Price Fluctuation of Cowpea in Taraba State, Nigeria

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***Abstract*: - The study was conducted to forecast future prices of cowpea in Taraba State, Nigeria. Secondary data were collected from the Agricultural Development Project (ADP) of Taraba State for a period of 5 years (2013-2017). Multistage and Purposive sampling techniques were used for selection of the study area. Dicky Fuller Test and Simple Exponential Smoothing Model were used to analyze the data. The unit root test analysis revealed that all the markets price series were non-stationary at level at 5% significant level, but became stationary after first difference at 5% significant level. The result of exponential smoothing revealed that the cowpea prices in Taraba State will be higher from September to November in the year 2018. It is recommended that an attempts should be made by governments, trade unions and non-Governmental organization to reduce excessive externality costs associated with the cowpea marketing 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.**

***Key words:* Cowpea, Market price, fluctuation and forecasting**.

I. INTRODUCTION

The price of Agricultural commodities has experienced unprecedented fluctuations and continuous increases since 2002 until mid-2008 (Akpan and Udoh, 2009). They reported that this brought about price volatility, food inflation, poverty and hunger, coupled within adequate market price transmission, high food prices have increased the levels of food deprivation, droved millions of people into food insecurity, worsening conditions for many who were already food insecure, and threatening long term global food security. Price of cowpea is highly unstable between seasons and consumers pay different amounts for the same product in different markets which is separated by just a few kilometers (Akpan *et al.*, 2014).Sustainability of agricultural activities is hinged on effective price system. In the recent past, the market for agricultural commodities in Nigeria has shown a pattern of long-term price fall and short-term price instability (IMF, 2010; Akpan*et al.*, 2014). The volatility in price of agricultural commodities in Nigeria has been attributed to various factors which include 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 Sunday, 2007; Adebusuyi, 2009). Hence, price of agricultural commodity is one of the major determinants of quantity of agricultural commodities supplied by farmers and demanded by consumers. Product price instability among agricultural commodities is a regular phenomenon across Nigeria (Akpan, 2007; Akintunde *et al.,* 2012). Instability in agricultural commodity prices among markets could be detrimental to the marketing system and the economy as a whole. It could cause inefficiency in resources allocation among sellers and consumers depending on the source of variability and increase the level of poverty among low income earners in the society (Polaski, 2008).

Information on price of agricultural commodity and its trend in both developed and developing countries like Nigeria is important to the producers, marketers, consumers and policy makers, because understanding the trend of such variations is therefore, essential for good planning (Zoellick, 2008). Despite the potential of cowpea marketing in Taraba State there are little study conducted on cowpea marketing and price in the State. Therefore, the study was conducted to determine the stationarity series in the data and analyze the future price of cowpea in order to allocate resources efficiently among sellers and consumers, and to reduce the level of poverty especially among low income earners in the society so as to achieve efficient cowpea marketing.

II. METHODOLOGY

2.1 Study Area

The study was conducted in Taraba State due to its potential in cowpea production and marketing activities in Nigeria. Taraba State lies largely within the middle of Nigeria and consists of undulating landscape dotted with a few mountainous features. These include the scenic and prominent Mambilla Plateau. The state lies largely within the tropical zone and has a vegetation of low forest in the southern part and grassland in the northern part. The state lies roughly between latitudes 6.25'N and 9.30'E and between longitudes 9.30'N and 11.45'E and has an estimated land area of about 54,428 sq. km (Adebayo and Tukur, 1999). Taraba State is bounded in the west by Nasarawa State and Benue State, Northwest by Plateau State, North by Bauchi State and Gombe State, Northeast by Adamawa State, it also shares an international boundary on the East, which separates Taraba State from the Republic of Cameroun (Adebayo, 1999). The major occupation of the people of Taraba State is agriculture. Cash crops produced in the state include coffee, tea, groundnuts and cotton. Crops suchas maize, rice, sorghum, millet, cassava, and yam are also produced in commercial quantity. In addition, cattle, sheep and goats are reared in large numbers, especially on the Mambilla Plateau, and along the Benue and Taraba valleys.

2.2 Sources of Data and Sampling Procedure/Techniques

Secondary data was used for the study. Secondary data on monthly basis for cowpea market prices/100kg was obtained from Agricultural Development Programme (ADP) office for a period of 5 years (2013-2017) since that was the only information available on cowpea marketing. Multistage and Purposive sampling technique were adopted for the selection of the study area on the basis of cowpea production output and market activities. Selection of the study involved four stages. Stage one involved selection of Taraba State purposely. Second stage was purposive selection of agricultural Zones, in the third stage was selection of Local Government Areas (LGAs) purposely, while in the fourth stage was purposive selection of markets. Taraba State has been divided in to four agricultural zones based on soil, climate and vegetation by Taraba Agricultural Development Programme. Taraba State has 16 Local Government Areas which is divided in to four agricultural zones viz; Zone I, Zone II, Zone III and IV. Cowpea production and marketing is concentrated in zone I and II. Therefore, Zone I and Zone II were purposely selected. Furthermore, three Local Government Areas from Zone I and two Local Government Areas from Zone II were purposely selected making a total of five (5) LGAs. Finally, one main cowpea market from each selected Local Government Areas was purposely selected making a total of five (5) markets for the study.

2.3 Analytical techniques

Inferential statistics were used as analytical tools. This involved the use of Dickey Fuller (DF) Test, and Simple Exponential Smoothing Model.

2.3.1 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:

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

Y_t is a random walk with drift or constant:

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

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

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

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 δ=0 (ρ=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. 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 [=β1/ (1-ρ)] 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 δ=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% significant level, we reject the hypothesis that δ=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% significant level, 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.

2.3.2 Simple Exponential Smoothing Model

The simple exponential smoothing was used to forecast future price of cowpea in Taraba 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.

The SES model is given by the model equation

$$y(t)=\beta(t)+\varepsilon(t), \qquad \textbf{(4)}$$

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 due to declining correlation as you go back into the past, to down-weight older observations.

Formally, the simple exponential smoothing equation takes the form of

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

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

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

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

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

where residual

$$et = yt - Ft \quad \textit{(8)}$$

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:

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

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

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

$\alpha\left(y_3 + (1-\alpha)y_2 + (1-\alpha)^2 y_1\right) + (1-\alpha)^3 \cdot y_1; \quad \ldots$

The forecast equation in general form is

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

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

$$\alpha, \alpha(1-\alpha), \alpha(1-\alpha)^2, \ldots \quad \textit{(10)}$$

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: = Taraba State market prices [Zing market (TA_1), Jalingo main Market (TA_2), Iware market (TA_3), Mararaban Gassol Market (TA_4 and Garba Chede Market (TA_5)].

III. RESULTS AND DISCUSSION

3.1 Unit Root Test Result

The analysis of dickey fuller (DF) test presented in table 1 below revealed that all the market price series were non-stationary at level at 5% level of significant. 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 Taraba state contained unit root, meaning that the price series is non-stationary as shown in the graphs below. Therefore, this study is in consonant with Zalkwi,*et al.* (2015) who reported that the prices were non- stationary in the tow markets in Maharashtra State of Indiaat 1 %level of significant and there is stationarity in the series at 1% level of significant after first differencing. But disagree with the study of Adesolaand Rahji, (2015) who revealed that all price series in the states were stationary at level I (0) at 1% except for Abia state that the monthly price series were all non-stationary at 5%.

Table 1: Unit Root Test Result

Variables	At level Test Stat.	At first difference Test Stat.	5% critical Value
TR1	-1.741**	-8.610**	-3.491
TR2	-2.247**	-8.001**	-3.491
TR3	-2.136**	-6.091**	-3.491
TR4	-2.356 **	-5.680**	-3.491
TR5	-2.005**	-4.928**	-3.491

Source: Computed Result (2018).

**5% Significant level

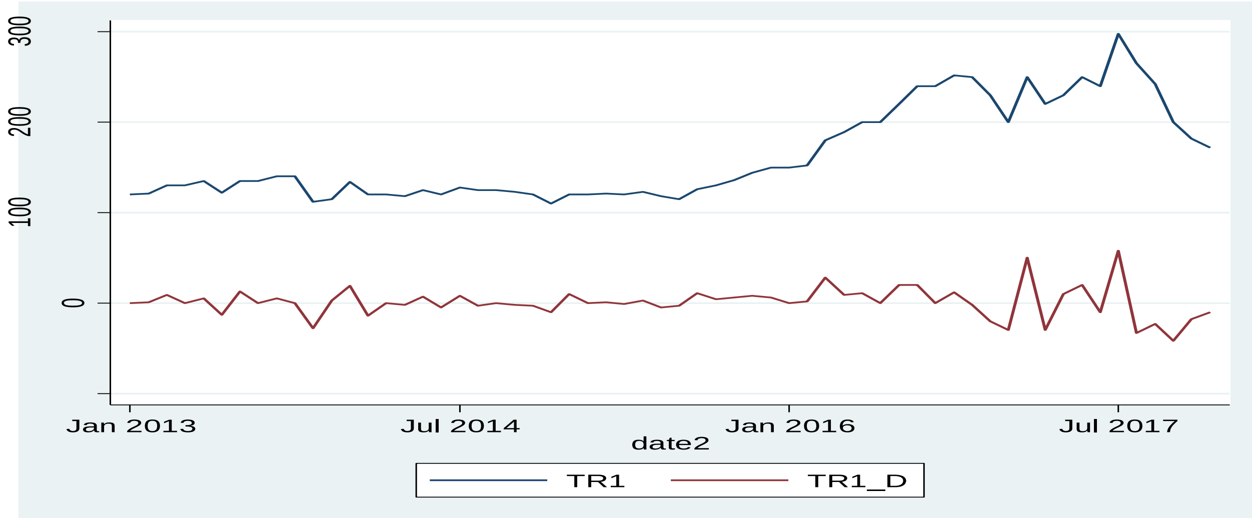

Fig. 1: Graph Presentation of Unit Root Test Both at Level and First Difference for Zing main market

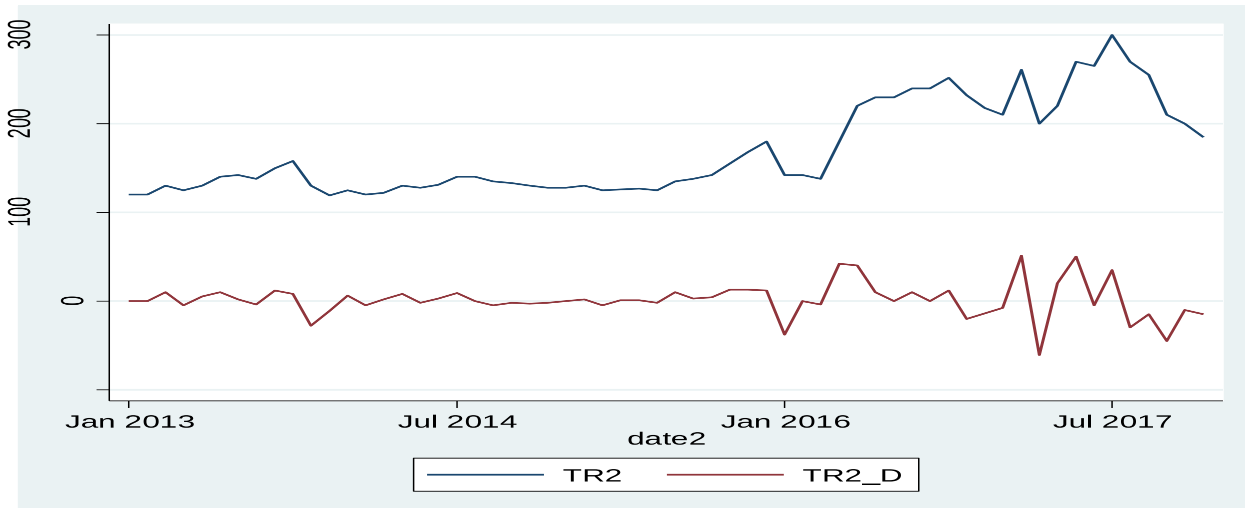

Fig. 2: Graph Presentation of Unit Root Test Both at Level and First Difference for Jalingo main Market

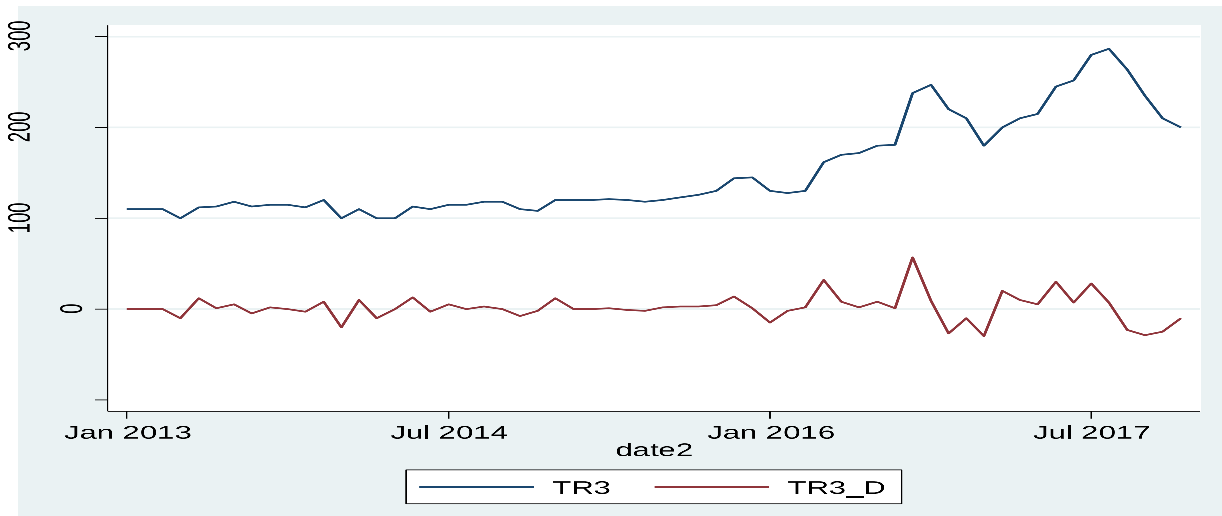

Fig. 3: Graph Presentation of Unit Root Test Both at Level and First Difference for Iware Market

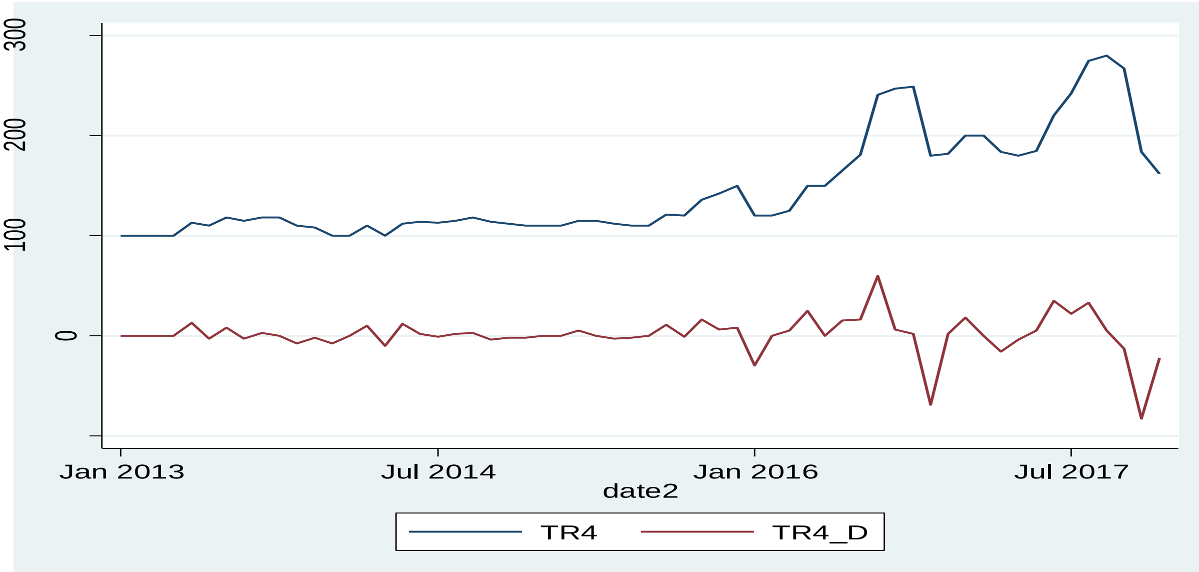

Fig. 4: Graph Presentation of Unit Root Test Both at Level and First Difference for Mararaban Gassol market

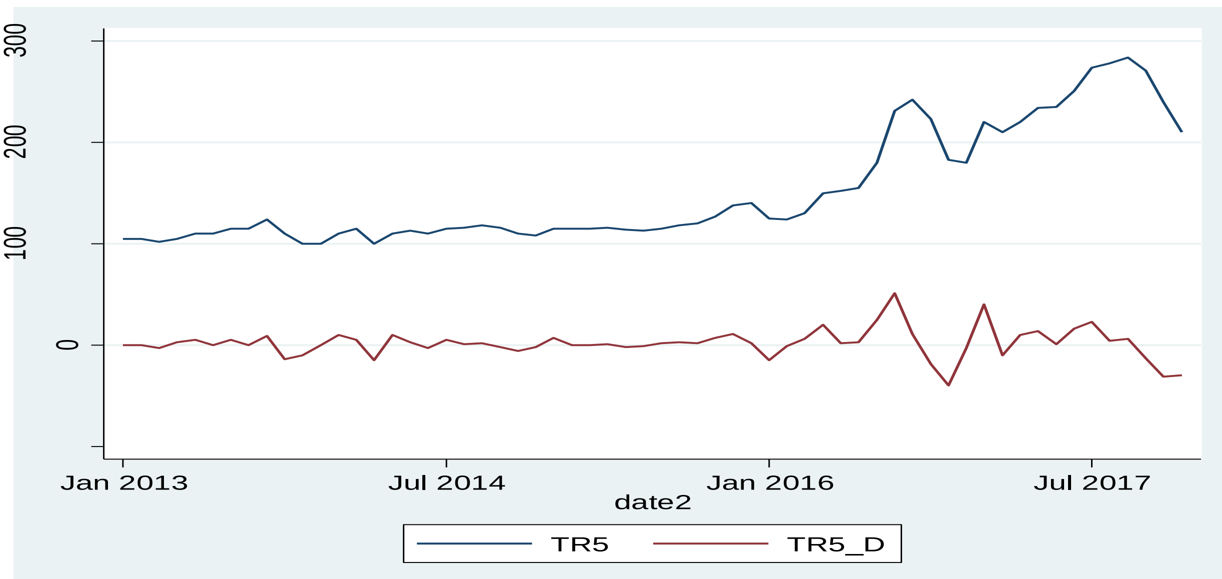

Fig. 5: Graph Presentation of Unit Root Test Both at Level and First Difference for Garba Chede Market

3.2 Forecasted Price of Cowpea from January to December 2018 of Adamawa and Taraba States

The results of cowpea price forecasting in Taraba State from January to December 2018 of markets investigated indicated that the prices of cowpea in Zing Market (TR1) and Jalingo main Market (TR2) will be higher (176.87 and 185.19) in September and lower (145 and 143) in January as presented in the graphs below. The price of cowpea in Iware Market (TR3) and Mararaban Gassol (TR4) revealed that it will be higher in October and November (169.27 and 175.79) and lower in January (126 and 132). Lastly, there will be upward trend, meaning that the prices will be higher towards the end of the year in Garba Chede (TR5) i.e. in October (174.38/kg) and lower (132/kg) in January. This implies that the farmers will only get good market price for their produce in in Taraba State from the month of September to November, 2018 in the above market as can be seen 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 and According to Ibrahim *et al.* (2013) who revealed that the period after harvest in December sales are generally low and thereafter begin to climb.

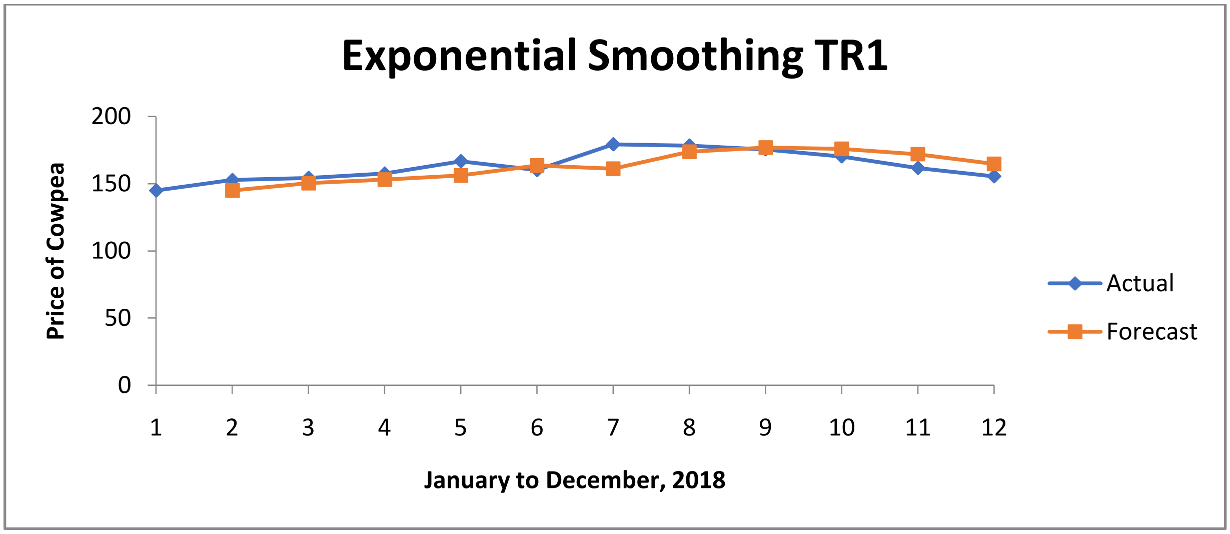

Fig. 6: Graph showing forecasted price of cowpea in Zing market Taraba State

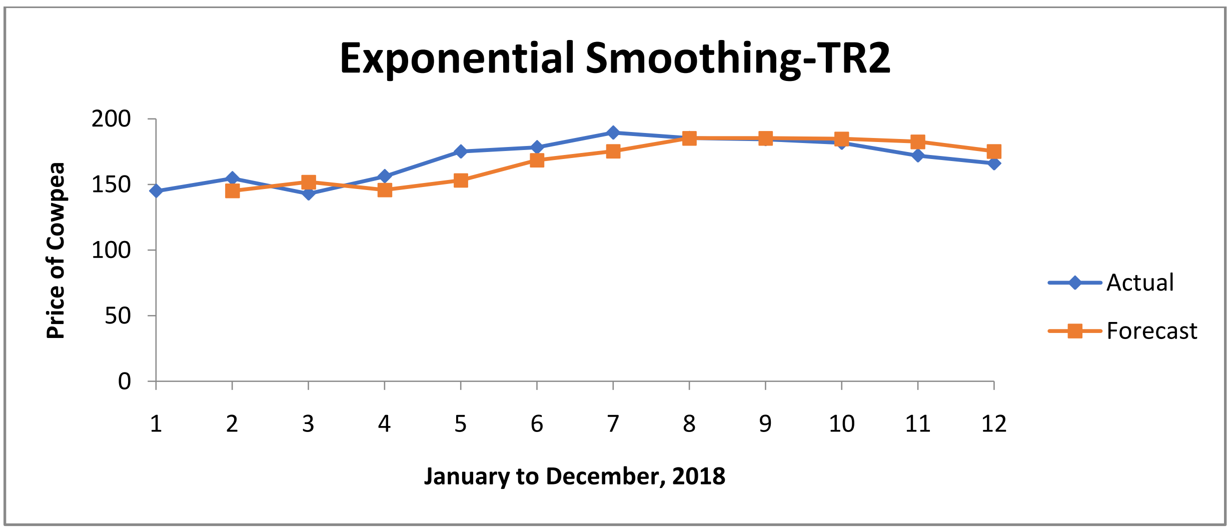

Fig. 7: Graph showing forecasted price of cowpea in Jalingo main Market Taraba State

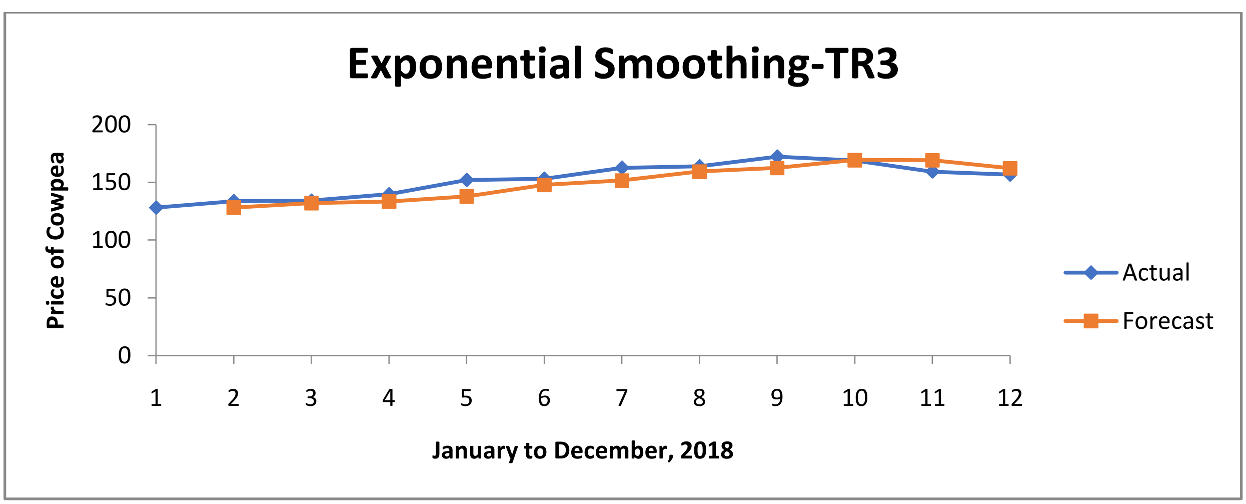

Fig. 8: Graph showing forecasted price of cowpea in Iware market ofArdo-Kola LGA. Taraba State

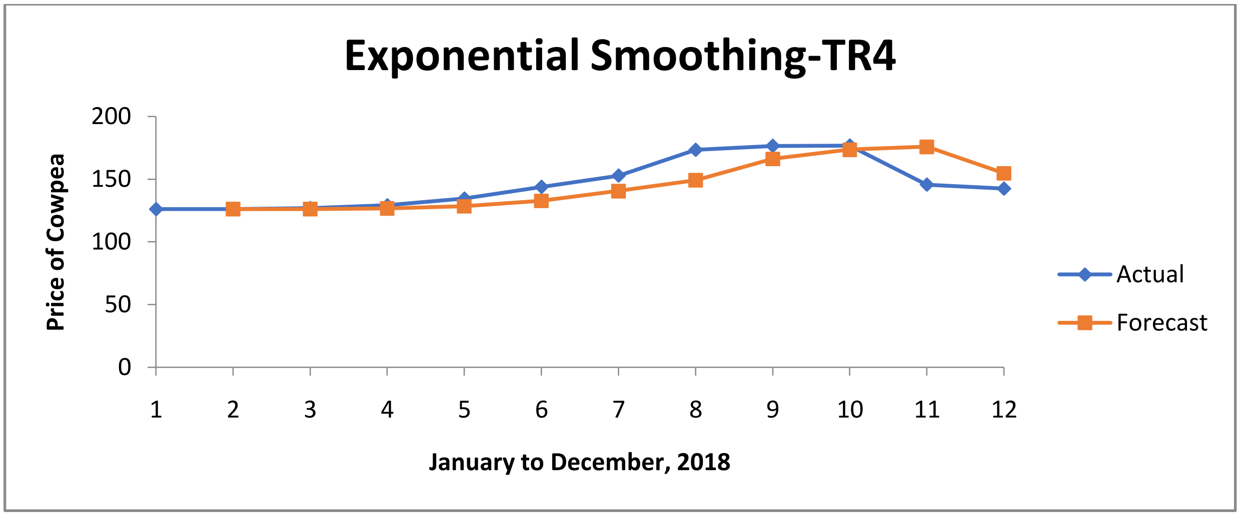

Fig. 9: Graph showing forecasted price of cowpea in Mararaban Gassol Market Gassol LGA. Taraba State

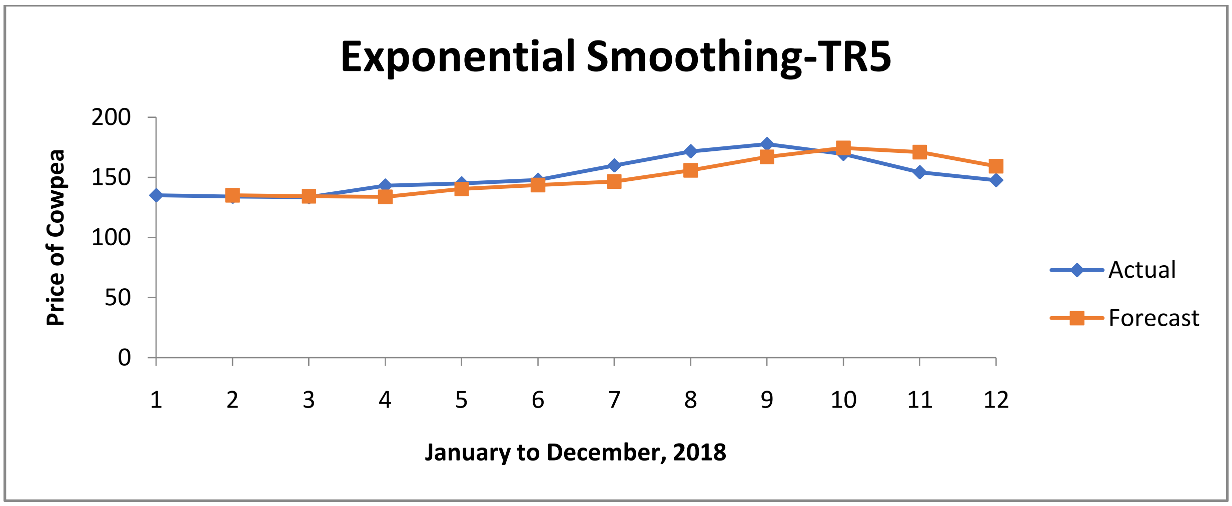

Fig. 10: Graph showing forecasted price of cowpea in Garba Chede Market Bali LGA.

Table 2: Forecasted Price of Cowpea/kg from January to December 2018 of Taraba State.

Months	TR1	TR2	TR3	TR4	TR5
January	145	143	125	126	132
February	145	145	128	126	135
March	150.26	151.72	131.92	126	134.16
April	153.02	145.62	133.38	126.56	133.62
May	156.09	153.03	137.73	128.27	140.19
June	163.45	168.41	147.72	132.27	143.42
July	161.03	175.26	151.42	140.43	146.42
August	173.75	185.16	159.24	149.09	155.81
September	176.87	185.19	162.43	166.11	166.86
October	175.84	184.64	169.27	173.45	174.38
November	171.89	182.51	169.08	175.79	170.89
December	164.69	175.15	162.14	154.66	159.21

Source: Computed Result (2018).

IV. CONCLUSION

The study concluded that price series were not constant at level but after first differencing all the price series became constant and the analysis indicated that there will be upward trend in cowpea prices (prices will be higher) in Taraba State from September to November in the year 2018. Price will play a major role in the allocation of the resources between production and consumption. Farmers, marketers and consumers will be in constant need of price forecasts to facilitate accurate production and marketing decision making.

V. RECOMMENDATIONS

Based on the analysis of the study the following recommendations are made.

1. 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.
2. Provision of better infrastructural facilities by farmers and marketers 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.
3. In order stabilize the price of commodity, Government could establish viable storage facilities couple 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.
4. Government, trade unions and other non-Governmental organization should help to reduce excessive externality costs associated with the marketing of cowpea in the states. This will go a long way in minimizing the total variable cost and bring about insignificant price differential among cowpea markets in the states.
5. Lastly, it is recommended that cowpea farmers should not hasted to dispose their farm product until the lean period when the prices shoot up, that is from September to November so as to obtain good price for their products in the study area.

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