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Analysis of Integration in the Wholesale Maize and Rice Markets in Northeast, Nigeria

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Abstract

The study investigated the analysis of integration in the wholesale maize and rice markets in Northeast, Nigeria. Secondary data on monthly basis for wholesale maize and rice price per kilogram obtained from National Bureau of Statistics website for period of 7 years (2017 – 2023) were used for the study. Purposive sampling techniques was used. Inferential statistics were used to analyze the data of the study. The study revealed that at first difference all the price series were stationary. The markets' cointegration test findings demonstrated that, despite their physical separation, they were linked in terms of price transmission over the long and short terms; nonetheless, the degree of integration is low. The results of the study indicate that one pair showed bi-directional causation, 6 and 5 links showed uni-directional in rice and maize markets respectively, also thirteen (13) and fourteen (14) pairs of rice and maize market price respectively, showed no causal relationship between them. The study showed that prices in GOMR, ADM, and YOM States adjusted to equilibrium more quickly over time than the prices in the other states. It's also suggested that a percentage increase in ADR, BORR, TAR, BORM and YOM price would lead to increase of 38.9% 23.6%, 27.1%, 30.4% and 38.2% in TAR, GORR YOR, ADM and GOMM respectively. This shows that there is short run relationship between the states in the study area. Therefore, it is recommended that, to facilitate integration, market players should invest in technology (electronic trading platforms) and standardize trading and settlement procedures. This would help to minimize operational inefficiencies across various markets.

Keywords: integration, wholesale, maize, rice and markets

INTRODUCTION

Cereal remains the primary meal in African families, but production of grains like rice, sorghum, and maize is insufficient, hence they have to be imports from Asia, America, Europe, or Australia. Africa's arable land, labor force, and favorable climate are underutilized (Adebayo and Ibraheem, 2015). Despite increasing cereal cultivation land, environmental challenges like drought, high soil salinity, diseases, pests, and poor management hinder crop yield. The traditional farming practices have done little in overcoming these challenges, therefore Traditional farming practices need to be improved using molecular and biotechnological transgenic approaches (Adebayo and Ibraheem, 2015). Global agricultural commodity prices have experienced volatility, impacting food affordability particularly during the COVID-19 pandemic. Nigeria, the largest cereal crop producer, faces negative impacts due to increased demand from rural and urban populations (Food and Agriculture

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Organization, 2017). 208 million people in sub-Saharan Africa eat maize, a staple grain that is essential to their economic and food security. Despite low average yields, it occupies 33 million hectares. Rice, a crucial staple, faces challenges due to population growth, urbanization, and changing eating habits (Harold, 2015 and Seck *et al.,* 2013).

Markets are essential for both food security and reasonable food costs, particularly in emerging nations with inadequate spatial integration (Frelat, *et al.,* 2016 and Headey *et al.,* 2019). In Nigeria, price volatility has an impact on grain production because low demand for maize drives up prices. Due to increasing demand without matching supply in the South-South area, the Buhari administration's restriction on the importation of foreign rice has resulted in higher prices for local rice (Dillon and Barrett, 2016; Hastings *et al.,* 2021).

According to Goletti, Ahmad, and Farid (2015), market integration include government policies, pricing levels, local manufacturing, and marketing infrastructure. It incorporates price shocks between markets as well as the movement of surplus demand (Ekakitie, 2013). Prices are set concurrently in many places in spatially integrated markets due to rivalry among arbitragers, which guarantees unique equilibrium (Akanni, 2013). Marketing professionals can take advantage of the market by misrepresenting pricing signals, which can cause inefficient product movement and skew companies' marketing decisions (Goodwin and Schroeder 2015).

Nigeria's food marketing system has occasionally failed to address price stability due to information asymmetry and the impact of intermediaries on the market, pricing, and food security at the local level, which is disputed. The majority of data suggests that middlemen's interference raises consumer purchasing costs while reduces producer selling prices, reducing farmer profit margins. The intermediaries also engage in temporary arbitrage, which may result in future food price hikes. In order to offer information on the long-term behaviour of the rice and maize markets across space and time, the degree of closeness of price movements, and the efficiency and speed of price transmission, research on the market integration of cereals in Nigeria is necessary. This will aid market intermediaries/participants in discovering trade opportunities throughout areas and marketplaces for effective resource allocation across distance and time, as well as any reasonable policy on agricultural commodity pricing. This will assist to reduce poverty by increasing farmers' and marketers' personal income and boosting their chances for food security.

METHODOLOGY

Study Area

The study was conducted in Northeast Nigeria. It lies between latitude 11° 32' and 11° 4' north and longitude 13° 32' and 13° 25' east and located between the Sudan Savannah and Sahel Savannah vegetation (Akinyemi, *et al.,* 2022). With a land area that makes up over one-third of Nigeria, the Northeast is the country's biggest geopolitical zone. The semi-desert Sahelian savanna and the tropical West Sudan savanna eco-regions make up the majority of the zone's environmental divisions (Akinyemi, *et al.,* 2022). Approximately 26 million people live in the region, making up 12% of the nation's overall population. The most populated cities in the Northeast are Maiduguri and Bauchi, which are also ranked fifteenth and seventeenth in Nigeria, respectively. It is well-known for its cattle and agricultural growth, both of which have a significant impact on the national economy. The region is not as densely populated as compared to the southern region of the country (Akinyemi, *et al.,* 2022).

Sources and Methods of Data Collection

Secondary data on monthly basis for maize and rice price per kilogram was used and obtained from each state ADP or Nigerian Bureau of Statistics for the period of 7 years (1/1/2018-31/6/2024).

Method of Data Analysis

Inferential statistics involved the use of Augmented Dickey Fuller (ADF) Test, Johansen Co-Integration Model, Granger Causality Test and Vector Error Correction Model.

Augmented dickey fuller test

For both theoretical and practical purposes, the stationarity series in the data was tested using the enhanced Dickey-Fuller (ADF) method. The ADF tests can be expressed as

$$\Delta P_t = \alpha_0 + \delta_1 t + \beta_1 P_{t-1} + \sum_{j=0}^{q} \beta_1 \Delta P_{t-j} + \varepsilon_t \quad (1)$$

Where

$\Delta P_t = P_t - P_{t-1}$, $\Delta P_{t-1} = P_{t-1} - P_{t-2}$, $\Delta P_{n-1} = P_{n-1} - P_{n-2}$ etc.

P = the price in each state

α_0 = constant or drift

t = time trend variable

q = number of lag length selected based on Schwartz information criterion (SIC)

ε_t = pure white error term

The test for a unit root in the price series was carried out by testing the null hypothesis that β_1 (coefficient of P_{t-1}) is zero. The alternative hypothesis is that β_1 is less than 0. A non-rejection of the null hypothesis suggests that the time series under consideration is non-stationary (Gujarati 2004).

Testing for lag length

A test for a suitable lag length to be included in the co-integration test was performed because the results of co-integration tests can be quite sensitive. The number of lag was selected base on final prediction error (FPE), Akaike information criterion (AIC), Schwarz Bayesian information criterion (SC), and Hannan-Quinn criterion (HQ) criteria.

Johansen co-integration test

In this study co-integration analysis is concerned with the existence of relationship among prices in different locations (Engle and Granger, 1987). Johansen and Juselius (1990) developed a multivariate co-integration method which was a robust procedure for testing long run relationship between stationary prices variables and also allow tests for multiple co-integrating vectors. In a co-integration regression, it creates a test statistic known as the likelihood ratio (LR) test to ascertain the number of co-integrating vectors.

Thus, it is express as

$$LR_{tr}(r/n) = -T \sum_{i-r+1}^{n} \log(1 - \lambda) \quad (2)$$

$$LR_{max}(r/n + 1) = -T\log(1 - \lambda) \quad (3)$$

Where:

LR = likelihood ratio

n = number of variables

λ = max eigenvalue

T = sample size

r = number of co-integrating vector = 0, 1, 2….n – 1

Σ = summation

Consequently, in order to reject the hypothesis that there is no co-integration, or r = 0, the selection cointegrating equation criteria is that the trace statistical value must be larger than the critical value at the 5% level of significance.

Granger causality test

Granger causality test was used to determine the direction of price movement and the leading markets between the states market price of rice and maize markets in Nigeria. This test is one of the important econometric tools to be used to determine whether past change in a time-series variable, say "X", has an influence on the current variable, "Y", or whether the relationship works in the opposite or bilateral direction. The model for Granger causality testing is represented thus

$lnP_{kt} = \psi_0 + \sum_{i=1}^{n} \psi_{ki} lnP_{k(t-i)} + \sum_{i=1}^{n} \psi_{ki} lnP_{k(t-i)} + \varepsilon_t$ (6)

Where

P_{kt}, = price in selected markets

$P_{k(t-i)}$ = lagged prices in price in selected markets

$\psi i's$ = parameters to be estimated;

n = the numbers of lags; and

ε_t = the error term.

An F-test, which is comparable to the Wald Test, was employed to demonstrate the existence of causation. It is stated as $F_{RP_t} = \dfrac{(SSE_r - SSE_u)/m}{SSE_u/(n-2m-1)} \sim F_{[m,(n-2m+1)]^{\alpha}}$ (4)

Where

SSEr = is the sum of squared errors of equation with restricted coefficients of lagged *Rp* (that is to say that coefficient is set to zero);

SSEu = 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.

Vector error correction model (VECM)

The cointegrated series' short run and long run cointegration, as well as the rate of adjustment to equilibrium, were assessed using VECM.

The vector error correction models for the long and short runs were calculated as

$\Delta X_t = C_1 + \lambda_1 Z_{t-1} + \beta_1 \Delta X_{t-1} + \text{----------} a_1 Y_{t-1} + \text{----------} + \varepsilon_{xt}$ (5)

$\Delta X_t = C_2 + \lambda_2 Z_{t-1} + \gamma_2 \Delta X_{t-1} + \text{----------} + \delta_1 Y_{t-1} + \text{-------} + \varepsilon_{xt}$ (6)

Where

ΔX_t = price change at selected markets at time t;

ΔX_{t-1} = price change at selected in past period;

δ = the speed of adjustment parameter; and

ε_{xt} = is a bivariate white noise.

Therefore, long run relationship and speed of adjustment between the market pairs exist if the cointegrating equation of the long run is negative, less than one and significant at 5%, while short run relationship also exist if the chi-square statistics is significant at 5% level

RESULTS AND DISCUSSION

Unit Root Test

Table 1 shows that rice and maize market prices at first difference were not stationary at the 5% level, indicating they are influenced by earlier prices. Because the variables were non-stationary at levels, any attempt to utilize them will lead to false regression, which is not ideal for policy making and cannot be used for long-term prediction. But the P-value for the coefficients is significant at the 5% level, indicating the price series is stationary at the first difference I(1). This study is in line with that of Adekunle (2015) who indicates that the price series of food grains markets in Southwest Nigeria were stationary at first difference. This

showed that the price series were integrated of order one I(1) and Dorothy *et al.* (2017) who reported that were non-stationary at respective levels.

Table 1: Results of Augmented Dickey Fuller (ADF) Test

	AT LEVELS AT 5%							AT FIRST DIFFERENCE AT 5%						
							RICE							
States	Intercept		intercept & trend		None			Intercept		intercept & trend		None		
	ADF	P-value	ADF	P-value	ADF	P-value	Remark	ADF	P-value	ADF	P-value	ADF	P-value	Order of integration
ADR	-2.9862	0.0416	-3.6032	0.0097	-1.9550	0.6156	Non-stationary	-2.9918	0.0001	-3.6122	0.0006	-1.9556	0.0000	I(1)
BORR	-2.9862	0.3066	-3.6032	0.3456	-1.9550	0.4824	Non-stationary	-2.9919	0.0002	-3.6121	0.0016	-1.9557	0.0000	I(1)
GOMR	-2.8968	0.9566	-3.4649	0.5022	-1.9448	0.9786	Non-stationary	-2.9862	0.0312	-2.9918	0.0000	-3.6122	0.0000	I(1)
TAR	-2.8968	0.9605	-3.4649	0.3589	-1.9448	0.9783	Non-stationary	-2.8972	0.0001	-3.4655	0.0000	-1.9448	0.0000	I(1)
YOR	-2.8968	0.8339	-3.4649	0.3998	-1.9448	0.9053	Non-stationary	-2.8972	0.0000	-3.4655	0.0000	-1.9448	0.0000	I(1)
							MAIZE							
ADM	-2.8968	0.9923	-3.4649	0.9195	-1.9448	0.9845	Non-stationary	-2.8972	0.0000	-3.4655	0.0000	-1.9448	0.0000	I(1)
BORM	-2.8968	0.9623	-3.4649	0.8505	-1.9447	0.9502	Non-stationary	-2.8972	0.0001	-3.4655	0.0000	-1.9448	0.0000	I(1)
GOMM	-2.8968	0.9848	-3.4648	0.9112	-1.9448	0.9821	Non-stationary	-2.8972	0.0000	-3.4655	0.0000	-1.9448	0.0000	I(1)
TAM	-2.8968	0.9724	-3.4649	0.8178	-1.9448	0.9612	Non-stationary	-2.8972	0.0001	-3.4655	0.0000	-1.9448	0.0000	I(1)
YOM	-2.8968	0.9684	-3.4655	0.8984	-1.9448	0.9700	Non-stationary	-8.4958	0.0000	-3.4655	0.0000	-1.9448	0.0000	I(1)

Source Output from E-views

Note: ADR= Adamawa State rice market price, BORR= Borno State rice market price, GOMR= Gombe State rice market price, TAR= Taraba State rice market price, YOR= Yobe State rice market price, ADM = Adamawa State maize market, BORM= Borno State maize market, GOMM= Gombe State maize market TAM= Taraba State maize market and YOM= Yobe State maize market price

Optimal Lag Selection

Too few lags could exclude crucial data, also too many lags could increase prediction error. Experience, expertise, and economic theory are usually the greatest sources for determining the optimal number of lags (Sadiq, *et al.,* 2018). The results presented in Table 2 shows that, lag six (6) is the optimum lag length appropriate for the specified variables, as specified by LR, FPE, AIC, and HQ. The ideal lag duration of time series in the creation of ADF and all subsequent models must be one in order to provide greater interpretation, logically coherent findings, and avoid biases of time series due to their sensitivity to lag length.

Table 2: Optimal Lag Selection Result

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-3087.743	NA	2.47e+23	79.40367	79.67560	79.51253
1	-2635.239	788.9811	1.82e+19	69.87793	72.59721*	70.96651
2	-2537.034	148.5674	1.27e+19	69.43676	74.60340	71.50506
3	-2451.850	109.2095	1.41e+19	69.32950	76.94348	72.37752
4	-2321.482	137.0543	6.17e+18	68.06363	78.12497	72.09137
5	-2166.100	127.4923	2.11e+18	66.15642	78.66511	71.16388
6	-1891.112	162.1728*	6.70e+16*	61.18235*	76.13839	67.16953*

* indicates lag order selected by the criterion
LR: sequential modified LR test statistic (each test at 5% level)
FPE: Final prediction error
AIC: Akaike information criterion
SC: Schwarz information criterion
HQ: Hannan-Quinn information criterion

Degree of Market Integration between the State Pairs

To determine the level of market integration between market pairings for rice and maize, the study used Johansen co-integration. Table 3 presents the co-integration analysis results utilizing Johansen multivariate analysis. According to the study, four of the ten pairs exhibit at least one cointegrating linear equation of cointegration of the rice and maize markets prices respectively, Trace statistics, therefore, disprove the null hypothesis that zero integrates linear equations between the following market pairs of rice and maize such as ADR-BORR, ADR-GOMR, ADR-YOR, TAR-YOR, ADM-BORM, ADM-GOMM, ADM-YOM, and TAM-YOM. Therefore, price signals are transferred throughout these states that are cointegrated, and any market shock that takes place in one sends signals to other markets. This also implies that the four states price pairs have a long-run equilibrium integration as reported by Liefert (2014) that there is a long-run cointegration relationship between the aggregate consumer, agricultural commodity food prices, and world market prices. While the remaining 6 market pair's show no integration among them. This suggests that they do not have a long-term relationship may be due to insufficient free movement of price signals and market information across states to keep market players informed about supply, demand, and prices for rice and maize, the degree of market integration between states' markets for these commodities is weak (low) as revealed by Moses (2017) that market integration in rural and urban maize markets in Nigeria were integrated but the level of integration was low. A low level of integration can result in monopolistic and oligolistic market structures, high transaction costs, difficulties with risk diversification, and restricted access to resources (skilled labour and technology), which can impair farmers' capacity for production and innovation. This study disagrees with results of Pratap (2016) who stated that there is no long-run association between DACP and IACP. In addition, there is no cointegration between (DAP) and (IAP). However, the DEP and IEP prices have a long-run equilibrium relationship. During this time, there is no long-run link between DMP disagrees and that of Iheke and Obasi (2017) who revealed that there is strong or high rate of integration in price between urban and rural rice markets as they move in the same direction. But agrees with findings of

Table 3: Results of Johansen Co-integration test

State pairs	Trace statistics	5% Critical value	P-value
ADR-BORR	16.33786	15.49471	0.0373**
ADR-GOBR	22.58119	15.49471	0.0036**
ADR-TAR	9.193535	14.26460	0.2704
ADR-YOR	15.93168	15.49471	0.0430**
BORR-GOMR	10.51115	15.49471	0.2434
BORR-TAR	7.220092	15.49471	0.5522
BORR-YOR	15.15895	15.49471	0.0561
GOMR-TAR	12.01939	15.49471	0.1560
GOMR-YOR	14.15565	15.49471	0.0788
TAR-YOR	16.97588	15.49471	0.0297*
ADM-BORM	18.81824	15.49471	0.0152**
AD-GOBM	21.60317	15.49471	0.0053**
ADM-TAM	10.93209	15.49471	0.2157
ADM-YOM	16.33786	15.49471	0.0373**
BORM-GOMM	5.287123	15.49471	0.7776
BORM-TAM	14.99409	15.49471	0.0594
BORM-YOM	13.76641	15.49471	0.0896
GOMM-TAM	11.48270	15.49471	0.1835
GOMM-YOM	10.11158	15.49471	0.2723
TAM-YOM	19.43559	15.49471	0.0121*

Source Output from E-views

Note: ADR= Adamawa State rice market price, BORR= Borno State rice market price, GOMR= Gombe State rice market price, TAR= Taraba State rice market price, YOR= Yobe State rice market price, ADM = Adamawa State maize market, BORM= Borno State maize market, GOMM= Gombe State maize market TAM= Taraba State maize market and YOM= Yobe State maize market price

Direction of Price Formation and Transmission between the State Markets Pairs

After it was found that there is a co-integration between the states market prices of rice and maize, the Granger causality test was employed to determine the causal variable. Twenty (20) linkages for both rice and maize market prices respectively were examined in the study. The result revealed that only one pair showed bi-directional causation between BORR-ADR (rice markets) and BORM-ADM (maize markets). Indicating that both states have a feed-forward and feed-backward process in price formation. This study agrees with the findings of Edet *et al*. (2014) who suggested a bi-directional relationship between the rural and urban price of pawpaw and leafy fluted pumpkin in Akwa Ibom State, Nigeria.

Six (6) and five (5) links for rice and maize market respectively showed unidirectional causality which indicates that the price of other states causes granger over other states, which means that the direction of price flow from ADR→GOMR, TAR→BORR, YOR→BORR, TAR→GOMMR, YOR→GOMR, TAR→YOR, GOMM→ADM, YOM→BORM, YOM→BORM, YOM→GOMM, and TAM→GOMM. Therefore, any price shock or changes in the states that causes granger over other will be transmitted to the other states all things being equal. This study is in line with that of Sadiq *et al.* (2019) who shows that there was a bi-directional influence on pricing in the rural market between Lefane and Manigi markets in Niger State, Nigeria, across zones and value chains, suggesting that both markets show feed forward and feed backward dynamics in price formation, and also Zungeru-Manigi market pair show that the Zungeru market has strong exogeniety with the Manigi market (unidirectional causality). Finally, thirteen (13) and fourteen (14) pairs of rice and maize market price respectively, revealed no connection of causation between them. This suggests that these phases were not dependent on one another. On the other hand, in the long run, price transmission might still exist even in the absence of causation. It further shows that TAR market prices occupied the leadership position (central state) in rice price formation and also TAM and YOM market prices occupied the leadership position (central state) in maize market price formation in in the study area since they causes over-ganger other states.

Table 4: Granger causality test between Selected Markets Pairs

Null Hypothesis	F-Statistic	Prob.	Decision of Null Hypothesis	Direction
BORR →ADR	2.05209	0.0712*	Rejected	Bidirectional
ADR → BORR	3.49075	0.0047**	Rejected	
GOMR → ADR	1.53117	0.1821	Accepted	Unidirectional
ADR → GOMR	2.51289	0.0300**	Rejected	
YOR → ADR	2.80750	0.0172**	Rejected	Unidirectional
ADR → YOR	1.51075	0.1887	Accepted	
TAR → BORR	2.09854	0.0653*	Rejected	Unidirectional
BORR → TAR	1.35654	0.2455	Accepted	
YOR → BORR	2.33155	0.0423**	Rejected	Unidirectional
BORR → YOR	1.21294	0.3111	Accepted	
TAR → GOMR	4.66181	0.0005***	Rejected	Unidirectional
GOMR → TAR	0.66933	0.6747	Accepted	
YOR → GOMR	1.94482	0.0867*	Rejected	Unidirectional
GOMR → YOR	0.59580	0.7326	Accepted	
YOR → TAR	1.27202	0.2826	Accepted	Unidirectional
TAR → YOR	3.62558	0.0037***	Rejected	

BORM → ADM	4.01302	0.0018***	Rejected	Bidirectional
ADM → BORM	2.41357	0.0362**	Rejected	
GOMM → ADM	2.51984	0.0296**	Rejected	Unidirectional
ADM → GOMM	1.66397	0.1441	Accepted	
TAM → BORM	3.26399	0.0072***	Rejected	Unidirectional
BORM → TAM	1.67809	0.1405	Accepted	
YOM → BORM	2.79315	0.0177**	Rejected	Unidirectional
BORM → YOM	1.51281	0.1880	Accepted	
TAM → GOMM	2.45771	0.0333**	Rejected	Unidirectional
GOMM → TAM	0.75900	0.6047	Accepted	
YOM → GOMM	2.31125	0.0439**	Rejected	Unidirectional
GOMM → YOM	0.88725	0.5095	Accepted	
YOM → TAM	0.70250	0.6486	Accepted	Unidirectional
TAM → YOM	2.10717	0.0643*	Rejected	

Source Output from E-views.
Note: At 1%, 5%, and 10%, respectively, the levels of significance are indicated by ***, **, and *.
ADR= Adamawa State rice market price, BORR= Borno State rice market price, GOMR= Gombe State rice market price, TAR= Taraba State rice market price, YOR= Yobe State rice market price, ADM = Adamawa State maize market, BORM= Borno State maize market, GOMM= Gombe State maize market TAM= Taraba State maize market and YOM= Yobe State maize market price

Speed of Adjustment to Equilibrium in the Long Run

VECM's result of long-term speed adjustment to equilibrium is presented in Table 5. The adjustment coefficients for ADR, GOMR, ADM, and YOM States prices are -0.2051, -0.0226, -0.0061, and 0.0055, respectively. Indicating that prices will be adjusted in two weeks, one week, one week, and one week, respectively for the recent divergence in the rice and maize market prices in ADR, GOMR, ADM, and YOM States. This suggests that the prior discrepancy in the ADR, GOMR, ADM, and YOM States should eventually be reversed in a week. From the results, it can be inferred that the prices in GOMR, ADM, and YOM States adjusted to equilibrium more quickly over time than the prices in the other states. This is because any disequilibrium can be adjusted in just one week, indicating that these states have higher chances of correcting any disequilibrium may be due to their high levels of market competition, flexibility, and capital availability. This could result in fewer pricing anomalies and market inefficiencies, more market and economic stability, and effective resource allocation. This result agrees with the findings of Alufohai and Ayantoyinbo (2014) who reported that urban (OSO) maize price in Osun State, Nigeria, responds faster than the rural price and that of Sunday *et al.* (2015) who reported that, the price of local rice in both rural and urban markets Adjusted faster than prices of foreign rice once there is an exogenous shock in the marketing process of rice in Akwa Ibom State.

Table 5: VECM Result

States	Coefficient	Std. error	T-value	Period
ADR	-0.205107	0.07867	-2.60715***	2 weeks
BORR	-0.005042	0.00750	-0.67258	-
GOMR	-0.022594	0.00555	-4.06746***	1 week
TAR	-0.002411	0.00587	-0.41079	-
YOR	-0.001048	0.00677	-0.15483	-
ADM	-0.006058	0.00307	-1.97205**	1 week
BORM	-0.001213	0.00404	-0.30044	-
GOMM	-0.006873	0.00460	-1.49476	-
TAM	0.002884	0.00357	0.80741	-
YOM	-0.005484	0.00312	-1.75554*	1 week

Source Output from E-views
Note: The levels of significance at 1% and 5%, respectively, are indicated by the notes *** and **.

ADR= Adamawa State rice market price, BORR= Borno State rice market price, GOMR= Gombe State rice market price, TAR= Taraba State rice market price, YOR= Yobe State rice market price, ADM = Adamawa State maize market, BORM= Borno State maize market, GOMM= Gombe State maize market TAM= Taraba State maize market and YOM= Yobe State maize market price

Short Run Relationship between the States

The result in Table 6 revealed that the short-run coefficients of ADR and TAR, BORR and GORR, TAR and YOR, BORM and ADM, YOM and GOMM are 0.3893, 0.2364, 0.2705, 0.3042 and 0.3817 respectively. This suggested that a percentage increase in ADR, BORR, TAR, BORM and YOM price would lead to increase of 38.9% 23.6%, 27.1%, 30.4% and 38.2% in TAR, GORR YOR, ADM and GOMM respectively. Therefore, there is short-run relationship between the states in the study area as revealed by Taru (2014) a 1% increase in the urban price of rice in the short-run had increased the rural price by 18%, while in the long-run, rural price would increase by 127.6 %, but disagree with finding of Muhammad *et al.* (2021) who revealed that both grain rice price and rice price are not a significant influence in short-run equilibrium.

Table 7: VECM Result

States	Coefficient	Std. error	T-value
ADR-TAR	0.389253	0.18562	2.09703
BORR-GOMR	0.236410	0.13435	1.75960
TAR-YOR	0.270537	0.14586	1.85473
BORM- ADM	0.304147	0.15616	1.94771
YOM-GOMM	0.381671	0.20221	1.88748

Source Output from E-views

Note: ADR= Adamawa State rice market price, BORR= Borno State rice market price, GOMR= Gombe State rice market price, TAR= Taraba State rice market price, YOR= Yobe State rice market price, ADM = Adamawa State maize market, BORM= Borno State maize market, GOMM= Gombe State maize market TAM= Taraba State maize market and YOM= Yobe State maize market price

CONCLUSION AND RECOMMENDATIONS

In conclusion the study suggest that there is integration between the market price of maize and that of rice in the study area, but the level of integration is weak. Additionally, there is proof of causality as the Taraba market prices held the top spot (central state) in the creation of rice prices. Also, Taraba and Yobe States market prices held the top spot (central state) in the establishment of maize prices and there is short-run relationship between the states.

The study's conclusions led to the formulation of the following recommendations, which should guarantee future price integration of the rice and maize markets in Northeast Nigeria. They include

1. To facilitate integration, market players should invest in technology (electronic trading platforms) and standardize trading and settlement procedures. This would help to minimize operational inefficiencies across various markets.
2. To ensure transparency, improve decision-making, and strengthen causal relationships, market participants, the government, and NGOs should promote the exchange of market information and data.
3. The establishment of channels for the dissemination of market information and extension services regarding current supply, prices, and demand signals is recommended for both government and non-governmental organizations (NGOs). This will enable market

participants to stay informed about the state of the market and coordinate their responses to varying market dynamics.
4. To take advantage of momentary mispricing and quickly align terms and prices across interconnected markets, market participants should engage in cross-market arbitrage operations.
5. Better and more extensive market research and information sharing among farmers and dealers is desperately needed by both government and private organizations through cereal marketers. This will improve knowledge, help mitigate supply uncertainty and lower the risk involved in aftermarket trade, and give farmers and traders a place to store excess cereals.

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Conflict of Interest Disclosure
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