



MARKET INTEGRATION ANALYSES OF COWPEA (*Vigna unguiculata* [L] Walp) IN SELECTED LOCAL GOVERNMENT AREAS OF GOMBE STATE, NIGERIA

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ABSTRACT

The study analyses market integration of cowpea (*Vigna unguiculata* [L.] Walp) in selected Local Government Areas of Gombe State, Nigeria. Secondary data were obtained on monthly average retail prices per 100kg bag of Cowpea for the period 2012 – 2019 from Bureau of Statistics, Gombe State. Data collected were analyzed using Augmented Dicky Fuller test, Engel and Granger test and pairwise Granger causality test. Augmented Dicky Fuller test indicates that the price series were non stationary at levels, but at first differencing the price series were integrated of order I(1). Engel and Granger two step cointegration test results revealed a coefficient of 0.54 and 0.34 for Billiri and Yamaltu Deba respectively. The value of R^2 was high at 71.09%. The residual base test results indicated an Engle-Granger tau-statistic of - 3.333168 with P-value of 0.14 at 5% level of probability. It was also established that the price series data for Billiri market was the price leader. The study concluded that the price series were non-stationary at levels, but at first differencing the price series were stationary and integrated of order I(1). Only unidirectional causal relationship exists between price series data for Billiri and Gombe, Billiri and Yamaltu/Deba, Gombe and Yamaltu/Deba. It was recommended that policy by stakeholders should therefore be market specific addressing the needs of each market, improvement of existing markets functions through enhanced access to market information, the establishment of market infrastructure including physical buildings, road networks and storage facilities at low cost.

Keywords: Cowpea, Price, Market, Stationarity and Co-integration

INTRODUCTION

The need for the market system to be well structured and efficiently organised cannot be over emphasized. It enhances the pace of economic development by encouraging specialisation, generation of foreign exchange earnings, development of an exchange economy, provision of income and employment opportunities for marketing agents (Olukosi *et al.*, 2005). Such a system would enable producers, middlemen and consumers in the marketing chain to derive maximum gains. It would also help in elimination of unprofitable arbitrage and isolation of spatially differentiated markets and would ensure that efficient allocation of resources across space and time is achieved (Nkang *et al.*, 2007). A market is a place where parties can gather to facilitate the exchange of goods and services, the parties involved are usually buyers and sellers (Kenton, 2021). Thus, a market refers to an arrangement whereby buyers and sellers come in close contact with each other directly or indirectly to sell and buy goods and services. Agricultural marketing on the other hand as defined by Mohammed (2019) is the performance of all business activities involved in the flow of agricultural products and services from the initial points of agricultural production until they reach the hands of the ultimate consumers. In a market base economy, prices play a very important role of equilibrating, allocative, and rationing purposes. Agricultural product prices in such an economy are determined by the interaction of demand and supply as there is no visible hand that makes economic decisions. In a mixed economy however, both the government and price mechanism play vital roles (Haji, 2014). In theory, spatial price determination models suggest that, if two markets are linked by trade in a free market regime, excess demand or supply shocks in one market will have an equal impact on price in both markets. Within this context, complete price transmission between two spatially separated markets is defined as a situation where changes in one price are completely and instantaneously transmitted to the other price, as postulated by the Law of One Price (LOP), (Taru, 2014). A market is



said to be integrated if there is perfect transmission of price through time and space. A farmer's production plan is governed by the price expectations of the various prices of commodities in the coming season or off season and/or prices of commodities in the previous season and/or previous off season. The results of this study will throw more light on the market performance and other marketable qualities of cowpea within and between markets under study.

The study examined the analyses of market integration of cowpea in the study area. The specific objectives of the study were to: test for stationarity of price series, determine the cointegration of the price series by estimating the extent and direction of market integration, establish the price leader between the markets selected and examine policy implications based on the study.

METHODOLOGY

The Study Area

Gombe State is located in the Sudan Savannah region of Nigeria. It lies on longitudes 9° 30' E and 12° 30' E and latitudes 8° 45' N and 11° 45' N and has a land area of 18,768 square kilometre with a projected population of 3,772,2389 persons from population of 2,365,040 as at 2023 based on National Population Commission (NPC) (2006) census, (Federal Republic of Nigeria (FRN) (2009). The surface soil is free draining sandy loam which are suitable for cereals and legumes. The climate is hot and dry, it experiences an alternating dry and wet season. The rainy season begins mostly from May/June and ends at September/October. Average annual rainfall of 850mm and maximum shade temperatures of 104°F has been recorded around April with humidity as low, varying from 20-30%. Average temperature is warm, not exceeding 30°C (Gombe State Ministry of Finance and Economic Development, (GMFED), 2006; NPC, 2006). The main occupation of the people is farming, some major crops grown include cowpea, groundnut, maize, millet among others, cattle, goat and sheep are commonly reared (GMFED, 2006). Gombe LGA, a market consuming community is multi-ethnic, mainly made up of Bolewa, Fulani, Tangle, Tera, Tula and Waja and it is mainly urban and a consumer settlement. Yamaltu-Deba and Billiri LGA's are both known for their high production and marketing of Cowpea (GMFED, 2006; NPC, 2006). Gombe LGA is an urban market and considered as the reference market Billiri and Yamaltu-Deba LGAs are rural markets and considered as supplying markets.

Sampling Procedure

A multi-stage sampling procedure was employed for the study. The first stage involved the purposive selection of Gombe State being known for cowpea production and marketing. The second stage also involved purposive selection of three Local Government Areas (LGAs), one from each of the three zones of Gombe State namely; Billiri from south, Yamaltu-Deba from central and Gombe from north that are prominent for cowpea production and marketing. **Method of Data Collection** Secondary data were used in this study. The data was obtained from Bureau of Statistics, Gombe State. The type of secondary data were time series data for monthly average retail prices per 100kg bag of Cowpea from the sampled markets (Billiri, Gombe and Yamaltu Deba markets) of Gombe State for the period 2012 – 2019. A total of 94 monthly average retail prices per 100kg bag of Cowpea were used for this study.

Method of Data Analysis

The Augmented Dickey-Fuller (ADF) test was used to test for stationarity while Engel and Granger test was employed to estimate the extent and direction of market integration and Granger causality test was used to show the association between time series variables (Lamarana, 2024). The test was performed using EViews 13 Statistical software.

Test of Stationarity

The price series in this study was tested for stationarity using ADF test. When a series is non-stationary, it requires transformation to avoid errors in estimation, therefore it is recommended to perform the ADF test (Jena, 2016). It is presented by the general formula as adopted from Bor (2020).

$$\Delta Y_t = \beta_1 + \beta_2 + \delta Y_{t-1} + \sum_{i=1}^m \alpha_i \Delta Y_{t-1} + \varepsilon_t \quad \dots(1)$$



where, Y_t = price series of a given market at time t

t = length of time series

β_1 = constant

β_2 = coefficient of linear time trend

δ = parameter of interest

$Y_{(t-1)}$ = price in a given market in the previous year

m = number of lags to be included in the model

α_i = coefficient of the $\Delta Y_{(t-1)}$

ε_t = random error term

Δ = differential

(Bor, 2020)

The guiding hypotheses for this test was; H_0 : price series data are non-stationary

Engel and Granger Test

This technique was used to estimate the extent and direction of market integration as adopted from Bor (2020). The technique analyses spatial market integration in a context of short run price deviations that level up in the long run. The guiding hypothesis for this test was; H_0 : there is no co-integration between the markets.

The co-integration regression equation can be presented as:

$$P_{t1} = \beta_0 + \beta_1 P_{t2} + \varepsilon_t \quad \dots(2)$$

where; P_{t1} = the price at the j th market at time t

P_{t2} = the price at the i th market at time t

β_0 = constant term

β_1 = co-integration parameter

ε_t = random error term with constant variance

(Bor, 2020)

Granger Causality Test

Prices in one market are regressed on the lagged values of the other markets. It handles pairs of time series variables and determines the leader and the follower role of the markets (Chalil, 2016 & Lamarana, 2024). The test was done within the framework of Vector Autoregressive (VAR) to test the hypothesis P_{t2} causes P_{t1} . This tests the price transmission within the selected markets (Rapsomanikis *et al.*, 2006). The guiding hypotheses for this test was; H_0 : there are no causal relationships in the cowpea market

Vector Error Correction Model (VECM)

It estimates the speed at which prices adjust to the long run equilibrium (Chalil, 2016). This speed is essential since it measures the extent of market integration in the short run, dynamics of price relations and the speed of adjustment over time, (Rapsomanikis *et al.*, 2006). The general formula of VECM can be presented as adopted from Bor (2020) as follows:

$$\Delta Y_{it} = \alpha_i + \sum_{j=1}^n \theta \Delta Y_{jt-1} + y_i \varepsilon_{it} + \varepsilon_t \quad \dots(3)$$

where, ΔY_{it} = first difference of price series

Y_{jt} = price series in the second market

y_i = Speed of adjustment

ε_{it} = residual

ε_t = error term of residual

θ = short run dynamics

(Bor, 2020)

The hypotheses tested by the model was; H_0 : error correction term equal to zero

RESULTS AND DISCUSSION

Test for Stationarity

Table 1 shows the results at levels, for price series in Gombe, the P-values were 0.1250, 0.4395 and 0.5032 for the models with intercept, trend and intercept and with no trend or intercept respectively. Since all the resulting P-values are greater than the significance level at 1%, 5% and



10%, the null hypothesis (price series is non-stationary) is accepted. For price series in Billiri (Table 1), the P-values obtained at level were 0.1324, 0.3318 and 0.4370 at intercept, trend and intercept, with no trend or intercept respectively. The P-values are greater than 1%, 5%, and 10% significance level. We can deduce that prices in Billiri are non stationary in levels at the three models at 1%, 5% and 10% probability. For the price series in Yamaltu-Deba (Table 1), P-values of 0.0829, 0.0642 and 0.4409 were obtained at intercept, trend and intercept and with no trend or intercept respectively. This indicated that price series in Yamaltu-Deba are non stationary at 1% and 5% level of significance in all the three models, but at 10% level of significance, price showed some evidence of stationarity for the models with intercept and trend and intercept. Whereas, for the model with no trend or intercept, prices were non stationary. Table 1 also showed the results of the first differencing of the price series. Since all P-values are resulting zero for all the price series (Gombe, Billiri and Yamaltu Deba) at all the three models (intercept, trend and intercept and with no trend or intercept), we reject the null hypothesis (price series are non-stationary). The results indicated that at first differencing, the price series are stationary and integrated of order I(1). The results are similar to that of Traore and Diop (2021), Iroegbute *et al.* (2019) and Bor (2020).

Table 1: Result of ADF Test of Cowpea Prices

		Levels		First Difference	
	Model	t.-Statistic	P-Value	t. Statistic	P-Value
Prices in Gombe	Intercept	-2.474049	0.1250	-13.3981	0.0001**
	Trend and Intercept	-2.281479	0.4395	-13.4205	0.0000**
	None	-0.485133	0.5032	-13.4648	0.0000**
Prices in Billiri	Intercept	-2.445135	0.1324	-9.31916	0.0000**
	Trend and Intercept	-2.491225	0.3318	-9.30074	0.0000**
	None	-0.641207	0.4370	-9.3691	0.0000**
Prices in Yamaltu Deba	Intercept	-2.670969	0.0829*	-8.40456	0.0000**
	Trend and Intercept	-3.352999	0.0642*	-8.43335	0.0000**
	None	-0.632096	0.4409	-8.45105	0.0000**

Note; **Significant at 5

Source; Bureau of Statistics, Gombe State, 2022 and Author's Computation, 2023

Engel and Granger Test

A coefficient of 0.54 and 0.34 were obtained for Billiri and Yamaltu Deba, respectively which indicated that a 1% increase in prices in Billiri will cause a 0.54% increase in prices in Gombe, while a 1% increase in prices in Yamaltu Deba will cause a 0.34% increase in prices in Gombe (Table 2). A constant value of 3446.88 was obtained which is not significant at P-value of 0.067 at 5% level of significance. Furthermore, t. statistic values of 3.86 and 2.48 which are both significant at 5% level of significance with P-values of 0.00 and 0.015 for Billiri and Yamaltu Deba respectively were obtained. The value of R^2 was high at 71.09% which signifies that the model is fit and explains the percentage variation of the price series data in Gombe that is explained by the price series data of Billiri and Yamaltu Deba. The second step involved the Engel and Granger cointegration test. The results are presented in Table 2. The results indicated an Engle-Granger tau-statistic of -3.333168 with P-value of 0.1441 which are greater than 0.05. This would retain the acceptance of the H_0 : there is no co-integration of price series and conclusion is made that there is no interdependence in the markets. Engle and Granger Test Equation showed that the $P < 0.05$, 0.0012 and 0.0001 for the residuals and differencing of residuals, respectively, implying that the residuals are stationary. This indicated that the regression is not spurious. The results are similar to the finding of Bor (2020) but contradicts the findings of Venujayakanth *et al.* (2017), Sunga (2017), Traore and Diop (2021).



Table 2: Result of Engel and Granger Cointegration Test

Variable	Coefficient	STD Error	t-statistics	Probability
Fully Modified Least Square Method (FMOLS)				
Billiri	0.536624	0.138879	3.863977	0.0002**
Yamaltu Deba	0.341829	0.137641	2.48348	0.0148**
Constant	3446.884	1860.544	1.852621	0.0671NS
R-squared	0.710911	3702.136		
Adjusted R-squared	0.704626			
Engel and Granger Cointegration Test				
Tau-statistics	-3.333168			0.1441NS
Z-statistics	-21.85088			0.0863NS
Engel and Granger Test equation				
Residual	-0.324344	0.097308	-3.333168	0.0012**
D(Residual)	-0.395292	0.095355	-4.145494	0.0001**
Durbin Watson statistics	2.071524			

Note; ** Significant at 5% NS=Not significant at 5%, STD=Standard

Source; Bureau of Statistics, Gombe State, 2022 and Author's Computation, 2023

Granger Causality test

A Granger Causality test was conducted and the results obtained are displayed in Table 3. It was observed that only unidirectional causal relationships exist between the market pairs, (Billiri Granger cause Gombe, Billiri Granger cause Yamaltu-Deba and Gombe Granger cause Yamaltu Deba) with F-statistics probability values of 0.012, 0.002 and 0.003 at 5% probability, respectively. Whereas, the null hypothesis that Gombe does not granger cause Billiri, Yamaltu Deba does not Granger cause Billiri and Yamaltu Deba does not Granger cause Gombe were accepted at 5% probability with F-statistics probability values of 0.617, 0.311 and 0.933, respectively. It can be deduced that short run unidirectional causal relationship exists between price series data for Billiri and Gombe, Billiri and Yamaltu Deba, Gombe and Yamaltu Deba while no short run causal relationship was observed between Gombe and Billiri, Yamaltu Deba and Billiri, YamaltuDeba and Gombe. The result also revealed that price series data for Billiri as a price leader whose price changes influenced the other prices. The results concur with that of Iroegbute *et al.* (2019).

Table 3: Result of Granger Causality Test

Null Hypothesis	F-statistics	Probability
D(Gombe) does not Granger cause D(Billiri)	0.8232	0.6174NS
D(Billiri) does not Granger cause D(Gombe)	2.5116	0.0112**
D(YamaltuDeba) does not Granger Cause D(Billiri)	1.1927	0.3113NS
D(Billiri) does not Granger cause D(YamaltuDeba)	3.1115	0.0022**
D(YamaltuDeba) does not Granger Cause D(Gombe)	0.4361	0.9335NS
D(Gombe) does not Granger cause D(YamaltuDeba)	2.9938	0.0030**

Note; ** Significant at 5% NS=Not significant at 5%,

Source; Bureau of Statistics, Gombe State, 2022 and Author's Computation, 2023

Vector Error Correction Model (VECM)

The VECM is applicable when the variables are co-integrated and follow a random walk (Minot, 2011). When two variables are not cointegrated, it implies there is no long run relationship and any regression model formed thereafter is spurious and the result is meaningless (Bor, 2020). Since from the cointegration analysis, we found no integration existing in the local markets, conducting the VECM is not necessary. The absence of integration means that the markets are not linked by competitive arbitrage. Implying that each market determines its price.



Policy Implication

The results indicated that at first differencing, the price series are stationary and integrated of order I(1). However, further analysis using the Engel and Granger cointegration and granger causality tests, it was observed that there is no long run equilibrium to which prices respond. In designing policies this is a crucial consideration since existence of correlation in the markets means that policy changes in one market would have a similar effect on all the other markets (FAO, 2010). The absence of causal relations means that demand and supply in each of the markets are unique. Policy should therefore be market specific addressing the needs of each market. The goals could include improved market access by both producers and consumers. One policy option is the improvement of existing markets functions. Since market efficiency can be improved through market integration; policy should address the issues that improve market integration.

CONCLUSION AND RECOMMENDATIONS

The study concluded that the price series are non stationary at levels, but at first differencing the price series are stationary and integrated of order I(1). The H_0 : there is no co-integration of price series was accepted. Only unidirectional causal relationship exists between price series data for Billiri and Gombe, Billiri and YamaltuDeba, Gombe and Yamaltu Deba. It was also established that the price series data for Billiri market was the price leader whose price changes influenced the prices series for Gombe and YamaltuDeba. Policy should therefore be market specific addressing the needs of each market and improvement of existing markets functions through enhanced access to market information, the establishment of market infrastructure including physical buildings, road networks and storage facilities.

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