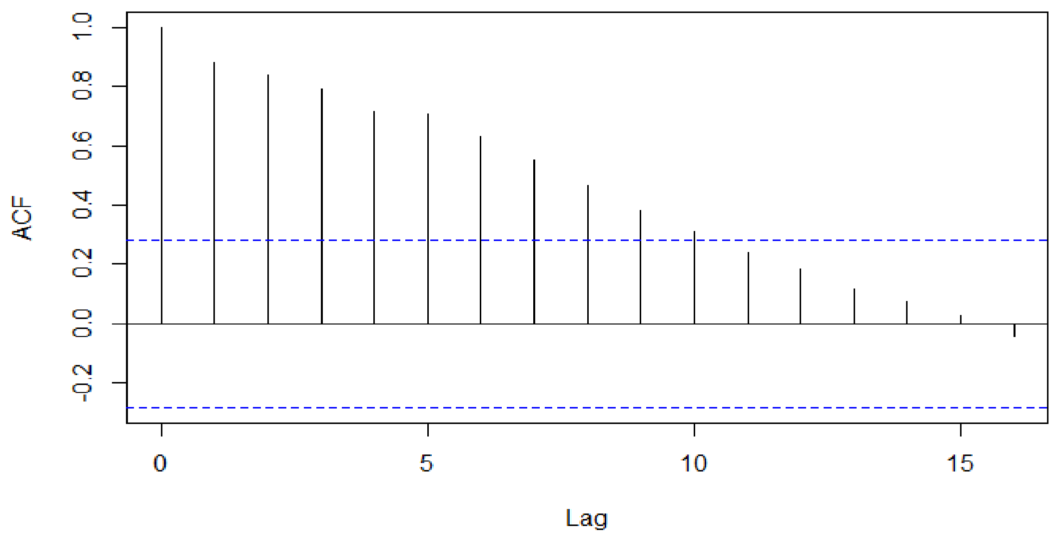

Figure 4a: ACF Plot of Rice Price

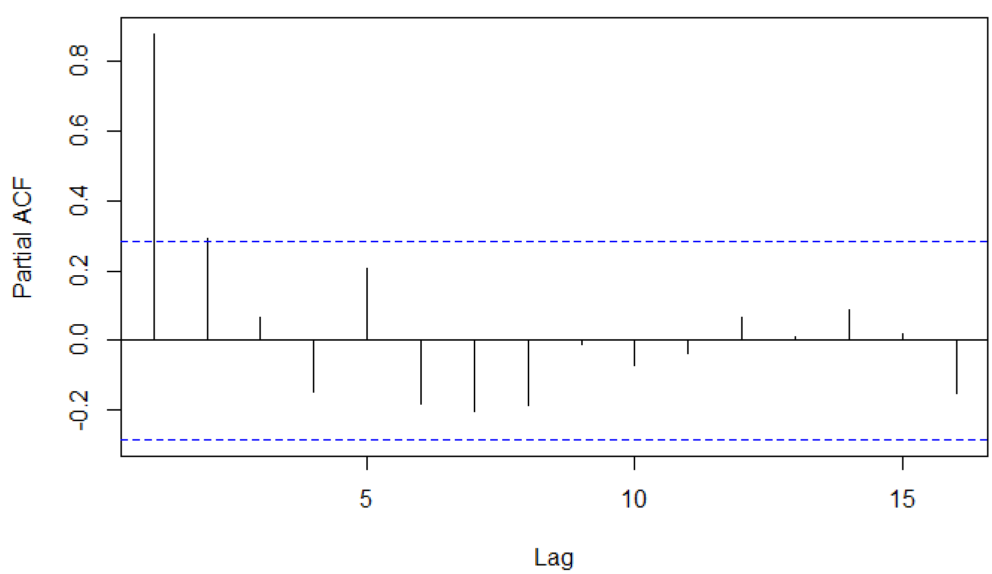

Figure 4b; PACF plot of Rice Price

Test for stationary of rice production and price data

Furthermore, Augmented Dickey-Fuller unit root tests for rice production and price shown in Table 1 reveal that the rice production series was not stationary. Thus, the data was differenced and tested, and the data indicated to be stationary after first difference. Similarly, the rice price dataset was found to exhibit the same feature and was therefore stationary after first difference. Therefore, further and precise analysis can be carried out on the dataset since the stationarity test has been conducted and order of integration of the data has been known.

Table 1: Augmented Dickey-Fuller Test Rice Production Data

Dickey-Fuller Test	Lag Order	P-value	Order
-2.9848	0	0.1775	I(0)
-3.3137	3	0.04863	I(1)

Source: Data Analysis, 2017

Table 2: Augmented Dickey-Fuller Test Rice Price Data

Dickey-Fuller Test	Lag Order	P-value	Order
-3.3926	0	0.06838	I(0)
-3.7861	3	0.02807	I(1)

Source: Data Analysis, 2017

Figure 5 and Figure 6 show the movement of the stationary differenced Rice Production and Rice Price dataset respectively. The datasets show a pattern of random sequence and a stable linear trend. The series moves around a fixed point and these show that the rice production and price data has an integration order of I(1) which implies that differencing this datasets once, made the rice production and price datasets stationary. The ACF and PACF plot of differenced rice production and rice price data in Figure 7a, 7b, 8a and 8b respectively also shows that the rice production and rice price datasets became stationary after first difference

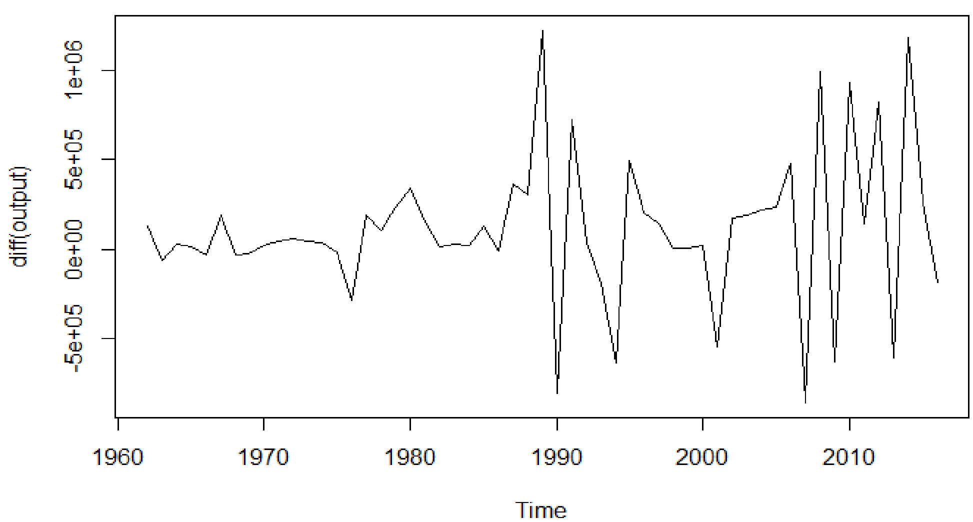

Figure 5: Time series plot of the Differenced Rice Production data

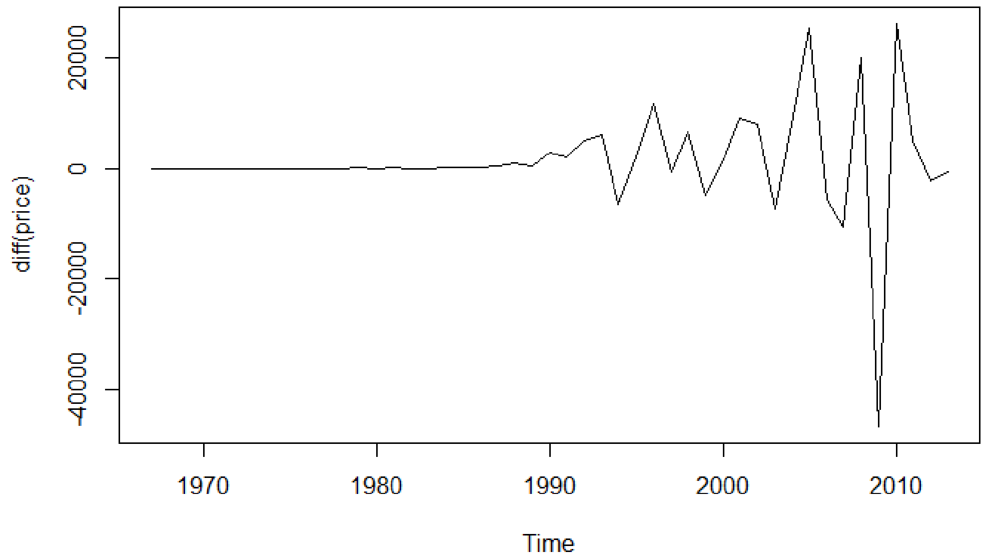

Figure 6: Time series plot of the Differenced Rice Price data

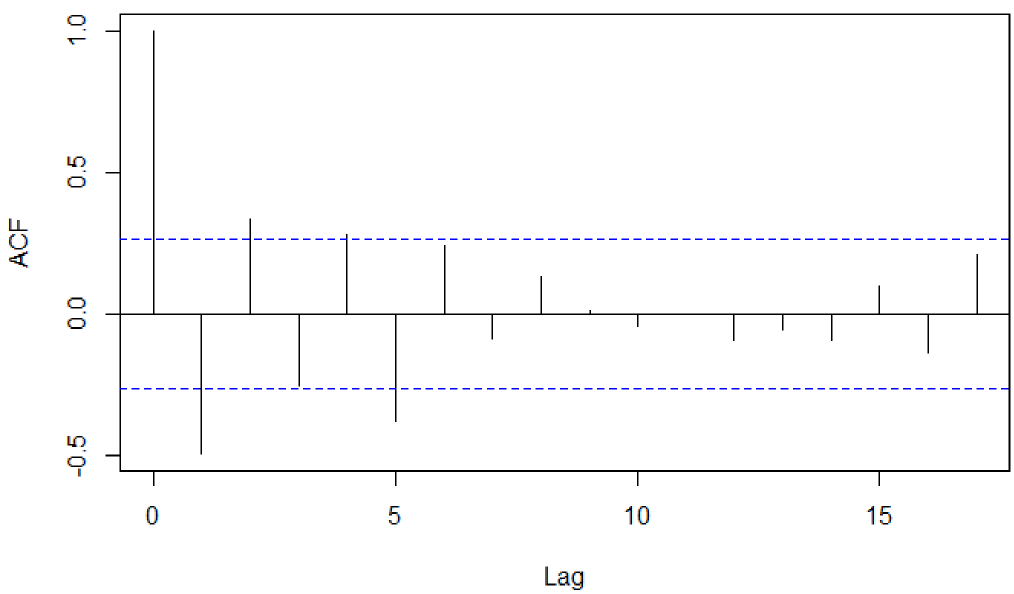

Figure 7a: ACF plot of the Differenced Rice Production Data

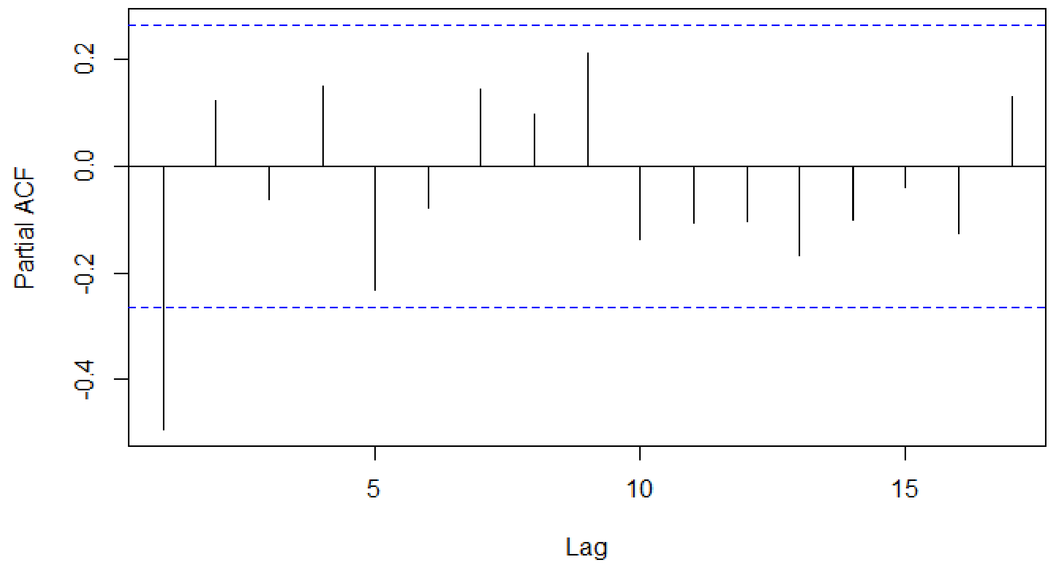

Figure 7b: PACF plot of the Differenced Rice Production Data

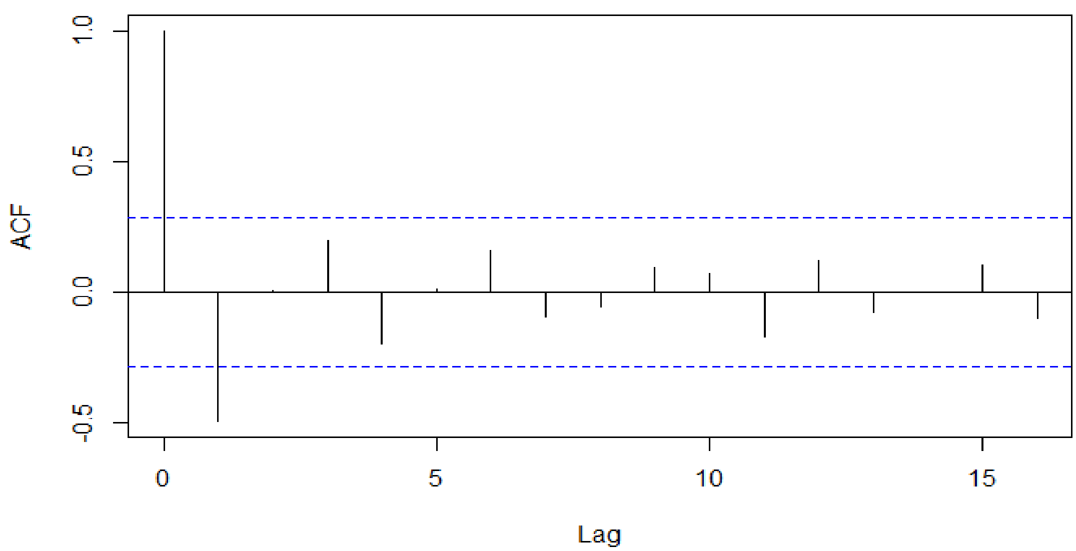

Figure 8a: ACF plot of the Differenced Rice Price Data

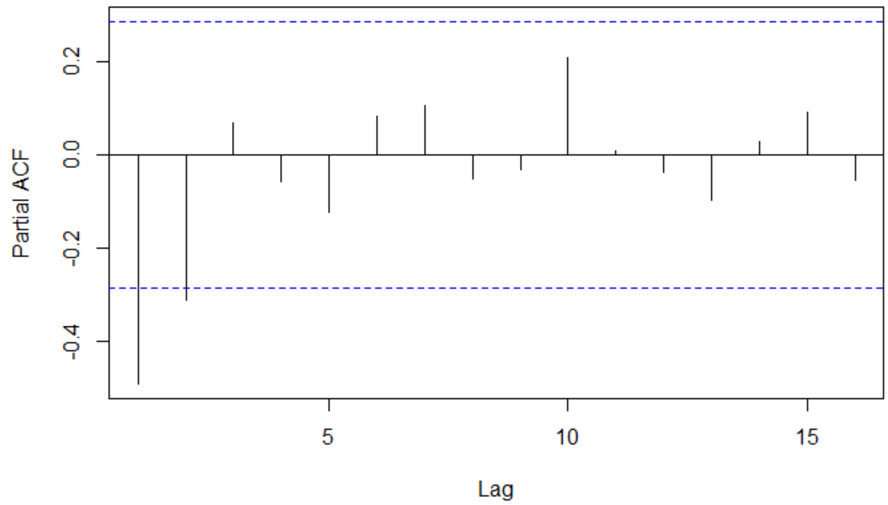

Figure 8b: PACF plot of the Differenced Rice Price Data

.

Model Selection

Production data of rice for fifty-six years (56) period was used while the rice price data for forty-eight years (48) period was used for modeling purpose. The identification of model is determined by the order of AR and MA. The order of AR and MA component is suggested by the sample ACF and PACF plots based on the Box-Jenkins approach. The significant lag of the PACF suggests the order of AR while the significant lag of the ACF suggests the order of MA. The sample ACF and PACF of the differenced rice production data suggests the Model to be ARIMA (1,1,5). Although, after several iterations and consideration of other models, ARIMA (1,1,0) was suggested to be the best model because it has the smallest Akaike Information Criterion (AIC) and Bayesian Information criterion (BIC) which was computed by the *auto.ARIMA* function of R statistical software. Using the similar procedure, the sample ACF and PACF of the differenced rice price data suggests the model to be to be ARIMA (1,1,1) although after several iterations and consideration of other models ARIMA (0,1,1) which also has the smallest AIC and BIC.

Table 3: Autoregressive Integrated Moving Average (ARIMA) models fitted for time series data on rice production and rice price and corresponding Akaike criterion and Schwarz criterion.

VARIABLE	MODEL TYPE	AIC	AICc	BIC
Rice Production	ARIMA (1,1,0)	1570.8	1571.27	1576.82
Rice Price	ARIMA (0,1,1)	988.69	989.25	994.24

Source: Data Analysis, 2017

As given in Table 3, ARIMA (1, 1, 0) with drift was the best model based on the selection criteria used for rice production time series. The ARIMA model (1, 1, 0) produced the least AIC, AICc and BIC values of 1570.8, 1571.27 and 1576.82 respectively and hence the best model that fits the data set and can be used for forecasting the rice production. In the same pattern, ARIMA (0, 1, 1) with drift was the best model based on the selection criterion used for rice price time series. The ARIMA model (0, 1, 1) produced the least AIC, AICc and BIC values 988.69, 989.25 and 994.24 respectively and hence the best model that fits the data set and can be used for forecasting the rice price.

Model Estimation

ARIMA Model Estimation

ARIMA models are usually estimated under forecasting into a stationary series. A stationary series is one whose values vary over time only around a constant mean and variance. Tables 4 and 5, show the parameter estimates of the adequate model for rice production and price.

Table 4: Estimates of Rice Production Parameters
ARIMA (1,1,0) was estimated and the estimated parameters are shown in Table 5.

MODEL	Coefficient	S.E
Constant	109633.96	33.155.48
AR(1)	-0.4880	0.1161

Source: Data Analysis, 2017

Table 5: Estimates of Rice Price Parameters
ARIMA (),1,1) was estimated and the estimated parameters are shown in Table 6

MODEL	Coefficient	S.E
Constant(drift)	1264.4918	559.1046
MA(1)	-0.5542	0.1065

Source: Data Analysis, 2017

Model Diagnostics

Model diagnostic checks are done through the analyzing of the residuals from the fitted model. The ACF and PACF of the standardized residuals and modified Box-Pierce (Ljung-Box) test were used to check adequacy of the rice production and rice price model as shown in Figure 9 and 10 respectively. The ACF and PACF of the residuals confirmed that there is no form of correlation among the residuals. This therefore shows that the selected model is good for prediction purposes.

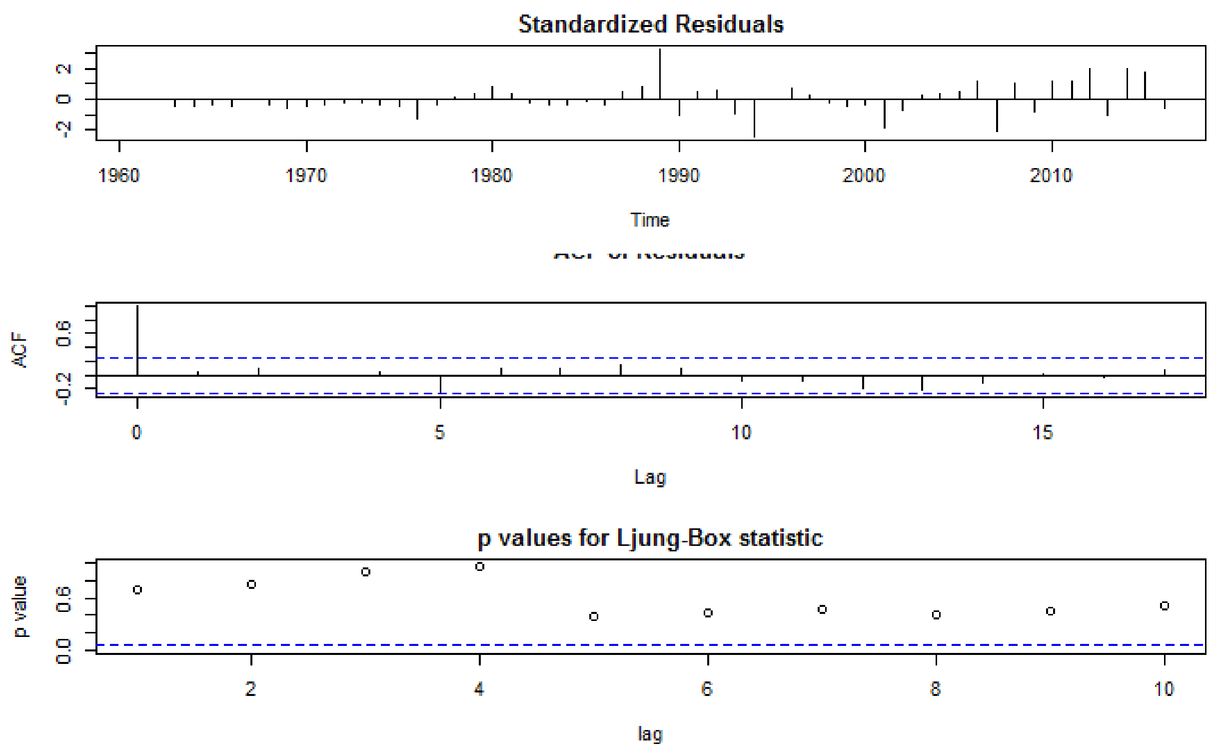

Figure 9: Residual Plots for ARIMA (1,1,0) of Rice Production

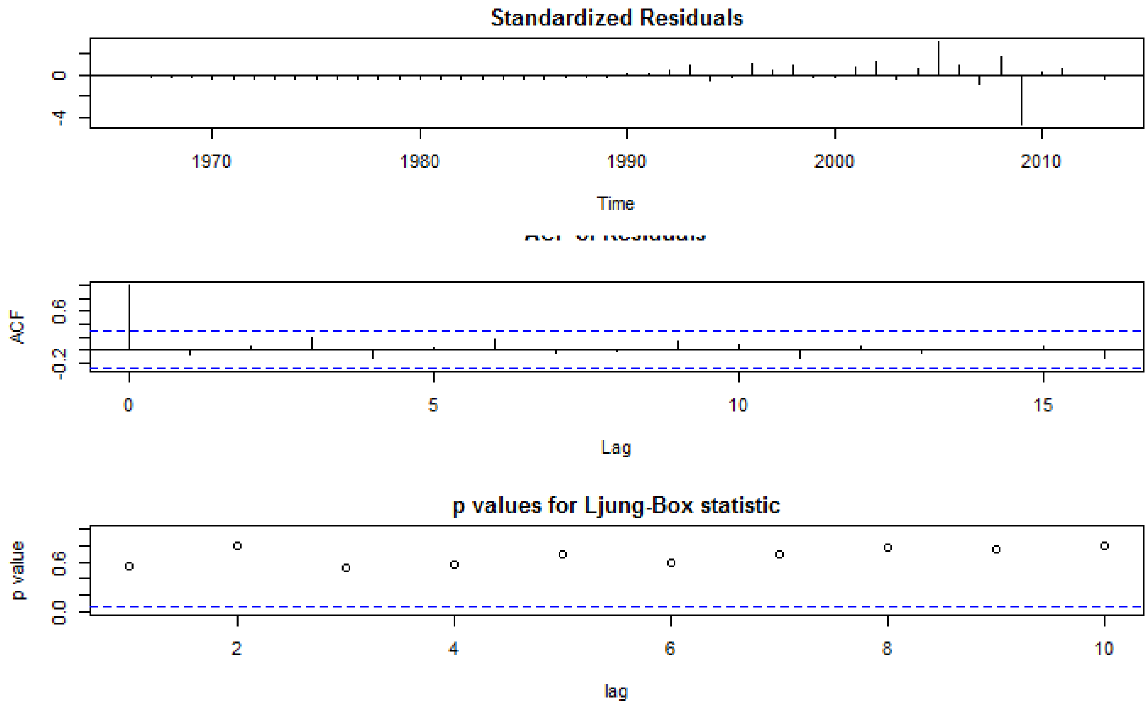

Figure 10: Residual Plots of ARIMA (0,1,1) of Rice Price

Forecasting Evaluation and Accuracy Criteria

The model was also evaluated in terms of their forecasting ability of future Paddy Rice Price with Mean Error (ME), Root Mean Square Error (RMSE), Mean Absolute Error (MAE), Mean Percentage Error (MPE), Mean Absolute Percentage Error (MAPE). Therefore, the model exhibit minimum values of the forecast error which depicts that the model is good and fit for the forecast.

Table 6: Rice Production Forecast Model evaluation statistics

Measure	ME	RMSE	MAE	MPE	MAPE
Parameter Estimation	93.00	360422.5	263523.4	-13.5371	22.29125

Source; *Data Analysis, 2017*

Table 7: Rice Price Forecast Model Evaluation Statistics

Measure	ME	RMSE	MAE	MPE	MAPE
Parameter Estimation	-55.431	8273.311	4833.26	-451.2326	464.134

Source; *Data Analysis, 2017*

Forecasts of Rice Production and Price

ARIMA (1,1,0) was adopted for 24 years ahead and forecast for rice production from 2017 – 2040 which are given in Table 6. The forecasted values of Rice Production reveals that rice production will rise to 6,324,438 tonnes in 2017 and will continue to rise, all things being equal till it reaches 8,798,795 tonnes by 2040. The time series plot revealed that rice price on the other hand will continue to increase greatly from year 2017 to year 2040. ARIMA (0,1,1) was adopted for 27 years ahead and forecast for rice price from 2014 to 2040 which are given in Table 7. The forecasted values for rice price reveals that rice price will rise to 59245.17 naira per tonne in 2017 and will continue to rise till it reaches 92121.96 naira per tonne in 2040. The time series plot revealed that rice price will continue increase greatly between the years 2014 to year 2040.

Table 8: Forecast of Rice Production 2017 - 2040

	RICE PRODUCTION		
Year	**Point Forecast**	**Lo 95**	**Hi 95**
2017	6324438	5598305	7050571
2018	6363801	5548034	7179568
2019	6507729	5526822	7488636
2020	6600626	5517087	7684166
2021	6718428	5524463	7912393
2022	6824076	5536718	8111434
2023	6935655	5557769	8313541
2024	7044340	5583118	8505562
2025	7154437	5613643	8695231
2026	7263845	5647736	8879954
2027	7373589	5685361	9061818
2028	7483169	5725854	9240485
2029	7592830	5769007	9416652
2030	7702451	5814479	9590423
2031	7812091	5862072	9762111
2032	7921722	5911573	9931871
2033	8031357	5962824	10099891
2034	8140991	6015677	10266304
2035	8250625	6070009	10431241
2036	8360259	6125708	10594809
2037	8469893	6182679	10757106
2038	8579527	6240836	10918217
2039	8689161	6300102	11078220
2040	8798795	6360408	11237182

Source: Data Analysis, 2017

Table 9: Forecast of Rice Price From 2014 - 2040

	Point Forecast	**Lo 95**	**Hi 95**
2014	59245.17	42497.99	75992.36
2015	60509.66	42173.9	78845.42
2016	61774.15	41976.88	81571.42
2017	63038.65	41880.58	84196.71
2018	64303.14	41866.66	86739.62
2019	65567.63	41921.75	89213.51
2020	66832.12	42035.76	91628.48
2021	68096.61	42200.84	93992.39
2022	69361.11	42410.72	96311.49
2023	70625.60	42660.35	98590.84

Table 9. Continues

2024	71890.09	42945.54	100834.63
2025	73154.58	43262.80	103046.36
2026	74419.07	43609.16	105228.98
2027	75683.56	43982.11	107385.02
2028	76948.06	44379.45	109516.66
2029	78212.55	44799.29	111625.81
2030	79477.04	45239.96	113714.12
2031	80741.53	45699.99	115783.07
2032	82006.02	46178.08	117833.97
2033	83270.52	46673.06	119867.97
2034	84535.01	47183.90	121886.12
2035	85799.50	47709.64	123889.36
2036	87063.99	48249.45	125878.54
2037	88328.48	48802.53	127854.43
2038	89592.97	49368.20	129817.75
2039	90857.47	49945.80	131769.13
2040	92121.96	50534.74	133709.17

Source: Data Analysis, 2017

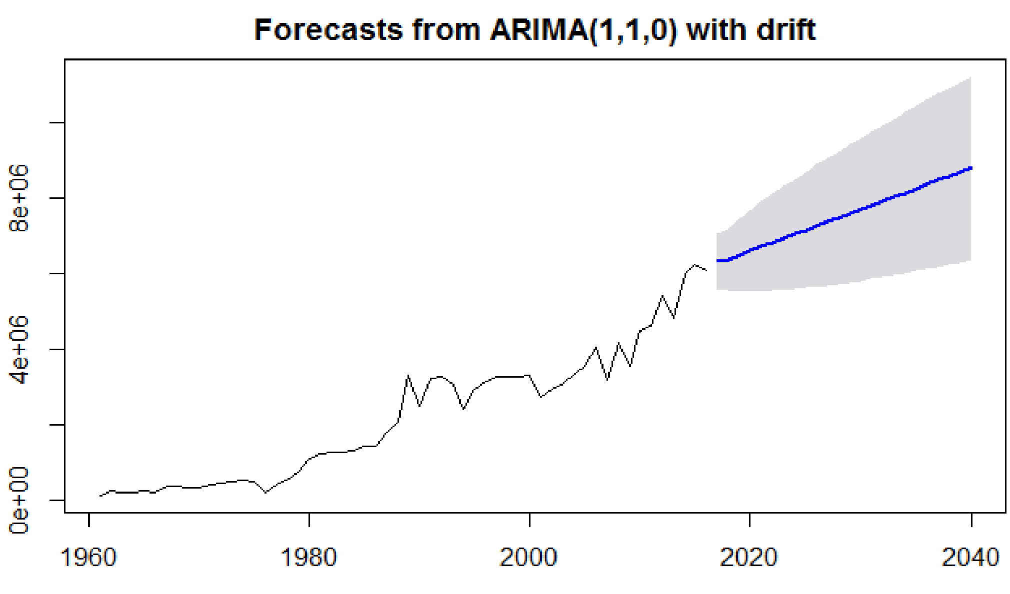

Figure 11: Forecast of Rice Production in Nigeria

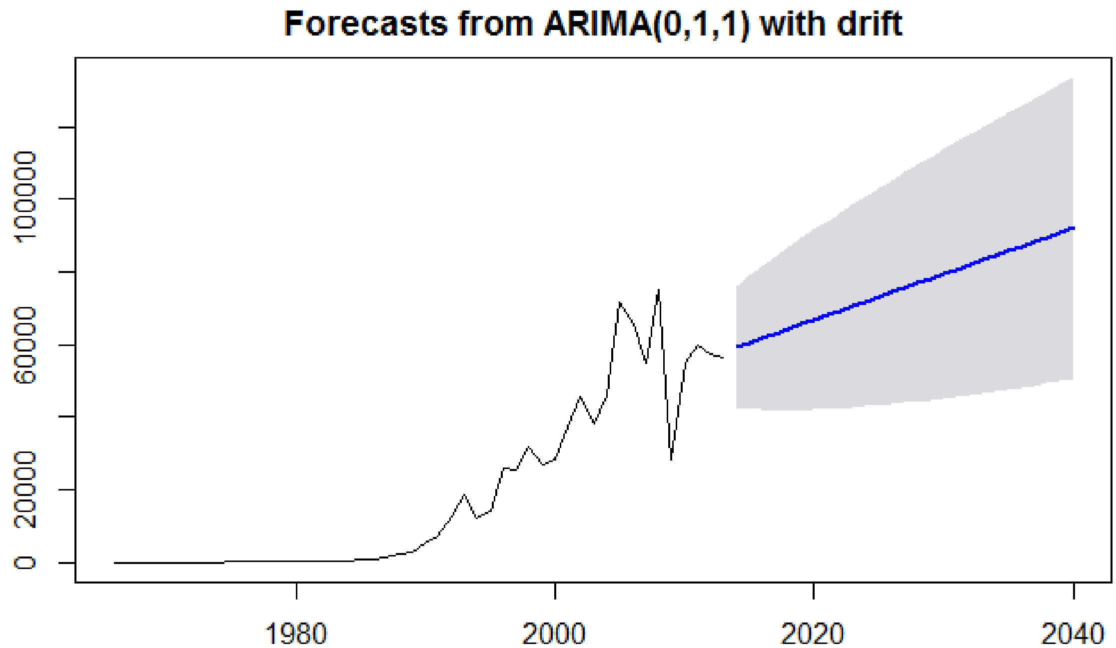

Figure 12: Forecast plot of Rice Price in Nigeria

CONCLUSION AND POLICY RECOMMENDATIONS

The results of this study show that show that rice production is on an increasing trend in Nigeria and it will continue to increase greatly form year 2017 to year 2040. Similarly, rice price is on an increasing trend in Nigeria, it will continue to increase greatly from years 2014 to years 2040.

In the phase of increasing population and consumption, it is advised that government and other stakeholders should take effort to increase output of rice in Nigeria. While this will greatly contribute to the Nigerian agricultural growth, it will also help to prevent food insecurity. Farmers should also be willing to accept better yield technologies and access loans from the Central Bank of Nigeria. The government should also improve the technological processes in of rice production so as to keep the cost of production at a minimal level and thereby reducing the price of rice. This will encourage the farmers to produce more and will also keep this essential food commodity within the reach of ordinary citizen.

REFERENCES

.

Abubakar, S. (2013). Why Nigeria imports N1bn rice daily, DAILY TRUST.http://allafrica.com/stories/201308080475.html

Areepong,Y(1999). Forecasting of Strategy Agriculture Products: Vegetables and Fruits, Master Thesis in Statistics, Chulalongkorn University,

Badmus M.A and O.S. Ariyo 2011. "Forecasting Cultivated Areas and Production of Maize in Nigerian using ARIMA Model" *Asian Journal of Agricultural Sciences* 3(3): 171-176.

Box, G. E. P. and G. M. Jenkins (1976) *Time Series Analysis: Forecasting and Control*, 2nd edn., Holden-Day, San Francisco

Daramola, B. (2005). Government Policies and Competitiveness of Nigerian Rice Economy. Paper presented at the 'Workshop on Rice Policy & Food Security in Sub-Saharan Africa' Organized by WARDA, Cotonou, Republic of Benin, November 07-09, 2005

De Datta, S.K.(1981) Principles and Practices of Rice Production. John Wiley and Sons, London

FAOSTAT (2013). Agricultural production database. Food and Agricultural Organization of the United Nations, FAO, Rome, Italy. Accessed on June14, 2013 http://faostat.fao.org/site/703/default.aspx#ancor

FOSTAT (2010). Journal of Agriculture and Social Research, 10(2). http//www.faostatfao.org (2010)

Gathondu, E.K. (2012). Modeling of wholesale prices for selected vegetables using time series models in Kenya (Masters of Science thesis). University of Nairobi, Kenya

Gujarati, D.N. (2004) Basic Econometrics. 4th Edition, McGraw-Hill Companies.

Karim, Md. R. Awal, Md. A. and Akter, M. (2010). Forecasting Of Wheat Production In Bangladesh"

Bangladesh J. Agril. Res. 35(1) : 17-28.

Ljung, G. M. and Box, G. E. P. (1978) On a Measure of Lack of Fit in Time Series Models, *Biometrika* 65(2), 297-303

Najeeb, I. Khuda, B. Asif, M. and Ahmad, S. A. (2005). "Use of the ARIMA Model for Forecasting Wheat Area and Production in Pakistan", *Journal of Agriculture and Social Sciences,* Vol. 1(2) 120-122.

Padhan, P.C., 2012. Application of ARIMA model for forecasting agricultural productivity in India. *J. Agric. Soc. Sci.,* 8: 50–56.

Sahu, P.K., Mishra, P.,, Dhekale, B.S., Vishwajith K.P. and K. Padmanaban (2015) Modelling and Forecasting of Area, Production, Yield and Total Seeds of Rice and Wheat in SAARC Countries and the World towards Food Security. *American Journal of Applied Mathematics and Statistics, 3(1), 34-48*

Spore (2005). Rice: A success story for some: CTA BI-monthly Magazine. A publication of Technical centre for Agriculture and Rural Cooperation, 115 (2005): pp 4-5.

Tripathi, R., Nayak, A.K., Shahid, R.R.M., Kumar, A.,Mohanty, S., Panda, B.B., Lal, B. and P. Gautam (2014) Forecasting Rice Productivity and Production of Odisha, India, Using Autoregressive Integrated Moving Average Models. Hindawi Publishing Corporation Advances in Agriculture Volume 2014, Article ID 621313, 9 pages http://dx.doi.org/10.1155/2014/621313