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Spatial Integration between Markets of Cowpea (*Vigna Unguiculata*) in Adamawa and Taraba States, Nigeria

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Abstract

The study was conducted to assess spatial integration between markets of cowpea in Adamawa and Taraba States, Nigeria. The sources of data for the study were secondary data which were collected from the Agricultural Development Project and State Planning Commission of Adamawa and Taraba States for a period of 5 years (2013-2017). Multistage and Purposive sampling techniques were used for selection of the study area. Inferential statistics such as Dicky Fuller Test, Johansen Co-Integration Model, Granger Causality Test, Error Correction 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 Granger Causality revealed that the X^2 is 4.8787 and 0.3912 and probability values of 0.087 and 0.822 for Adamawa and Taraba States markets, respectively, which indicated that Adamawa State cowpea market is the leading market over Taraba State cowpea market at 10% level of significance. The analysis of Vector error correction model indicated that that, Adamawa State cowpea price adjusted faster than that of Taraba State with the estimated adjustment coefficients of 0.2799 and 0.0089 and P values of 0.005 and 0.779 for Adamawa and Taraba States markets' price equations and confirmed the existence of the short run and long-run market integration between the market pairs at 5% level of significant. The study concluded that there is co-integration between Adamawa State cowpea markets and Taraba State cowpea markets but the co-integration is low and therefore, recommended that 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 so as to help increase market integration level through increased speed of price transmission.

Key Word: Integration, Markets, Cowpea, Price

Introduction

Attainment of an efficient market performance is determined by the extent to which price signals are transmitted across markets. In Nigeria, over the years, self-sufficiency in food production, effective marketing system and pricing policies which will ensure stable and remunerative incomes for farmers has been the nation's target. However, there are several impediments to the efficient functioning of markets, particularly agricultural commodity markets. These include high cost of transportation, difficulties in accessing market information, lack of viable and cheap post-harvest technology that results in post farm gate losses due to perishable nature of agricultural products.

Spatial market integration of agricultural products has been widely used to indicate overall market performance (Faminow and Benson, 1990). In spatially integrated markets, competition among arbitragers will ensure that, a unique equilibrium is achieved where local prices in regional markets differ by no more than transportation and transaction costs. Thus, Information of spatial market integration, thus, provides indication of competitiveness, the effectiveness of arbitrage, and the efficiency of pricing (Sexton *et al.*, 1991). If price changes in one market are fully reflected in alternative market, these markets are said to be spatially integrated (Goodwin and Schroeder, 1991). Prices in spatially integrated markets are determined simultaneously in various locations, and information of any change in price in one market is transmitted to other markets (Gonzalez-Rivera and Helfand, 2001). Non-integrated markets may convey inaccurate price signal that might distort producers' marketing decisions and contribute to inefficient product movement (Goodwin and

Schroeder, 1991), and traders may exploit the market and benefit at the expense of producers and consumers. In more integrated markets, farmers specialize in production activities in which they are comparatively proficient, consumers pay lower prices for purchased goods, and society is better able to reap increasing returns from technological innovations and economies of scale (Vollrath, 2003).

The rising global food prices pose serious threats to political and economic stability especially to the developing countries. There have been riots in Burkina Faso, Cameroun, Egypt, Indonesia, Cote d'Ivoire, Mauritania, Mozambique, Senegal and Zimbabwe among others where food prices had risen by 65 % from 2008-2013. World Bank has identified 33 countries at risk of public disorder on account of soaring food prices (Taru 2014). According to Akpan and Udoh (2009), agricultural commodities price has experienced unprecedented fluctuations and continuous increases since 2002 until mid-2008, They argued that this has brought about price volatility, food inflation, poverty and hunger, coupled with inadequate market price transmission and 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.

Sustainability of agricultural activities is hinged on effective market 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 (International Monetary Fund (IMF), 2010; Akpan, *et al*., 2014). The volatility in price of agricultural commodities especially cowpea 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 shocks such as flood, pests, diseases, and inappropriate response by farmers to price signals (Gilberts, 1999; Udoh and Sunday, 2007; Adebusuyi, 2009).

Hence, agricultural commodity price 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. It could also increase poverty level among low income earners in the society (Polaski 2008). The extent of uncertainty caused by price inefficiency and instability in the agricultural sector has made the industry a risky one. Therefore, there is the need to examine the integration between different markets in relation to competitiveness, effectiveness of arbitrage and pricing efficiency in agricultural products marketing in Nigeria

Materials and Methods

Study Area

The study was carried out in Adamawa and Taraba States being among the principal producing and marketing states of cowpea in Nigeria. Adamawa is a state in Northeastern Nigeria. The state is located between latitudes 9°20′N and 12°30′E, and longitudes 9.33°N and 12.5°E and it has total land area of about 36,917 km^2 (14,253.7 Sq Km). It shares boarder with Borno state to the Northwest, Gombe to the West, Taraba state to the Southwest and Cameroon to the East. Topographically, it is a mountainous land crossed by the large river valleys - Benue, Gongola and Yedsarem. The valleys of Cameroon, Mandara and Adamawa mountains form part of the landscape (Adebayo, 1999).

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, 1999). Taraba State is bounded in the west by Nasarawa and Benue States, Northwest by Plateau State, North by Bauchi and Gombe States, Northeast by Adamawa State, it also shares an international boundary on the East, which separates Taraba State from the Republic of Cameroun (Adebayo, 1999).

Sampling Procedure/Techniques

Purposive and multistage 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 Adamawa and Taraba States purposely due to their relative importance in cowpea production and market arrival. In the second stage was purposive selection of agricultural Zones, in the third stage was selection of Local Government Areas purposely, and while in the fourth stage was purposive selection of markets. Adamawa State has been divided in to four agricultural zones based on soil, climate and vegetation by Adamawa Agricultural Development Programme. These zones are zone I, II, III and IV. The production and marketing of cowpea is mainly concentrated in zone I, II and III of the State. The study only concentrated on the main producing and marketing of areas. In this regard Zone I, II and III were purposely selected because of their importance in cowpea production and market arrival. Furthermore, two LGAs from zone I and II, and one LGA from zone III were purposely selected thereby making the total of five (5) LGAs due to their relative importance in cowpea production and market arrival. Lastly, one main cowpea market from each selected Local Government Area was purposely selected making a total of five (5) markets. 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 on the basis of cowpea market arrival. 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 also purposely selected making a total of five (5) markets for the study as illustrated below.

Sources and Methods of Data Collection

Secondary data was used for the study; it comprises of monthly prices/100kg of cowpea markets prices/100kg was obtained from Agricultural Development Programme (ADP) office, Ministry of Agriculture and the State Planning Commission for a period of 5 years (2013-2017). The reliability of the price series from the State Planning Commission was assumed to be high coupled with the fact that, it is the only information available on cowpea marketing.

Analytical Techniques

Inferential statistics were used as analytical tools. This involved the use of Dickey Fuller (DF) Test, Johansen Co-integration Model and Granger Causality Tests Vector Error Correction Model.

Dickey Fuller (DF) test

Dickey fuller test was used to test the stationarity of 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

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. 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 [$=\beta1/(1-\rho)$] in the case of (2), and that Y_t is 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 DF or MacKinnon critical tau values, 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, we do not reject the null hypothesis, where the time series is non-stationary. Therefore, we accept the null hypothesis if the trace statistic is less than 5% critical value and vice-visa.

Johansen Co-integration Model

Johansen Co-integration model was used to determine the degree of integration between the selected market pair. In this study, the Johansen co-integration procedure was used because of its obvious advantages over the Engle procedure. The advantage is that, the Johansen's procedure enables the testing for estimation of more than one co-integrating relationships and also permits testing for the validity of any restrictions on co-integrating relationships implied by economic theory *(*Silvapulle and Jayasuriya, 1994).

Conceptual Model Specification

The general form of the Johansen's model was estimated for the Adamawa state and Taraba state markets' prices of cowpea can now be presented as follows:

If X_t denotes an $nx1$ unrestricted vector auto regression (VAR) in the levels of the non-stationary *I(1)* prices being considered, then:

$$X_t = \mu + a_1 X_{t-1} + a_2 X_{t-2} + \cdots + a_p X_{t-p} + E_t$$
$$= \mu + \sum_{i=1}^{p} a_i X_{t-i} + E_t \qquad \textbf{(4)}$$

where;
X_t is a *px1* vector of prices;
X_{t-1} is a *px1* vector of the ith lagged values of x_t;
μ is a *px1* vector of constants;
αi is a *pxp* matrix of unknown coefficients to be estimated;
P is the lag length; and

E_t is a *px1* vector of identically and independently distributed error terms with zero mean and contemporaneous covariance matrix, *E(EE)= Ω.*

By subtracting X_{t-1} from both sides of equation (3.2) and using I to represent a *pxp* identity matrix, we obtain

$$\Delta X_t = \mu + (a_1 - 1)\Delta X_{t-1} + (a_2 + a_1 - 1)X_{t-2} + \cdots + a_p X_{t-p} + E_t \qquad \textbf{(5)}$$

Also, adding and subtracting (α_1 $^{\alpha}{}_{+}$ α_2 $^{\alpha}1$) X_{t-3} to the right-hand side of equation (3.3) results to the relation in equation (3.4) as follows:

$$\Delta X_t = \mu + (a_1 - 1)\Delta X_{t-1} + (a_2 + a_1 - 1)X_{t-2} + (a_3 + a_2 + a_1 - 1)X_{t-3} + \cdots + a_p X_{t-p} + E_t \quad \textbf{(6)}$$

If the process is continued in this way, we arrive at equation 3.5.

$$\Delta X_t = \mu + \zeta_1 \Delta X_{t-1} + \cdots + \zeta_{p-1}\Delta X_{t-(p-1)} + \Pi X_{t-p} + E_t = \mu + \sum_{i=1}^{p-1} \zeta_i \Delta X_{t-i} + \Pi X_{t-p} + E_t \quad \textbf{(7)}$$

where;

$$\zeta_i = -\left(I - \sum_{i}^{i=1} \alpha_i\right), \text{ for } i = 1, 2, \ldots, p-1; \quad \Pi = -\left(I - \sum_{i}^{i=1} \alpha_i\right);$$

And X_{t-1} =(*pxp*) vector of X_{t-1} in first differences, for j = 1,2, …, p-1; X_t is a *px1* vector of prices;
X_{t-1} is a *px1* vector of the ith lagged values of X_t;
μ is a *px1* vector of constants;
P is the lag length; and
E_t is a *px1* vector of identically and independently distributed error terms with zero mean and contemporaneous covariance matrix, $E(EE)= \Omega$. It follows that the VAR (p) has been transformed into an ECM (p) with an error correction component, $\prod X_{t-p}$. Follows that the VAR (p) has been transformed into an ECM (p) with an error correction component $\prod X_{t-p}$. The matrix $\prod$ is of primary interest in equation (3.5) for two main reasons: The rank of *rank* ($\prod$) , is used to determine existence or otherwise of co-integration or long-run relationships between the variables – if the *rank* ($\prod$) = 0 , the variables are not co-integrated and the model is equivalent to a VAR in first difference; if 0 < *rank* ($\prod$) < *n* , the variables are co-integrated; and if *rank* ($\prod$) = *n* , the variables are stationary and the model is equivalent to a VAR in levels (Chang, 2000); The $\prod$ represents a product of two matrices α and β b or ($\prod = \alpha\beta'$), where β is the matrix of the cointegrating relationship. If $\beta X_t = 0$, the system is in equilibrium; otherwise, βX_t is the deviation from the long-run equilibrium, or the equilibrium error, which is stationary in a co-integrated system (Johansen and Juselius, 1990; Johansen, 1988).

The *a* is the matrix of speed of adjustment coefficients that characterizes the long run dynamics of the system. If *a* has a large value, the system will respond to a deviation from the long run equilibrium with rapid adjustment. Contrarily, if it has a small value the system will respond with slow adjustment to a deviation from the long-run equilibrium. At times the value of α = 0 for some system equations imply that the corresponding variable is weakly exogenous and does not respond to equilibrium error. At least one must have a non-zero value in a co-integrated system (Chang, 2000).

In view of the aforementioned concept, Johansen Maximum Likelihoods procedure for testing co-integration was proposed (Johansen and Juselius, 1990; Johansen, 1988). The procedure involves pre-testing the order of co-integration in individual series, determining the lag length for the ECM; and estimating the ECM and determining the rank of Π. The presence of a cointegrating relation would form the basis of the VEC specification. Therefore, we can say that there is cointegration between the market pairs because the trace statistics is greater than critical value (0 < *rank* (∏) < *n*) of the equation. We therefore, accept the alternative hypothesis, which state that there is co-integration between the market pairs.

Granger Causality Tests

The granger causality test was used to determine the leading market price of cowpea Adamawa and Taraba states. Granger causality provides additional evidence as to whether, and in which direction, price integration and transmission is occurring between two price series or market levels. This is because one granger causal relationship must exist in a group of co-integrated series (Chirwa, 2000). When granger causality run one way (uni-directional), the market which granger causes the other is tagged the exogenous market. Exogeneity can be weak or strong. Weak exogeneity occurs when the marginal distribution of $X_{i(t-1)}$ and $X_{j(t-1)}$ are significant, while strong erogeneity occurs when there is no significant granger-causality from the other variable. It could also be bi-directional which indicates that both series influence each other (e.g., X causes Y and Y also causes X).
The granger model used in this study is represented as:

$$RP_t = \alpha_0 + \sum_{i=1}^{m} \alpha_i UP_{t-i} + \sum_{j=1}^{m} \beta_j RP_{t-j} + e_t \qquad \textbf{\textit{(8)}}$$

where:
n = number of observation.
m = number of lag.
RP_t = Adamawa State market prices [Sabon kasuwa Mubi (AD1), Maiha main Market (AD2), Sabon kasuwa Gombi (AD3), Dumne market (AD4) and Jambutu market (AD5)].UP_t = Taraba State market prices [Zing market (TA1), Jalingo main Market (TA2), Iware market (TA3), Mararaban Gassol Market (TA4) and Garba Chede Market (TA5)].
α and β = parameters to be estimated.

To prove the existence of causality, an F-test, which is equivalent to the Wald Test, was used. It is expressed as:

$$F_{UP_t \rightarrow RP_t} = \frac{(SSE_r - SSE_u)/m}{SSE_u/(n-2m-1)} \sim F_{[m,(n-2m+1)]}(\alpha) \qquad \textbf{\textit{(9)}}$$

where;

SSE_r is the sum of squared errors of equation with restricted coefficients of lagged *UP* (that is to say that coefficients are set to zero);
SSE_u is the sum of squared errors of the unrestricted form of the equation, is the critical value;
n is the number of observations; and
m is the number of lags.

Error Correction Model

Error correction model was used to estimate the speed of adjustment and price transmission of integrated markets in the short and long run.

The study hypothesizes that both Adamawa and Taraba state markets' prices of cowpea are jointly and endogenously determined. The implicit representation of the model with two endogenous variables without an exogenous variable is expressed as:

$$X_t = (\ln\_RP_t,\ \ln\_UP_t) \quad (10)$$

Where *Xt* is as earlier defined, *ln-RPt* and *ln-UP*$_t$ natural logarithm values of the Adamawa and Taraba states market prices of cowpea. Given the VECM of equation above, the long- run cointegrating equation can be specified explicitly for the markets as:

$$\ln\_RP_t = \varphi_0 + \varphi_1 \ln\_UP_t + v_t \quad (11)$$

where;

φ_0 = is the log of a proportionality coefficient, is a constant term capturing transportation and other forms of cost;

φ_1 = is a long run static coefficient depicting the relationship between the Adamawa and Taraba states market prices; and

V_t = is the random error term with the standard assumptions.

If 1=0 there is no relationship between the Adamawa and Taraba states market prices; if 0< 1<1 there is a relationship, but the relative price is not constant, meaning that the goods will be imperfect substitutes; if 1=1 there is relationship with constant relative price, meaning that the "Law of One Price" holds and goods are perfect substitutes. Equation (3.8) describes a case where prices adjust immediately. If, however, a dynamic adjustment pattern is expected in prices, it will be accounted for by introduction of lags of the two prices, but even at that, the long-run relationship between prices take the same form depicted in equation (3.11) above (Asche *et al*., 2005).

$$\Delta RP_t = \psi_{10} + \sum_{i=1}^{p} \psi_{11i} \Delta RP_{t-i} + \sum_{i=1}^{p} \psi_{12i} \Delta UP_{t-i} - \rho(RP_{t-1} - UP_{t-1}) + v_{1t} \quad 12$$

$$\Delta UP_t = \psi_{20} + \sum_{i=1}^{p} \psi_{21i} \Delta RP_{t-i} + \sum_{i=1}^{p} \psi_{22i} \Delta UP_{t-i} - \rho(RP_{t-1} - UP_{t-i}) + v_{2t} \quad 13$$

where;

RP_t and UP_t are Adamawa and Taraba states markets prices of cowpea respectively, as earlier defined

Δ is the difference operator,

Ψ_{10} and Ψ_{20} are constant

Ψ_{11} and Ψ_{22} are the short-run coefficients,

ρ is the error-correction instrument measuring the speed of adjustment from the short-run state of disequilibrium to the long-run steady-state equilibrium; and

v_t is an error term assumed to be distributed as white noise.

Therefore, short run relationship can be determined if the significant level is not more than 5% and long run is determine if the P value of one or both markets is significant at any level.

Results and Discussion

Unit Root Test Result

Stationarity Tests for Price Series Integration tests concerns with the stationarity of any time series. Stationarity means that the stochastic properties of a time series i.e. mean, variance of the mean and covariance of the mean are constant and do not vary with time. Most economic time series data are not stationary because the mean of the series changes with time as a result of inflation or seasonality.

The unit root test results are presented in Table 4.1 using dickey fuller (DF) test. 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 due to urbanization of the area. 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 difference, 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 and Taraba states contained unit root, meaning that the price series is non-stationary. Therefore, this study is in consonant with Zalkuwi *et al.* (2015) who reported unit root in the two markets; no stationarity between the 2 markets at $P<0.01$ level of significance at level. But after first difference there was stationarity in the series at $P<0.01$ level of significance. This is in disagreement with the study of Adesola and Rahji (2015) who revealed that all price series in the states were stationary at level I (0) at $P<0.01$ except for Abia state at $P<0.05$ monthly price series in the states were all non-stationary.

Table 4.1: Unit Root Test Result for Cowpea Market

Variables	At level Test Stat.	At first difference Test Stat.	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
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

**5% significant level

Source: Computed Result (2018)

Johansen Co-integration Test Result

Johansen co-integration test addresses existence of relationship among the market pairs. Based on trace test likelihood ratio are presented in Table 2. From the result, the likelihood ratio it indicated that there are three (3) co-integrating equation at $P<0.05$ that is there are three stochastic trends. The number of co-integrating equations signifies the strength and stability of price linkages among markets. We therefore, reject the null hypothesis which states that, there is no co-integration between the market pairs. This is because calculated trace statistics are greater than the critical values of $P<0.05$ in these four equations.

On the whole, the results of Johansen co-integration tests indicate that Adamawa and Taraba states cowpea markets are integrated but the level of integration is low due to the inefficient free flow of market information to keep market participants well informed regarding current demand, supply and prices between the states. This indicated that the relationship between the Adamawa state cowpea market and that of Taraba state is weak. This study agrees with Ifejirika *et al.* (2013) and Zalkuwi *et al.* (2015) who revealed that trace statistics values are higher than the corresponding critical value at 5% significance level. So, there is a co-integration between the markets, there is at most 1 co-integration between the two markets. But disagrees with the study of Akanni (2013) who reported a strong relationship between the wholesale and retail prices of food grains markets in Ogun State of Nigeria. Also, this study disagrees with that of Adesola and Rahji, (2015) who stated that there exists strong and stable price linkage in onions markets as the price in one market can be used to predict other market prices in Nigeria.

Table 2: Johansen Co-integration Result for Cowpea Market Pairs

Max. Rank	Parms	LL	Eigenvalue	Trace Stat.	5% Critical value
0	110	-2479.4359	.	351.0484	233.13
1	129	-2431.372	0.80936	254.9207	192.89
2	146	-2388.8729	0.76903	169.9226*	156.00
3	161	-2361.4687	0.61131	115.1141	124.24
4	174	-2339.9643	0.52362	72.1054	94.15
5	185	-2324.9853	0.40341	42.1472	68.52
6	194	-2316.768	0.24675	25.7126	47.21
7	201	-2311.4205	0.16839	15.0178	29.68
8	206	-2306.5573	0.15439	5.2913	15.41
9	209	-2304.0996	0.08126	0.3758	3.76
10	210	-2303.9117	0.00646		

Source: Computed Results (2018).

Granger Causality Result

Table 3 shows the pairwise granger causality of cowpea. The result showed that out of the 10 cowpea markets links investigated for evidence of granger causality, the result of Granger Causality revealed that Adamawa state cowpea markets causes granger over Taraba state cowpea markets at $P<0.1$ level of significance. Hence, it occupied the leadership position in price formation and transmission. This implies that Adamawa state cowpea market is the leading market and therefore, any change in the price of cowpea in Adamawa state influences the price of cowpea in Taraba state this may be due to adequate free flow of cowpea and information between the market's pairs. This study is in consonant with the study of Adesola and Rahji (2015) reported that Kebbi state granger cause Abia, Lagos, Rivers, while Sokoto granger cause Abia and Oyo. Market prices in Kebbi and Sokoto States influence other consuming states because they are the producing states and Sunday *et al.* (2014) who revealed that all the adjustment were done by rural price of rice in Akwa Ibom state. But disagreed with the study of Ojo *et al.* (2015) who indicated that no market erned exclusively a leading position in Kwara State.

Table 3: Granger Causality Wald Tests

Equation	Excluded	X^2	df	Prob.
RP_t	$\longrightarrow UP_t$	4.8787	2	0.087 *
UP_t	$\longrightarrow RP_t$	0 .39124	2	0.822

***, ** and * implies statistics are significant at 1%, 5% and 10%, respectively

Source: Computed Results (2018)

Speed of Adjustment and Price Transmission of Integrated Markets in the Short Run and Long Run

The speed of adjustment is determined by the long-run parameter estimates or estimated adjustment coefficients given as -0.2799 and 0.0089 and P values of 0.005 and 0.779 for Adamawa and Taraba states markets' prices equations, respectively. Based on the adjustment coefficients, Adamawa State cowpea price appears to respond or adjusted faster relative than the Taraba state price due to changes in demand and supply, suggesting that the Taraba state is weakly exogenous. The adjustment coefficient of RP_t is statistically significant at P<0.01 but not significant for the UP_t. Therefore, there is long-run relationship at 1% level of significant among the markets since the significant level is not more than 5%, indicating that Adamawa state market price influences Taraba states market prices in the long-run.

On the other hand, the result of the short-run test indicated that, the Adamawa state and Taraba state price of cowpea have a short-run value of 0.0340. The result revealed that there is short-run relationship among the markets pairs at 5% significant level. Therefore, we reject null hypothesis and accept alternative hypothesis which states that, there is short-run relationship among the markets. Traders operating between these states could easily form correct expectation about price changes and this would help them in taking proper decisions on the volume and time of purchase of cowpea and therefore, minimizing the problem of price uncertainty. This study agrees with the studies of Zalkuwi *et al.* (2015) revealed a long run relationship among the markets between the two markets of sorghum. it indicates absence of long run causality running market Bangalore to market Sholapur in India and Ibrahim (2013) who revealed ashort run and long run integration between cowpea markets in the Production region (i.e., Kontagora X1), Consumption region (Bida X4) and Transitory region. (Sabon Wuse X5) and also between the two markets from the Transitory regions (i.e. Sabon Wuse X5 and Mokwa X6) in Niger State, but disagree with the study of Zalkuwi *et al.*, (2015) who reported lack of short run causality running from market Bangalore to market Sholapur in India.

Table 4: Result of Vector Error Correction for Speed of Adjustment and Long-Run Estimates for Cowpea

Variables	Coef.	Stad. Error	P-value
RP_t	-0.2799	0.9998	0.005***
UP_t	0.0089	0.0319	0.779

***, ** and * implies statistics are significant at 1%, 5% and10%.
Source: Computed Results (2018).

Table 5: Short Run Model

Variables	**chi2**	**Prob.**
RP_t and UP_t	10.42	0.0340**

***, ** and * implies statistics are significant at 1%, 5% and10%.
Source: Computed Results (2018)

Conclusion

Based on the analysis of the study, it is concluded that price series were not constant but after first differencing, all the price series became constant and there is co-integration between Adamawa state cowpea market and Taraba state cowpea market, but the degree of co-integration is low due to lack of efficient free flow of price signal or information between the market pairs. This implied that there is weak relationship between the variables in the system.

Recommendations

Based on the conclusion, recommendations were advanced for cowpea markets to be perfectly integrated in future. They include:

1. 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.
2. 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.
3. Market information dissemination through media outlets and extension service delivery about current demand, supply and price signal should be established by government and NGOs to keep market participants informed regarding current demand, supply and prices from various markets so as to help increase market integration level through increased speed of price transmission.
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 costs and bring about insignificant price differential among cowpea markets in the states.

5. There is also, a strong need for private organizations and the government through the marketers of cowpea to provide more and better dissemination of market intelligence and information among the farmers and traders to improve knowledge which would help combat supply uncertainty and reduce risk associated with inter-market trade and provide means of storing cowpea and in times of surplus.
6. To stabilize price of the 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.

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