AGRICULTURAL SCIENCE AND TECHNOLOGY, VOL. 11, No 3, pp 226 - 231, 2019
DOI: 10.15547/ast.2019.03.039

Analysis of cowpea price forecasting in Adamawa state, Nigeria

T. Joshua, J. Zalkuwi*

Department of Agricultural Economics and Extension, Faculty of Agricultural sciences, Adamawa State University Mubi, Adamawa State, Nigeria

(Manuscript received 15 March 2019; accepted for publication 5 June 2019)

Abstract. *The study was conducted to analyze cowpea price forecasting in Adamawa State, Nigeria. The sources of data for the study were secondary data which were collected from State Planning Commission of Adamawa State for a period of 5 years (2013-2017). Purposive sampling techniques were used for selection of the study area. Dicky Fuller Test and Simple Exponential Smoothing Model were used as analytical tools. The unit root test analysis revealed almost all the markets price series were non-stationary at level except Jambutu market (AD5) at 5% significant level but became stationary after first difference. The result of Exponential Smoothing Model showed that there will be upward trend of cowpea prices in Adamawa State in February and October - November in the year 2018 and therefore, it is recommended that provision of better infrastructural facilities such as construction of accessible and motorable roads, and communication network by government and NGOs. This would reduce transfer cost which usually gets translated to the prices of the cowpeas, especially across markets in critical distance.*

Keywords: cowpea, market price, forecasting, Adamawa State

Introduction

Cowpea (*Vigna unguiculata*) originated and was domesticated in Southern Africa and was later moved to East and West Africa, and Asia. It is a food and animal feed crop grown in the semi-arid tropics covering Africa, Asia, Europe, United States and South and Central America. The grains contain 25% protein, 64% carbohydrate and several vitamins and minerals (International Institute of Tropical Agriculture, 2010 cited in Zalkuwi et al. (2014).

More than 5.4 million tons of dried cowpea are produced worldwide annually, with Africa producing nearly 5.2 million tons and Nigeria being the largest producer and consumer in West Africa accounting for 61% of production in Africa and 58% worldwide where a dense population creates an enormous demand for the crop. In Nigeria, cowpea is mainly cultivated in the northern part of the country where it forms an important part of the farming systems (IITA, 2010). The appreciating economic importance is that it is a good supplement/complimentary source of protein from animals (meat, egg and fish). It also has a tremendous potential to contribute to the alleviation of malnutrition specifically amongst the poor (Ya'aishe et al., 2010).

Price of cowpea is highly unstable between seasons and consumers pay different amounts for the same product in different markets separated by just a few kilometers (Akpan et al., 2014). Post-harvest pricing and marketing suggested that agriculture, like any other private enterprise, is propelled by entrepreneurs who are motivated by profits from their investments and entrepreneurship. Therefore, in order to ensure maximum returns farmers must make their production decisions considering the most favourable place, time and form in which their products could be marketed (Ayinde and Idris, 2005).The volatility in price of agricultural commodities in Nigeria has been attributed to various factors including variances in bargaining power among consumers, cyclical income fluctuation among sellers and consumers, seasonality of production, natural factors such as flood, pests, diseases, and inappropriate response by farmers to price signals (Gilberts, 1999; Udoh and Akpan, 2007; Adebusuyi, 2009).

During harvesting periods, prices of farm products are generally low due to surpluses; in the off season, prices rise due to reduced production and seasonal changes (Akpan, 2002 and Akintunde et al., 2012). Hence, agricultural commodity price is one of the major determinants of quantity of commodities supplied by farmers and demanded by consumers. Product price instability among agricultural commodities is a regular phenomenon in markets across Nigeria (Akpan, 2007 and Akintunde et al., 2012).

Instability in agricultural commodity prices among markets could be detrimental to the marketing system and the economy as a whole. Because it could cause inefficiency in resources allocation among sellers and consumers depending on the source of variability. It could also increase poverty level especially among low income earners in the society (Polaski, 2008).

Information on price of agricultural commodity and its trend in developed and developing countries like Nigeria is important to the producers, marketers, consumers and policy makers, because understanding the trend of such variations is essential for good planning (Zoellick, 2008; Ikudayisi and Rahji, 2015). Despite the importance of cowpea marketing in Adamawa State there are little studies on of cowpea price in the State, that is why this study was designed to examine the future price of cowpea in Adamawa State for efficient allocation of resources among sellers and consumers, and to reduce poverty level among low income earners in the society so as to achieve efficient cowpea marketing.

*e-mail: jzalkwi4u@gmail.com; tjbajira36@gmail.com

Material and methods

Study area

The study was carried out in Adamawa State being among the principal producing and marketing states of cowpea in Nigeria. Purposive sampling technique was adopted for the selection of the study area on the basis of cowpea production output and market activities. Secondary data on monthly basis for cowpea market prices/100kg was obtained from Agricultural State Planning Commission for a period of 5 years (2013-2017). Dickey Fuller (DF) and Simple Exponential Smoothing Model were used to analyze the data.

Dickey Fuller test

Dickey Fuller test was used to determine the stationarity series in the data for theoretical and practical reasons and this was applied to regressions run in the following forms:

Y_t is a random walk or without constant:

$$\Delta Y_t = \delta Y_{t-1} + e_t \quad (1)$$

Y_t is a random walk with drift or constant:

$$\Delta Y_t = \beta_1 + \delta Y_{t-1} + e_t \quad (2)$$

Y_t is a walk with drift around a stochastic trend (constant plus trend):

$$\Delta Y_t = \beta_1 + \beta_2 t + \delta Y_{t-1} + e_t \quad (3)$$

Where:

Δ = Differencing operator;

ΔY_t = price of cowpea in market I at time t (series under investigation);

t = time or trend variable;

β_1, β_2 and δ = Coefficients;

e_t = error term (Dickey and Fuller, 1979).

In each case the null hypothesis is $\delta=0$ ($\rho=1$); that is, there is a unit root, this means that the time series is non-stationary. The alternative hypothesis is that δ is less than zero; that is, the time series is stationary. Under the null hypothesis, the conventionally computed t statistics is known as the τ (tau) statistic, whose critical values have been tabulated by Dickey and Fuller (1979). If the null hypothesis is rejected, it means that Y_t is a stationary time series with zero mean in the case of (1), that Y_t is stationary with a non-zero mean [$=\beta 1/(1-\rho)$] in the case of (2), and that Y_t is a stationary around a deterministic trend in equation (3).

It is extremely important to note that the critical values of the tau test to test the hypothesis that $\delta=0$, are different for each of the preceding three specifications of the DF test. If the computed absolute value of the tau statistics (τ) exceeds the critical tau values at 5% level of significant, we reject the hypothesis that $\delta=0$, in which case the time series is stationary. On the other hand, if the computed (τ) does not exceed the critical tau value at 5%, we accept the null hypothesis, were the time series is non-stationary. In conducting the DF test as in (1), (2), or (3), it was assumed that the error term e_t was uncorrelated.

Simple exponential smoothing model

The simple exponential smoothing was used to forecast future price of cowpea in Adamawa State. The simple exponential smoothing (SES) model is usually based on the premise that the level of time series should fluctuate about a constant level or change slowly over the time.

Mathematical formulation

The SES model is given by the model equation:

$$y(t)=\beta(t)+\varepsilon(t), \quad (4)$$

Where:

$\beta(t)$ takes a constant at the time t and may change slowly over the time;

$\varepsilon(t)$ is a random variable and is used to describe the effect of stochastic fluctuation.

Let an observed time series be $y_1, y_2, ..., y_n$. In any case, in this simple model, to predict y_t is merely to predict (estimate) β. To estimate, it makes sense to use all the past observations, but due to declining correlation as we go back into the past, to down-weight older observations.

Formally, the simple exponential smoothing equation takes the form of:

$$F_{t+1}=\alpha y_t + (1-\alpha)F_t, \quad (5)$$

Where:

y_t is the actual, known series value at the time t;

F_t is the forecast value of the variable Y at the time t;

F_{t+1} is the forecast value at the time $t+1$; α is the smoothing constant.

The forecast F_{t+1} is based on weighting the most recent observation y_t with a weight α and weighting the most recent forecast F_t with a weight of $1-\alpha$.

To get started the algorithm, we need an initial forecast, an actual value and a smoothing constant. Since F_1 is not known, we can:

- Set the first estimate equal to the first observation. Further we will use $F_1 = y_1$.
- Use the average value of the first few observations of the data series for the initial smoothed value.

Smoothing constant α is a selected number between zero and one, $0 < \alpha < 1$.

Rewriting the model (2) we can see one of the neat things about the SES model:

$$F_{t+1}-F_t = \alpha(y_t - F_t), \quad (6)$$

change in forecasting value is proportional to the forecast error. That is,

$$F_t+1 = F_t + \alpha e_t, \quad (7)$$

Where: residualet = yt – Ft (8)

is the forecast error at the time t.

So, the exponential smoothing forecast is the old forecast plus an adjustment for the error that occurred in the last forecast.

By iterating equation 4 we get:

$F_1 = y_1$; $F_2=\alpha y_1+(1-\alpha)F_1 = y_1$;

$F_3 = \alpha y_2+(1-\alpha)F_2=\alpha y_2+(1-\alpha)y_1 = \alpha y_2+\alpha(1-\alpha)y_1+(1-\alpha)^2 y_1$;

$F_4 = \alpha y_3+(1-\alpha)F_3 = \alpha y_3+(1-\alpha)(\alpha y_2+\alpha(1-\alpha)y_1+(1-\alpha)^2 y_1) =$

$= \alpha[(y_3+(1-\alpha)y_2+(1-\alpha)^2 y_1)](1-\alpha)^3 y_1)$;

The forecast equation in general form is:

$$F_{t+1} = \alpha \sum_{t-1} (1-\alpha)^k y_{t-k} + (1-\alpha)^t y_1, t \in N, k = 0 \quad (9)$$

Where:

F_{t+1} is the forecast value of the variable Y at the time $t + 1$ from knowledge of the actual series values y_t, y_{t-1}, y_{t-2} and so on back in time to the first known value of the time series, y_1.

Therefore, F_{t+1} is the weighted moving average of all past observations.

The series of weights used in producing the forecast $Ft+1$ is:

$$\alpha, \alpha(1-\alpha), \alpha(1-\alpha)^2, \quad (10)$$

It is obviously from the above seven equations that the weights are exponential; hence the name exponentially weighted moving average. The exponential decline of the weights toward zero is evident.

Note: Adamawa State market prices [Sabon kasuwa Mubi (AD1), Maiha main Market (AD2), Sabom kasuwa Gombi (AD3), Dumne market (AD4) and Jambutu market (AD5)].

Results and discussion

Unit root test result

The unit root test results using Dickey Fuller (DF) test are presented in Table 1 and Figures 1-5. The test was applied to each variable over the period of five years (i.e. 2013-2017). The results revealed that almost all the market price series were non-stationary except one market price series which is stationary [i.e. Jambutu market (AD5)] at level and at 5% level of significance as graphically shown in Figure 5. This implied that price series (mean, variance of the mean and covariance of the mean) changes with time as a result of inflation or seasonality. But at first different, market price series were all constant. This implied that mean, variance of the mean and covariance of the mean do not vary with time. Therefore, the null hypothesis is accepted and concluded that the cowpea prices in Adamawa state contained unit root, meaning that the price series is non-stationary. Therefore, this study is in consonant with Zalkuwi et al. (2015) who reported there is a unit root in the two markets, that is, there is no stationary between the 2 markets at 1% level of significance and all the price series became stationary at 1% level of significance after first differing. But this disagrees with the study of Ikudayisi and Rahji (2015) who revealed that all price series in Kebbi, Lagos, Oyo, Rivers and Sokoto states were stationary at level 1% except for Abia state where all monthly price series were non-stationary at 5% level of significance.

Table 1. Unit root test result

Variables	Test stat.	At level Teststat.	At first difference 5% critical value
AD1	-3.200**	8.319**	-3.491
AD2	- 3.147**	-7.696**	-3.491
AD3	- 2.674**	- 7.067**	-3.491
AD4	-2.552**	-7.185**	-3.491
AD5	-4.512	-9.805**	-3.491

Source: Computed Result (2018); **5% Significance level

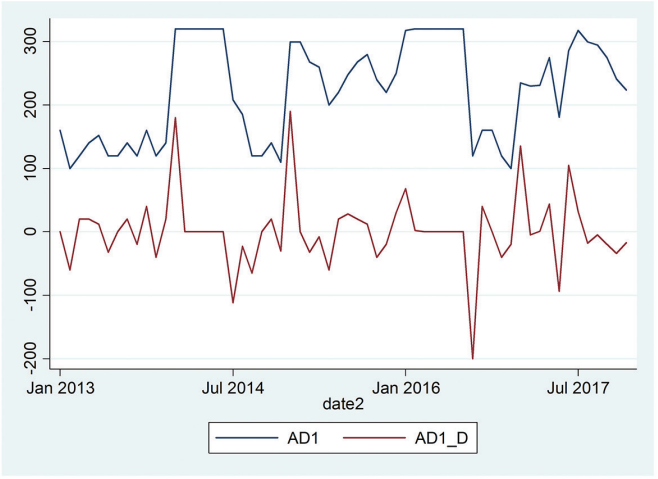

Figure 1. Unit Root Test both at level and first difference for Sabon Kasuwa Mubi

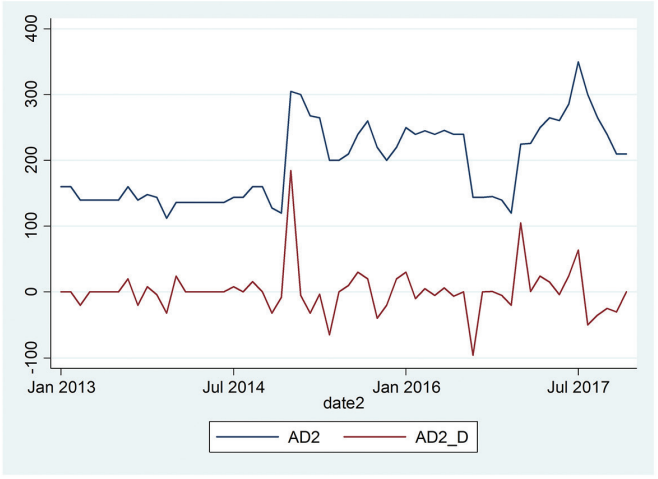

Figure 2. Unit Root Test Both at level and first difference for Maiha main Market

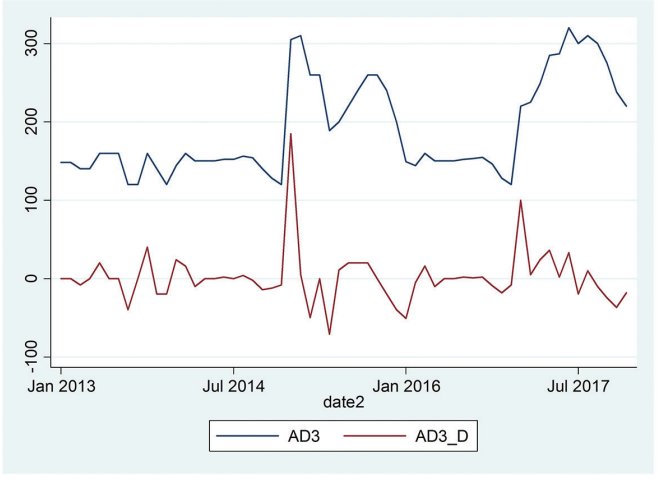

Figure 3. Unit Root Test Both at level and first difference for Sabon Kasuwa Gombi

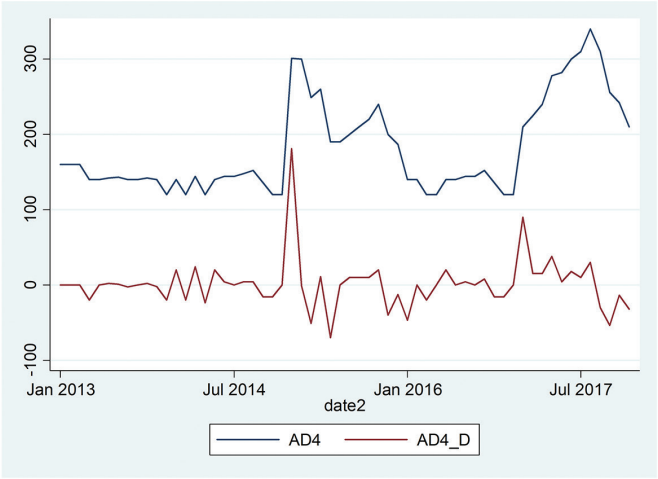

Figure 4. Unit Root Test Both at level and first difference for Dumne market

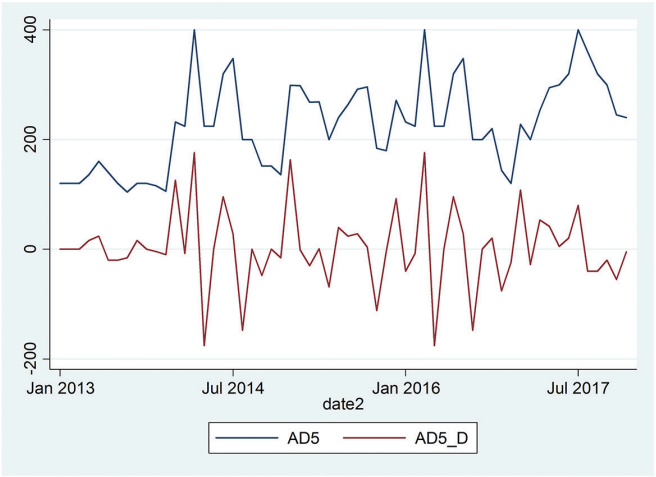

Figure 5. Unit Root Test Both at level and first difference for Jambutu market

Forecasted price of cowpea from January to December 2018 of Adamawa and Taraba States

The forecasted prices of cowpea in Adamawa State from January to December 2018 of markets under study (Table 2) revealed that the price of cowpea in Sabon Kasuwa Mubi (AD1) as shown in Figure 6 and Maiha main Market (AD2) will be higher in February (267 and 215) and lower in December (175.95 and 171.09) in Figure 7. This implies that farmers will obtain good price in the month of February as shown in the graphs below. This study agrees with the study of Mathew (2014) who reported that there was slight upward trend of cowpea price in Mubi North LGA of Adamawa State in January and February 2013.

Table 2. Forecasted price of cowpea/kg from January to December 2018 of Adamawa State

Months	AD1	AD2	AD3	AD4	AD5
January	267	210	190	190	220
February	267	215	193	190	222
March	257.8	213.2	196.1	189.4	215.9
April	253.9	209.4	193.1	184.6	266.5
May	260.2	209.3	195.8	183.9	240.7
June	242.3	200.4	189.8	180.1	227.3
July	249.9	200.4	194.4	182.3	255.8
August	244.9	211.9	196.1	186.4	283.9
September	215.3	201.9	195.9	193.4	247.0
October	201.1	196.2	197.2	194.4	233.2
November	194.0	186.7	196.5	185.7	206.6
December	175.9	171.1	181.3	170.8	179.2

Source: Computed Result (2018)

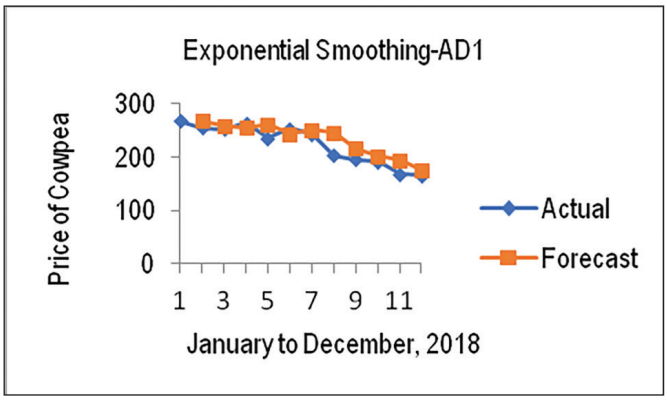

Figure 6. Forecasted price of cowpea in Sabon Kasuwa Mubi North Adamawa State

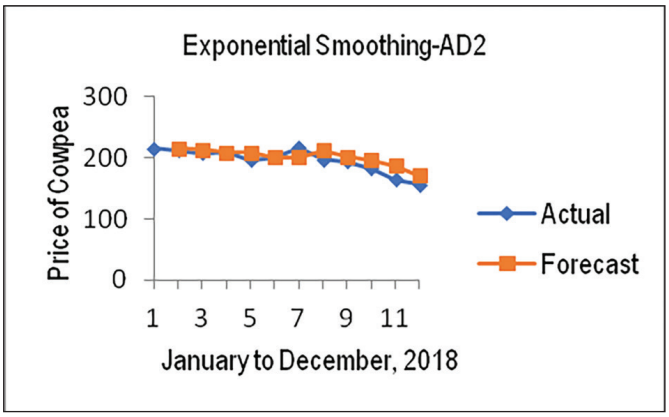

Figure 7. Forecasted price of cowpea in Maiha Main Market Adamawa State

The analysis also shows that the price of cowpea in Sabon Kasuwa Gombi (AD3) and Song Market (AD4) will be higher in October (197.2 and 194.4) and lower in the month of December (181.3 and 170.8) as presented in Figures 8 and 9. The price indicated that Jambutu market (AD5) will be higher in August (283.94) and lower in December (179.2) as graphically shown in Figure 10. This implies that farmers should dispose their produce in October in the above markets.

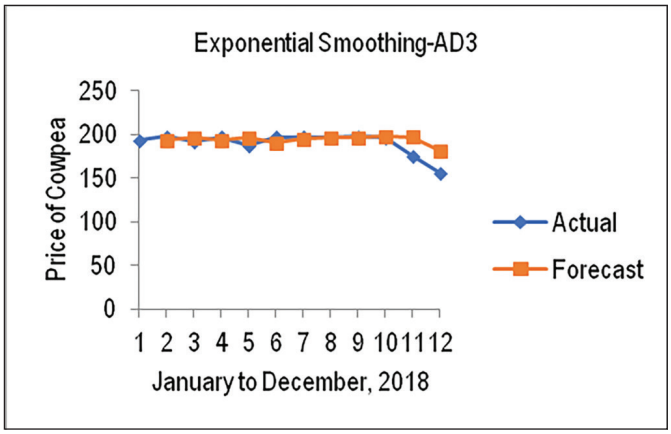

Figure 8. Forecasted price of cowpea in Sabon Kasuwan Gombi Adamawa State

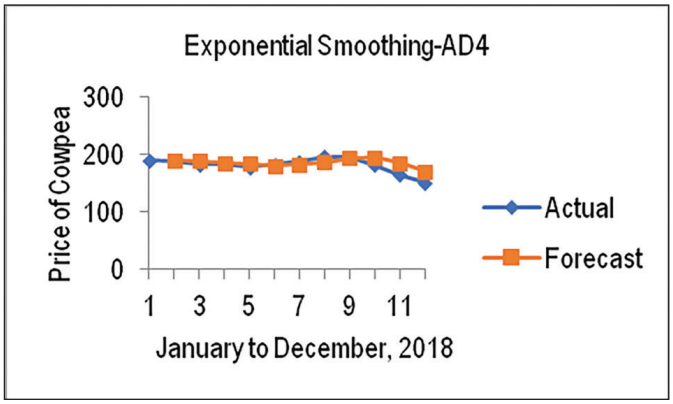

Figure 9. Forecasted price of cowpea in Dumne Market Song Adamawa State

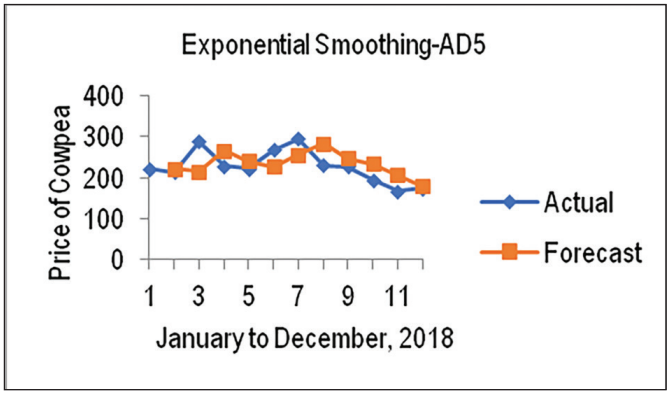

Figure 10. Forecasted price of cowpea in Janbutu Market Yola North Adamawa State

Conclusion

Based on the analysis of the study, it was found that price series were not constant but after first differing all the price series became constant and the result of exponential smoothing revealed that there will be upward trend of cowpea prices in Adamawa State in February and from August to early November in the year 2018. Price will play a major role in the allocation of the resources between production and consumption. Various participants in the cowpea markets (farmers, producers, buyers, etc.) will be in constant need of price forecasts to facilitate accurate marketing decision making. Based on the findings of this research, the following recommendations were made: (a) provision of better infrastructural facilities such as construction of accessible and motorable roads, and communication network; this would reduce transfer cost which usually gets translated to the prices of the cowpeas, especially across markets in critical distance; (b) the marketers should form cooperatives or associations that can assist them in the provision of physical facilities and better dissemination of market intelligence and information among them; (c) attempts should be made by governments, trade unions and other non-Governmental organization to reduce excessive externality costs associated with the marketing of cowpea in the states; this attempt will help to minimize the total variable cost and bring about insignificant price differential among cowpea markets in the states; (d) to minimize the total variable cost and bring about insignificant price differential among cowpea markets in the states; (e) to establish viable storage facilities coupled with introduction of weights and measures at both producing and consuming markets and involve brokers to process and store the commodity for a fee; if this is properly done, the price of commodity would be stabilized and guaranteed for both farmers and the consuming public; (f) cowpea farmers should not be hasted to dispose their farm product until the lean period when the price is higher so as to obtain good price for their products in the study area.

References

Adebusuyi BS, 2009. Stabilization of commodity market of interest to Africa. Paper presented at the workshop on constraints to growth in sub-Saharan Africa, held in Pretoria South Africa.

Akintunde OK, Akinremi TB, and Nwauwa LOE, 2012. Food grain marketing in Osun State, Nigeria: A Study of long-run price integration. Continental Journal of Agricultural Economics, 6, 1-9.

Akintunde OK, Yusuf SA, Bolarinwa AO and Ibe RB, 2012. Price formation and transmission of staple food stuffs in Osun state, Nigeria. ARPN Journal of Agricultural and Biological Science, 7, 699-710.

Akpan SB, 2002. Analysis of gross margin efficiency of rice beans and garri in selected markets in Cross River State.

(Unpublished undergraduate project work, Department of Agricultural Economics), University of Calabar, Nigeria, pp. 110-120.

Akpan SB, 2007. Relative price variability and inflation: A case study of Grain subsector in Nigeria. Thesis for MSc (Unpublished), Department of Agricultural Economics University of Uyo, Nigeria, pp. 54-57.

Akpan SB, Udoh EJ and UdoU J, 2014. Monthly price analysis of cowpea (beans) and maize in Akwa Ibom state, Southern Nigeria. International Journal of Food and Agricultural, 2, 65-86.

Ayinde OE and Idris AO, 2005. Inter-market and seasonal variation. In: Prices: An appraisal of maize marketing in Kwara State, Nigeria.

Dickey DA and Fuller WA, 1979. Distribution of the estimators for autoregressive time series with a unit root. Journal of the American Statistical Association, 74, 427-31.

Gilbert C, 1999. Commodity risk management for developing countries: paper prepared for the third meeting of the international task force (ITF) held in Geneva 23-24 June 1999.

Ikudayisi AA and Rahji MAY, 2015. Integration among spatial onion markets in Nigeria - A cointegration analysis. Global journal of human-social science, 15, 4-8.

International Institute of Tropical Agriculture (IITA), 2010. Annual Report, Ibadan.

Mathew E, 2014. Analysis of cowpea price fluctuation in Mubi North Local Government area of Adamawa State (Unpublished undergraduate project work, Department of Agricultural Economics and Extension), Adamawa State University Mubi, Nigeria, pp. 21-26.

Polaski S, 2008. Rising food prices, poverty and Doha round. Carnegie endowment for international peace. Principles and Application, Living Books Series G.M. Publications, Abuja, pp.15-20.

Udoh EJ and Akpan SB, 2007. Estimating exportable tree crop relative price variability and inflation movement under different policy regimes in Nigeria. European Journal of Social Science, 5, 17-26.

Ya'aishe AP and Petu-Ibikunle, 2010. Economic analysis of cowpea production among women farmers in Askira Uba L.G.A Borno state. African journal of general agriculture, 6, 7-9.

Zalkuwi J, Comfort Y and Ibrahim A, 2014. Analysis of cost and return in cowpea production in Adamawa State, Nigeria. The International Journal of Humanities and Social Studies, 2, 1.

Zalkuwi J, Rakesh S, Deepika J, Arpita G and Rehka R, 2015. Spatial market integration between two markets of sorghum in Karnataka and Maharashtra State of India. International Journal of Advances in Agricultural Science and Technology, 2, 13-25.

Zoellick RB, 2008. Remarks at the African Union Summit. Addis Ababa, World Bank, Washington, DC.