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# CO-INTEGRATION ANALYSIS: A FISH MARKET CASE IN BORNO STATE, NIGERIA

**Y. M. Bulama, A. A. Makinta and U. A. Buba**

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**Abstract**

This study estimated the extent of co-integration in fish prices in Borno, Nigeria. This study specifically analyzed the trend of fish prices and estimated the extent of co-integration in fish prices in Borno State, Nigeria. The study used time series data of prices of various categories of fishes that covered the period from January 2017 to December 2022, which were obtained from the National Bureau of Statistics and the Food and Agriculture Organization Statistics. The data were subjected to a unit root test and analyzed using graphs and Johansen's co-integration test. The results indicated that the prices of fish fluctuated over time. The results also revealed that the quantity of fish supplied and the prices of fish and its substitutes were integrated with seven co-integrating vectors, confirming strong short- and long-run relationships between the quantity of fish supplied and the prices of fish: dried tilapia, iced sardine, fresh tilapia, fresh African Arowana (*Bargi*), smoked catfish, and fresh catfish. It is recommended that fish farmers, processors, and marketers closely monitor changes in fish and substitute prices and adjust their production and marketing strategies accordingly to maximize their benefits and remain competitive in the market.

## INTRODUCTION

Fish are a vital source of food and income globally, and Nigeria is no exception. The country's fish production has been on the rise, reaching 1.3 million metric tonnes in 2022, valued at N320 billion (Odioko and Becer, 2022). This growth is attributed to increased aquaculture production, which accounted for 65% of the country's total fish production in 2022 (FAO, 2022). Nigeria's fish trade is also significant, with the country importing 1.5 million metric tons of fish in 2022, valued at N420 billion (Central Bank of Nigeria, 2022). Despite these gains, Nigeria still struggles to meet its domestic fish demand, leading to a significant reliance on imported fish. The country's

Department of Agricultural Economics, University of Maiduguri, Nigeria.
**Email:** ymbulama@gmail.com

inability to meet its domestic fish demand is evident in the significant supply-demand gap. The total domestic fish production in Nigeria was estimated to be 1.02 million metric tonnes in 2020 (National Bureau of Statistics, 2022). However, the country’s total fish consumption requirement is estimated to be approximately 2.7 million metric tonnes (Oyetola, 2022). This indicates a supply-demand gap of approximately 1.7 million metric tons. This gap highlights the need for increased investment in Nigeria's fisheries sector, particularly in aquaculture, to reduce reliance on imports and meet the country's growing demand for fish. Demand is outstripping supply, thus increasing prices. (Happiness et al., 2014). Although high prices can technically be good news for farmers, price fluctuations are extremely unfavourable as farmers and other agents in the food chain risk losing their investments if prices fall. One frequently cited reason for increased prices is ‘market fundamentals like; interest rates, gross domestic product (GDP) growth, trade balance surplus/deficits, and inflation levels.

The issue of price changes, co-movement of prices, and smooth transmission of price signals and information across markets separated by time and space is fundamental in agricultural commodity markets. Market prices that are highly unstable and move separately will convey inaccurate price signals that may distort marketing decisions and contribute to inefficient product movement. Furthermore, some marketing agents may exploit and benefit at the cost of other marketers’ gains and consumers’ welfare. Frequent changes and poor co-movement question the sustainability of current economic growth and the efficiency of the markets. Supporting livestock development (e.g., fish) by reducing excessive price fluctuations and encouraging price integration can reduce poverty and food insecurity, and ensure efficiency in spatially separated markets (Bulama, 2019).

Thus, market studies focus on characteristic price changes, linkages and agricultural commodity prices. The prices of agricultural products are not static; depending on seasonal or climatic conditions, they may increase or decrease. Therefore, price changes or fluctuations are inherent features of agricultural markets, and they will remain a normal risk to be managed by stakeholders in agricultural marketing as part of their business strategies. The lack of change in agricultural prices reflects a non-functioning market. Price changes within a certain bound are acceptable. However, excessive price changes are not desirable as they result in uncertain income for the marketer and a poor degree of consumer choice (Natcher and Weaver, 1999).

The Fish Price Index (FPI) analysis shows that overall fish prices have followed an upward trend in recent years due to supply limitations, particularly for capture fisheries, and continued strong worldwide demand that is higher than supply (FAO, 2020). Price fluctuations are not only harmful to consumers but also affect producers. Poor farmers generally do not have sufficient investment capital to sustain such unpredictability. This can result in suboptimal investment decisions and long term production compromise (Happiness et al., 2014).

Given the high demand for smoked fish in Borno State, the initial limited supply, and the associated rise in the price due to the ranging Boko Haram insurgency in the state, the change in climatic conditions, government regulation, poor infrastructure, seasonal production, and inadequate transportation and storage technology, the fish supply to Maiduguri, the state capital, was disrupted and the price soared. The raging Boko Haram insurgency in the northeast, has hit Baga, the main source of the state’s fish supply. Insurgents reportedly occupied the supply area and halted the business, leaving the fishers and processors out of business, leading to shortages and price hikes (Bello *et al.*, 2017).

The government attempted to restore the fish supply in Borno by deploying more troops and constantly patrolling the affected zones until the supply became steady and normal again (Mordi 2022). Furthermore, the supply of fish in the study area continued to soar to the point of being in excess, which brought the fish prices low and led to less emphasis on aquacultural fish farming in the state as girls and many other hawkers fried, dried or smoked the excess fish and sold them along streets. This circumstance affected the price and extent of integration of the fish prices and fish supply. Thus, the study focused on describing the fish price trend and the extent of integration in the fish prices of Borno State, Nigeria.

**MATERIALS AND METHOD**

The study area is Borno State, Nigeria. The state lies between latitudes $10^{o}$N and $13^{o}$N and longitudes $11.40^{o}$E and $14.40^{o}$E (fig. 1). The state shares international borders with Cameroun to the East, Niger to the North, and the Republic of Chad to the North-East. The climatic condition is harsh, with high temperatures fluctuating between $38^{0}$C and $44^{0}$C and a mean rainfall of about 500-750mm per annum (Bulama *et al.*, 2019).

The major occupations in the state are farming, fishing and marketing of dried tilapia, iced sardine, fresh tilapia, fresh African Arowana (*Bargi*), smoked catfish and fresh catfish. The supply of fish in Borno State, Nigeria, is mainly from catch fisheries and aquaculture. However, it is often inadequate to meet demand because, most of the fish is taken to other parts of the country (Bukar *et al*., 2018), while local sales are primarily through markets and roadside vendors.

The study employed time series data from secondary sources, including the Food and Agriculture Organization Statistics (FAOSTAT) for fish supply information, and the National Bureau of Statistics (NBS) for fish price information.

Monthly information on the quantity of fish supplied, prices of fishes such as: dried tilapia, iced sardine, fresh tilapia, fresh African Arowana (*Bargi)*, smoked catfish, and fresh catfish, and prices of substitutes such as, beef and chicken. Data pertaining to 72 months (6 years), spanning January 2017 to December 2022, were used in the study. Data were analyzed using STATA 14.2 and SPSS 20. The unit root was used to test for stationarity using Augmented Dickey Fuller and the Johansen's co-integration test was used to test for the presence and extent of co-integration in the price series. This value was estimated using E-Views 13.

**Unit Root Test**

Most economic time series trend over time and must undergo appropriate transformation to achieve stationarity. The unit root test was performed to check the order of stationary of the data (to avoid spurious relationships). Non-stationary time series data tend to cause estimation, inference and forecasting problems in empirical modeling. Non-stationary data are transformed into stationary data through the unit root test to free the data of these empirical problems, The objective is to convert an unpredictable process to one with a mean return to a long-term average and a non-time-dependent variance. A variable is considered stationary if it has a time-invariant mean and variance, and the covariance between the two periods does not depend on the length of the estimation period but on the lag between the periods. In practice, the most frequently used transformation process is integration or differencing (Rufino, 2011).

According to Bulama (2019), Rufino (2011), Acquah and Owusu (2012, and Obayelu and Alimi (2013), the first difference of the series is tested for stationarity to determine the order of integration, if one identifies the series to be non-stationary. A stationary series is said to be integrated of order zero or I (0) because it does not require differencing before attaining stationarity.

Most economic time series are I (1), that is, they generally become stationary only after taking their first difference. In general, if a non-stationary series must be differenced d times to make it stationary, it must be integrated of order d or I (d). The two well-known stationarity tests in literature are the Augmented Dickey-Fuller (ADF) test (Dickey and Fuller, 1979), and the Phillips-Perron (PP) test (Phillips and Perron, 1988). For this study, the ADF (Augmented Dickey-Fuller) test was used due to its simplicity and ease of interpretation. The test was conducted on the level and first differences in the price series to obtain results at I (0) and I (1) orders. The following ADF regression equation was used to test for stationarity:

$\Delta Y_{it} = \beta_1 + \beta_2 t + \delta Y_{it-1} + \alpha_i \sum_{i=1}^{m} \Delta Y_{it-1} + \varepsilon_t$ ------------------------------------------------------ 1

Where; $\beta_1$ is a constant, $\beta_2$ is the coefficient of a time trend;
$\delta$ is parameter that signifies the presence or absence of a unit root;
$Y_{it}$ is a vector to be tested for co-integration, that is the price of fish in the ith market;
t is the time or trend variable; i = 1, 2, 3, …,n (ith market)

$\Delta Y_t = Y_t - Y_{t-1;}$ ---------------------------------------------------------------------------------------2

$Y_t$ is the price time series; Δ is the first difference operator;
$Y_{t-1}$ is the lagged value of the price series; $\alpha_i$ is the coefficient of the lagged values of $Y_{t-1;}$ and
$\varepsilon_t$ is the pure white-noise error term and m is the lag order.
The null hypothesis that $\boldsymbol{\delta}=0$ is tested against the alternative that $\boldsymbol{\delta}< 0$.

**Johansen's (co-integration) Test**

The Johansen's test was used to test for the co-integration of fish prices in Borno. The existence of a long-run relationship among prices and the speed of adjustment of prices to equilibrium was tested using Johansen's (1988) test. Johansen's method is preferred over the other models because of its ability to test more than two variables at a time, and because it handles endogeneity and simultaneity problems found in bivariate models. Once stationarity is established, the series are integrated of order one (1, 1) or zero (1, 0), and then the co-integration (Johansen's) test is applied. The two series must be co-integrated of order I (1), if the individual series are non-stationary (i.e. have one or more unit roots) but a linear combination of them, called the co-integrating relationship, is stationary. If the linear combination of the variables is found to be co-integrated, then the long-run relationship between the variables can be more sufficiently established using ECM (Error Correction Model) or VECM (Vector Error Correction Model), which estimates the residuals obtained in the VAR model (Vector Auto Regression) (Bulama, 2019). Johansen's test comes in two main forms: Trace tests and Eigenvalue tests.

i. The trace test evaluates the number of linear combinations in the time series data i.e. K to equal to value $K_o$ and the hypothesis for the value of K to be greater than $K_o$ is as follows:

$H_o$: $K = K_o$
$H_1$: $K > K_o$

When using the trace test to test for co-integration in a sample, we set $K_o$ to zero to test whether the null hypothesis will be rejected. If rejected, we can deduce that a co-integration relationship exists in the sample. Therefore, the null hypothesis should be rejected to confirm the existence of a co-integration in the sample.

ii. The maximum eigenvalue test is defined as a non-zero vector that, when, the linear transformation is applied to it, it changes by scalar factor. The Maximum Eigenvalue test is similar to Johansen's trace test. The key difference between the two is that the null
hypothesis.

$H_o$: $K = K_o$
$H_1$: $K = K_o + 1$

In a scenario where $K= K_o$ and the null hypothesis is rejected, only one possible variable outcome to produce a stationary process. However, in a scenario where $K_o= m-1$ and the null hypothesis is rejected, there are m possible combinations. Such a scenario is impossible if the time series variables are stationary. Johansen, (1991) further explained that if the linear combination of the variables is found to be co-integrated, then the long-run relationship between the variables can be estimated using Vector Error Correction Model (VECM), which estimates the residuals obtained in the Vector Auto Regression (VAR).

Just like a unit root test, there can be a constant term, both or neither, in the model as Johansen's methodology begins with a statistical form as the VAR model of order $\rho$, given by:

$$Y_t = \mu + \Phi D_t + \Pi p Y_{t-p} + \cdots + \Pi_1 Y_{t-1} + \varepsilon_t \quad \text{------------------------------------------------3}$$

Where;

$\mu$ = Constants and $\rho$ = lag length

$Y_t$= is (K x 1) vector of variables assumed to be I (1)

$\Phi$= coefficient of the deterministic trend

$Y_{t-1}\ldots Y_{t-p}$ = lagged items of $Y_t$,

$\Pi_1 \ldots . \Pi p$ = (K x K) matrices of the unknown parameters,

$\varepsilon_t$= noise error terms

**RESULTS AND DISCUSSION**

**Trends in Fish Prices**

As indicated in Figure 1, for the 72-month period under consideration, the price of fresh tilapia ranged from ₦500-2500/kg. This revealed that the price of fresh tilapia experienced a hike in January 2017 and declined around February 2018. From there, it was somewhat steady with fewer fluctuations up to 2020. Afterward, it continued until reaching peak around 2022. This may imply a decrease in production and supply, which may be due to supply hindrance by the insurgents in 2017, as reported by Bello *et al.,* (2017).


**Figure 1:** Trend in the price of fresh tilapia in Borno, Nigeria.

**Source:** Calculated from fish price series, 2023.

Figure 2 shows an increase in the price of iced sardine from ₦400 – 900/kg between January 2017 and mid-2018. The price declined in January 2019 and increased to approximately 1300 naira/kg in 2022 with few fluctuations. This implied an upward trend, as sardine is an imported fish that passes through different marketers before reaching its ultimate consumer.

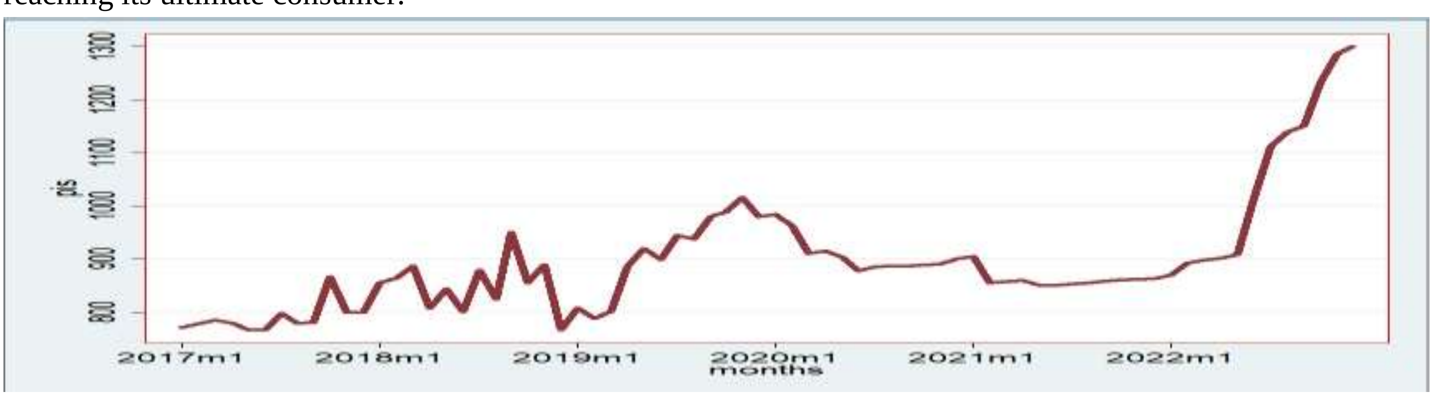


**Figure 2:** Trend in iced sardine price in Borno, Nigeria.

**Source:** Calculated from fish price series, 2023.

Figure 3 shows some upward and downward trends in the price of dried tilapia, and finally, it shows a decrease a slight fluctuation in the price from ₦900 to 800/kg between February 2020 and December 2022. This implied that suppliers may have experienced a decrease in supply and transportation costs, allowing them to reduce prices. According to a study by the Food and Agriculture Organization (FAO), reducing transportation costs can lead to lower prices for fish products (FAO, 2018).

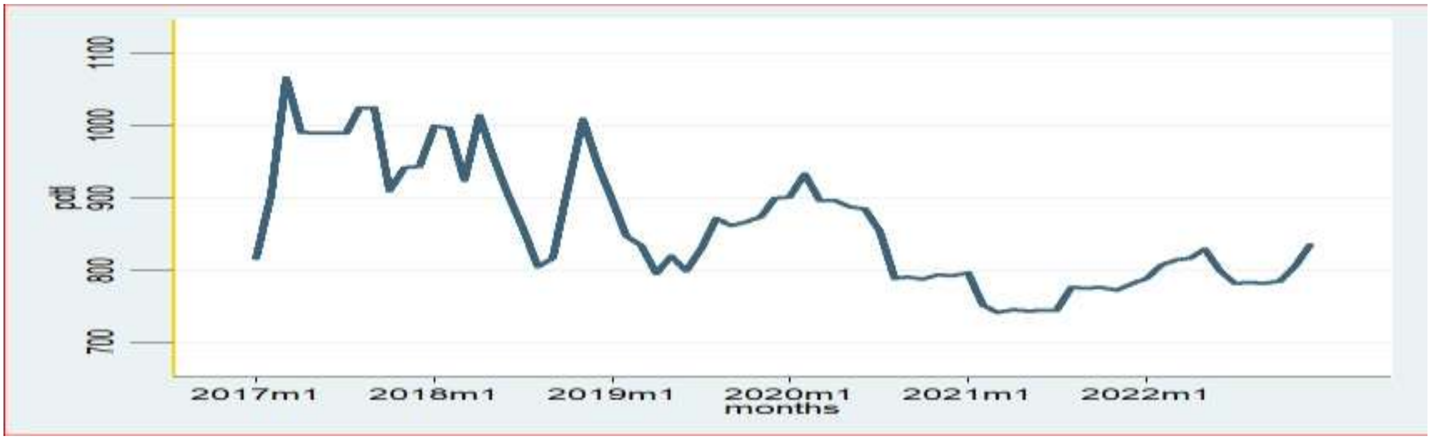


**Figure 3:** Trend in dried tilapia price in Borno, Nigeria.

**Source:** Calculated from fish price series, 2023.

Figure 4 shows the increase in the price of fresh catfish (pfc) from ₦1000 to 1040/kg between January 2017 and mid-2020. However, it showed a continuous decline from late 2020 to December 2022. This decline might be attributed to an oversupply of fresh catfish in the market, which would lead to a downward pressure on prices. This oversupply could be due to increased production by local fish farms or increased fresh catfish imports. According to the World Bank, changes in supply and demand can lead to fluctuations in market prices of fish (World Bank, 2013).

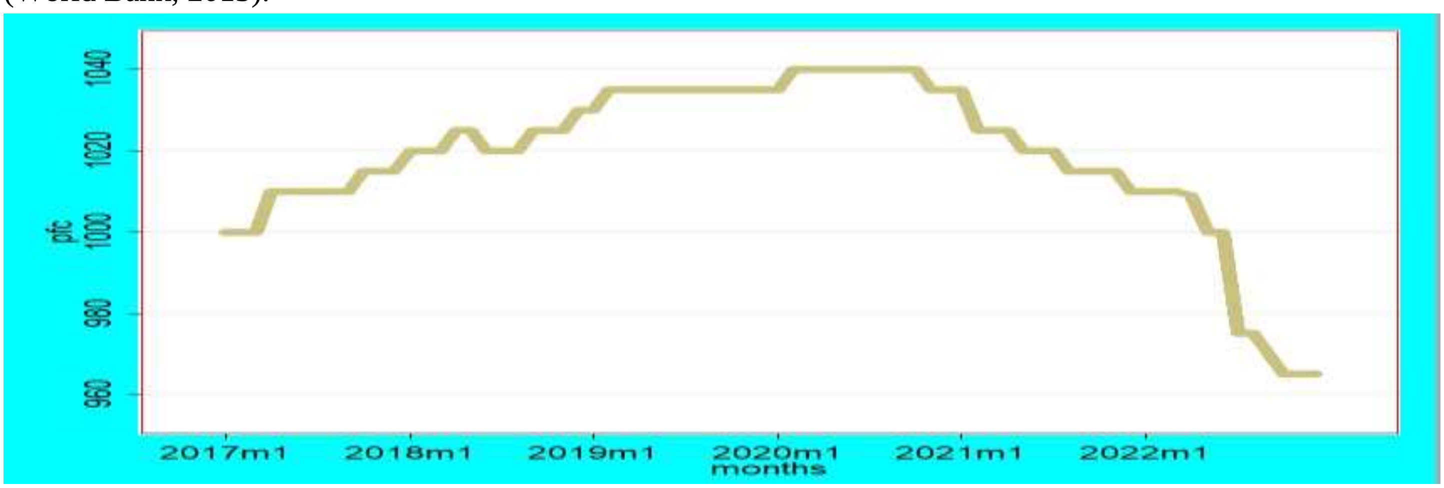


**Figure 4:** Trend in fresh catfish price in Borno, Nigeria.

**Source:** Calculated from fish price series, 2023

Figure 5 shows upward and downward trends in the price of African Arowana (Bargi). It also showed a decrease in price from ₦1700 to 1450 between January 2020 and mid-2021. A slight increase to ₦1600 was depicted between late 2021 and 2022. This implied that suppliers might have engaged in price competition to gain market share, resulting in lower prices. This in accordance with a study by the Nigerian Agricultural Policy Research

Journal, which found that price competition is a common strategy used by fish market suppliers (Olajide *et al.*, 2022).

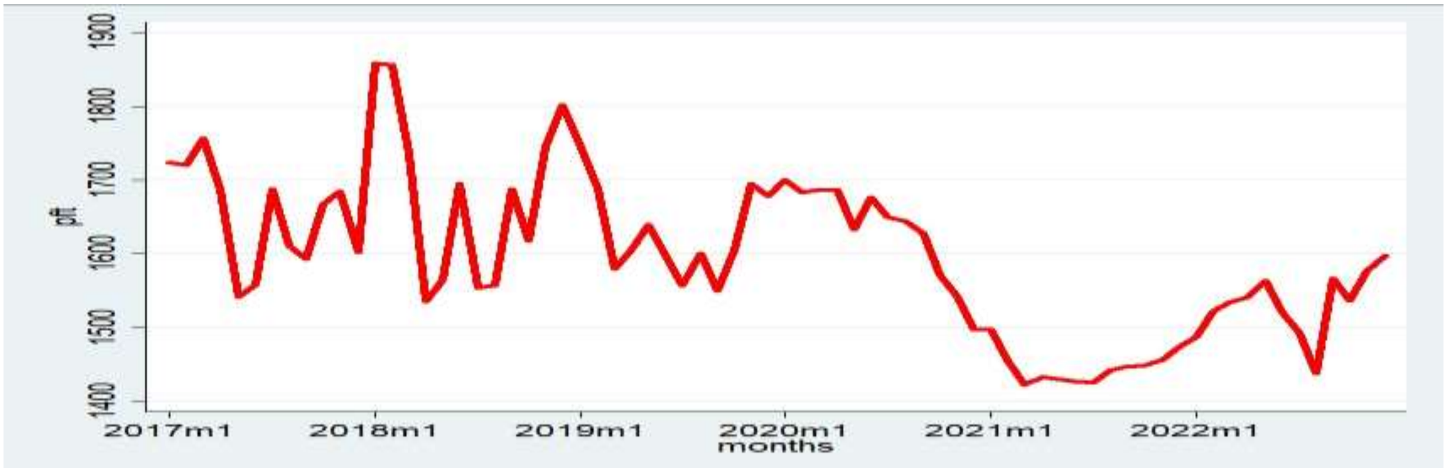


**Figure 5:** Trend in African arowana (Bargi) price in Borno , Nigeria.

**Source:** Calculated from fish price series, 2023

Figure 6 shows a steady increase in the price of smoked catfish from ₦1560 to 1600 from January 2017 to January 2020. However, a continuous decline in the price was observed from February 2020 to December 2022. This might be attributed to transportation cost, purchase price of fish, decrease in quantity of fish supplied, or a change in consumer preferences, with consumers becoming more price-sensitive and demanding lower prices. Jibrin *et al*. (2023) reported that the major perceived causes of price fluctuations in smoked fish transportation costs, consumer choices, purchasing fish price, and quantity of fish supplied.


**Figure 6:** Trend in smoked catfish price in Borno, Nigeria.

**Source:** Calculated from fish price series, 2023.

**Unit root test**

**Table 1: Unit root tesult**

| Variable | level | | | 1st Difference | | |
|---|---|---|---|---|---|---|
| | ADF Test-Stat | 1%C-value | Prob. | ADF Test-Stat | 1%C-value | Prob. |
| LNQ | 1.285831 | -3.527045 | 0.631 | -13.88122 | -3.527045 | 0.0001 |
| LNPDTL | 2.079238 | -3.525618 | 0.2536 | -7.748185 | -3.527045 | 0.0000 |
| LNPIS | -0.167191 | -3.528515 | 0.9369 | -4.942553 | -3.528515 | 0.0001 |
| LNPFTL | -0.212814 | -3.525618 | 0.9312 | -5.969706 | -3.527045 | 0.0000 |
| LNPFT | -1.461581 | -3.525618 | 0.5472 | -6.785955 | -3.527045 | 0.0000 |
| LNPFC | -1.045660 | -3.528515 | 0.7323 | -9.381194 | -3.528515 | 0.0000 |
| LNPSC | -1.283825 | -3.527045 | 0.6328 | -11.46379 | -3.527045 | 0.0001 |
| LNPB | -0.786526 | -3.525618 | 0.8166 | -10.44802 | -3.527045 | 0.0001 |
| LNPCH | 1.093204 | -3.525618 | 0.9971 | -7.935328 | -3.527045 | 0.0000 |

**Source:** Calculated from fish price series, 2023.

Table 1 presents the unit root test based on ADF under the null hypothesis of the presence of a unit root (non-stationary) and the alternative hypothesis, which implied stationarity in the series. The SIC provided the best fit for lag selection. By providing guides on the number lags to be used, it ensured that in the series there were no serial correlations. The series were non-stationary at level I(0) with ADF test statistics smaller than the 1% critical values. It became stationary after first differencing I(1) with ADF test statistics greater than the 1% critical values. The null hypothesis of non-stationarity was accepted at the level and rejected after taking the first difference of the series. The alternative hypothesis of the presence of stationarity was rejected at the level form of the series and accepted after the first differences of the series. Thus, after the first differencing, the series was stationary and was further tested for co-integration.

**Co-integration Test**

**Table 2: Johansen's Co-integration: Trace Test**

| Hypothesized number of Co-integration equation | | Eigen Value | Trace statistics | Critical Value | Prob. |
|---|---|---|---|---|---|
| None* | K = 0 | 0.807897 | 404.504 | 197.3709 | 0.0000 |
| At most 1 * | K= 1 | 0.758513 | 291.9693 | 159.5297 | 0.0000 |
| At most 2 * | K=2 | 0.527194 | 195.3453 | 125.6154 | 0.0000 |
| At most 3 * | K=3 | 0.504806 | 144.4085 | 95.75366 | 0.0000 |
| At most 4 * | K=4 | 0.429238 | 96.61768 | 69.81889 | 0.0001 |
| At most 5 * | K=5 | 0.307814 | 58.48441 | 47.85613 | 0.0037 |
| At most 6 * | K=6 | 0.266968 | 33.46718 | 29.79707 | 0.0181 |
| At most 7 | K=7 | 0.139897 | 12.34866 | 15.49471 | 0.1410 |
| At most 8 | K=8 | 0.030422 | 2.100816 | 3.841465 | 0.1472 |

**Source**: Calculated from fish price series, 2023.

*Denotes rejection of the hypothesis at 0.05 level test (Mackinnon- Haug-Michillis (1999) P-values).

The trace statistics for k = 7 and k = 8 are below the 5% critical value. Therefore, the null hypothesis of no co-integration is accepted. The trace statistics of k = 0 to k = 6 are above the critical values of 5%, indicating that the null hypothesis of no co-integration is rejected at the 5% level of significance. Thus, the result shows that there are seven (7) co-integrating vectors between the quantity supplied and the fish price series.

The results provide statistical evidence of co-integration between the quantity of fish supplied and the price series of fish such as: dried tilapia, iced sardine, fresh tilapia, fresh African Arowana (Bargi), smoked catfish, and fresh catfish, and the prices of substitutes (beef and chicken). Six co-integrating equations were obtained from the trace statistics (Table 2).

**Table 3: Johansen's Co-integration: Maximum Eigen Value Test**

| Hypothesized number of Co-integration equation | | Eigen Value | Max-Eigen statistics | Critical Value | Prob. |
|---|---|---|---|---|---|
| None * | K=0 | 0.807897 | 112.1811 | 58.43354 | 0.0000 |
| At most 1 * | K=1 | 0.758513 | 96.62401 | 52.36261 | 0.0000 |
| At most 2 * | K=2 | 0.527194 | 50.93680 | 46.23142 | 0.0146 |
| At most 3 * | K=3 | 0.504806 | 47.79080 | 40.07757 | 0.0056 |
| At most 4 * | K=4 | 0.429238 | 38.13327 | 33.87687 | 0.0146 |
| At most 5 | K=5 | 0.307814 | 25.01723 | 27.58434 | 0.1029 |
| At most 6 | K=6 | 0.266968 | 21.11852 | 21.13162 | 0.0502 |
| At most 7 | K=7 | 0.139897 | 10.24784 | 14.26460 | 0.1962 |
| At most 8 | K=8 | 0.030422 | 2.100816 | 3.841465 | 0.1472 |

**Source**: Calculated from fish price series, 2023.

*Denotes rejection of the hypothesis at 0.05 level test (Mackinnon- Haug-Michillis, 1999).

The Max-Eigen Test values from k = 5 to k = 8 are below the 5% critical value. Therefore, the null hypothesis is accepted. The Max-Eigen statistics from k = 0 to k = 4 are above the 5% critical value, indicating that the null hypothesis of no co-integration is rejected at the 5% significance level. The results showed five (5) co-integrating equations from the Maximum Eigen value statistics (Table 3). This shows a strong relationship between the prices of fish and the quantity supplied of fish.

The results from the Trace Test and Maximum Eigen Value Test above implied the existence of co-integration, indicating the quantity of fish supplied and the price series, such as dried tilapia, iced sardine, fresh tilapia, fresh African Arowana (*Bargi*), smoked catfish, fresh catfish, and prices of substitutes, beef and chicken in Borno State have a common trend.

The variables exhibit a long-run relationship, implying that the series are related and move together in the long-run. Even if shocks occur in the short run, which may cause the series to divert from equilibrium, they will converge to equilibrium in the long-run. This is related to the study of Etuk *et al.* (2010), which showed that 20.62% of all short-run deviations for the price of imported sardinella were corrected in the long-run and that the adjustment was instantaneous.

## CONCLUSION

It can be concluded that the prices of fish and the quantity supplied of fish were not stable over time, because of upward and downward trends. The quantity of fish supplied and fish prices moved together and were connected with seven co-integrating vectors.

It is recommended that fish farmers, processors, and marketers closely monitor changes in fish and substitute prices, and adjust their production and marketing strategies accordingly, to maximize their benefits and remain competitive in the market.

**REFERENCES**

Acquah, H. D. and Owusu, R. (2012). Spatial Market Integration and Price Transmission of Selected Plantain Markets in Ghana. *Journal of Sustainable Development in Africa*, 14(5): 208-217.

Bello, M. M., Sani, H., Bukar, A., and Rabiu, M. M. (2017). The Economic Effect of Insurgency on Smoked Fish Sellers in Maiduguri Metropolis of Borno State Nigeria. *Journal of Agricultural Extension*, 21(3): 37-45.

Bukar, A. M., Abubakar, M. S. and Baba, U. (2018). Assessment of Fish Production and Marketing in Borno State, Nigeira. *Journal of Fisheries and Aquatic Science*, 13(2): 123-135.

Bulama, Y. M. (2019). Analysis of Price Volatility and Integration of Cattle Markets In Nigeria. A Ph.D. This was thesis submitted to the Department of Agricultural Economics, Faculty of Agriculture, University of Maiduguri, Nigeria.

Bulama, Y. M., Idi, A. S., Jibrin, S., and Mustapha, F. (2022). Value Chain Analysis of the African Catfish (Clarias Gariepinus) among Female Farmers in Jere Local Government Area, Borno State, Nigeria. *Nigerian Journal of Fisheries and Aquaculture*, 10(1): 33-39.

Central Bank of Nigeria, CBN, (2022) National Survey on Fisheries Production in Nigeria. Retrieved 2024 *https://www.cbn.gov.ng/dfd/agriculture/cdi/fishery.html*

Dickey, D.A. and Fuller, W.A. (1979). Distribution of Estimators for Autoregressive Time Series with a Unit Root. *Journal of the American Statistics Association*. 74 (366): 427-431.

Etuk, E., Isangedighi, I., and Udom, D. (2010). Market Supply Response of Imported Sardinella in Cross River State, Nigeria. *Global Journal of Agricultural Sciences*, *9*(1): 48-51.

FAO. (2018). The State of World Fisheries and Aquaculture 2018—Meeting the Sustainable Development Goals. Rome. FAO. https://www.fao.org/documents/card/en/c/I9540EN

FAO. 2020. The State of World Fisheries and Aquaculture 2020. Sustainability in action. Rome. https://doi.org/10.4060/ca9229en

FAO. (2022). International Markets for Fisheries and Aquaculture Products. . *Global Fish Highlight: Food and Agriculture Organization of the United Nations Rome*,1(3): 63-68.

Happiness, Cecilia, R. and Alban M., (2014). Price Fluctuation of Agricultural Products and its Impact on Small-Scale Farmers Development: Case Analysis from Kilimanjaro, Tanzania, *European Journal of Business and Management*, 6 (36): 40-48

Jibrin, S. A., Bulama, Y. M., Idi, A. S., and Orjiakor, C. C. (2023). Analysis of Price Fluctuation and its Effect on Marketing of Smoked Fish in Maiduguri Metropolitan Council, Borno State, Nigeria. *Journal of Agricultural Economics, Environment and Social Sciences, 9(1):* 186-200.

Johansen, S. (1988). Statistical Analysis of Co-integration Vectors. *Journal of Economic Dynamics and Control*. 12(2-3), 231-254.

Mordi, K. M. (2022). Terrorism and Insurgency in Nigeria and Her Neighboring Countries: The Boko Haram Experience. *Terrorism*, 5(11): 23-34.

Natcher, W.C and Weaver R. D. (1999). Transmission of Price Volatility in Beef Markets: A Multivariate Approach: Selected Paper Presented at the 1999 AAEA Annual meeting, Nashville, Tennessee, USA.

National Bureau of Statistics (2022).National Agricultural Sample Survey. Public Access Data Set. Www. nigeriastat.gov.ng/pages/download/66

Obayelu, O. A. and Alimi, G. O. (2013). Rural-Urban Price Transmission and Market Integration of Selected Horticultural Crops in Oyo State, Nigeria. *Journal of Agricultural Sciences*, *58(3)*: 195-207.

Odioko, E., and Becer, Z. A. (2022). Economic Analysis of the Nigerian Fisheries Sector: A Review. *Journal of Anatolian Environmental and Animal Sciences, 7(2):* 216-226.

Olajide, O. A., Omitoyin, S. A., and Kosile-Palmer, O. (2022). Fish Price and Volatility Trends: An Assessment of Nigeria's Fishery Subsector. *Nigerian Agricultural Policy Research Journal (NAPReJ)*, 9(1): 64-75.

Oyetola, I. A., Sennuga, S. O., Bako, H., and Wilberforce, A. G. (2022). Exploring the Adoption of Fish Production Using Concrete Tank in the Municipal Area Council, Abuja. *South Asian Research Journal of Agriculture and Fisheries,* 4(2): 40-46.

Philips, P. C., and Perron, P., (1988). Testing for a Unit Root in Time Series Regression.

*Biometrica, 75(2):* 335-346.

Rufino, C.C. (2011). Analyzing the Philippines Inter-Regional Market Integration for Rice. *International Research Journal of Finance and Economics*, 6(9): 109-127.

World Bank. (2017). the Sunken Billions Revisited: Progress and Challenges in Global Marine Fisheries. The World Bank's Report.