# MARKET INTEGRATION OF DRY FISH MARKET IN OYO STATE NIGERIA

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**ABSTRACT**
*Market integration has been accepted as a condition for market efficiency. However, the Nigerian agricultural commodity markets have largely been characterized as oligopolistic in nature, with a few market leaders determining the prices and direction of flow of commodity. The paper examined the type and extent of short run market integration in dry fish markets in Oyo State, using the Augmented Dickey Fuller Unit Root Test, the Bivariate Autoregressive model and the Timmer's Index of market connection, in order to determine the level of efficiency of dry fish markets. The study made use of the Rural Sector Enhancement Programme (RUSEP) weekly commodity price data between 2001 and 2003. The study found that dry fish market was stationary in all markets studied except in Sango market. The bivariate auto regression shows that the dry fish markets were not integrated in the short run, however, they were integrated in the long run; with adjusted $R^2$, ranging from 0.002-0.44 showing low degree of price association. Pricing conducts analysis also shows that dry fish markets were independent and that instantaneous pricing were rare in the market pairs. Perfect price matching was also rare and lags were shown to be able to explain price changes in the dependent markets. The study concludes that dry fish markets integration is low and thus not competitive. It recommends provision of adequate market infrastructure, especially information and transportation to enhance transmission of price signal and information between markets.*

***Key Words:*** Spatial, Market Integration, pricing conducts, dry fish

## 1. Introduction

The livestock and fisheries industry in Nigeria is very important in terms of its contribution to livelihood, food and nutrition security, and trade revenue. The fisheries subsector in agriculture involves fishing and aquaculture. The fisher folks in the riverine and swamp areas engage in inland and marine water fishing, where they source for fish and other aquatic life forms such as crabs, lobsters and prawns. However, with the increased demand for fish and the low catch characteristic of inland and marine fishing in recent years, aquaculture has been on the increase. In recent times, aquaculture has become a veritable means of fighting food insecurity, poverty and unemployment issues especially in the urban areas. The demand for fish has been on the increase with the increased awareness of the nutritional benefits of fish. Fish is also the cheapest source of protein available and dry fish is able to solve protein problems with its longer shelf life than fresh fish. There is an increase awareness of the health impact of protein products as leading causes of health and labour efficiency, (Mafimisebi, 2001), for which fish can play an important role. The fisheries industry is also a major contributor to the economy of the country. A major part of the activities of both fisher folks and aqua culturist is the processing of the fish by drying them in order to increase their shelf life and add value. There is thus provision of income and veritable livelihood for the participants in the fisheries industry. The industry is also a major source of raw materials for the manufacturing and other industries within the country, especially the pharmaceuticals and feed industries. As a result of linkages, the sector also serves as the source of markets to other sectors within the economy, such as the pharmaceuticals, inputs and livestock feed sectors. Furthermore, the industry provides a source of revenue for the government through export of the dry fish. There have been efforts by producers and the government to improve the fisheries subsector.

One of such is the development of efficient agricultural marketing systems.

Literature on agricultural markets and marketing system shows that agricultural markets are mainly oligopolistic in nature and therefore neither integrated nor efficient, (Mendoza and Rosegrant, 1995; Okoruwa, 2004). The markets are often concentrated, suggesting non competitive pricing behaviour and market inefficiency, (Mendoza and Rosegrant, 1995). The presence of few large market agents within defined boundaries also suggests evidence of collusion and market power. This market structure has informed various government pricing policies, increased public spending on improved market services, uniform grading and standardization as well as organization of farmers into cooperatives. Market integration has been established for market efficiency, (Dittoh, 1994). It is therefore a measure of market performance for which commodity prices are used to determine. According to Mendoza and Rosegrant, (1995), Mafimisebi, (2001) and Okoruwa, (2004), market integration determines the efficiency of price transmission between physical markets, an indication of market efficiency. The principle of market efficiency which market integration typifies is based on the Law of One Price (LOP), which is an essential feature of perfect competition. The theory assumes that products are homogenous, there is perfect information about prevailing market conditions, many buyers and sellers as well as free exit and entry and complete mobility of factors of production.

Although there is an enormous potential for the trade in fish in Nigeria, market inefficiencies have been the case, such that prices are not adequate reflections of the production and other costs incurred. A very important ability of a market to efficiently and effectively perform its development functions depends on its integration. Market integration is the ease with which price changes and responses are transmitted spatially, temporally or in form between market pairs. This in turn depends on the availability and effectiveness of market infrastructure such as information, storage and transportation services. This becomes difficult to achieve in view of the inadequacies in the market infrastructure across the country and in Oyo State. The need for price analysis in any economy can therefore not be overemphasized. Price analysis shows efficiency in the employment of productive resources and allocation of productive efforts. Spatial pricing conducts of markets represent the equilibrium paths for demand and supply of commodity. Price movements show how information in production is transmitted in the market system and help identify opportunities for possible substitutions between markets and commodities. The degree of proximity in market prices will reveal the speed and accuracy of transmission of market information, (Jaraya, 1992). The information from this is essential in formulating price polices, production planning and forecasting. The need for this study is hinged on the importance of the development of agricultural markets in general and fish markets in specifics to the Nigerian economy in terms of its nutritional and economic benefits.

Market integration has become an important analysis in market studies and has been widely used in agricultural and financial studies. The need for consideration of space in agricultural marketing arises from the need to harmonise demand as a means of attaining spatial equilibrium and market efficiency Adekanye, (1998), using price consonance analysis found that there is variation in market integration of agricultural commodities in western Nigeria and that price differentials do not equal costs. The degree of long run co integration was studied by Golletti *et al,* (1995) in Bangladesh and the results found moderate long term integration. Adeleye (2004) found that using co integration analysis, long run relationship exists for rice markets in Nigeria. Low level long run integration was found in fresh and dry fish markets in Nigeria by Mafimisebi, 2002. According to Okoruwa, 2004, there is spatial price discrimination in sheep markets in Nigeria, suggesting high level of market segregation. Building on the studies above, this research focuses on verifying oligopolistic pricing behaviour in dry fish markets. However, this study is novel in the use of a dynamic bivariate autoregressive model for the analysis.

This study thus raised he following research questions; What is the differential level in prices in the dry fish markets in Oyo State? What is the level of market interdependence in the market pairs of dry fish? Is there evidence of collusion of market agents, instantaneous or delayed price

transmission and/or price leadership dry fish in the markets studied?

Based on the foregoing, the objective of this study was to assess the extent of spatial price equilibrium of the selected dry fish markets in Oyo State. Specifically, the study:

- Described the extent of variability in prices of dry fish markets in Oyo State
- Determined the level of independence in pricing behaviour between the markets of the commodities
- Examined the presence of instantaneous or delayed response to price matching.

## 2. Theoretical Framework and Literature

### Market Integration as a Measure of Market Performance

Market performance can be measured in two ways:

i. Market Integration, and
ii. Market Margins.

While market integration measures the interdependence between commodity markets, market margin is the difference between the price paid to the first seller and price paid by the last buyer. This is a relative measure of cost of marketing. This research focuses on market integration as a measure of the performance of dry fish markets in Oyo State. This is premised on the Oligopolistic nature of agricultural commodities which could give rise to collusion of market agents.

### Measurement of Market Integration

The importance of price discovery in agricultural marketing is that prices reflect costs of transportation, storage, processing and other value additions along the chain. Thus, the efficiency of a market is seen in its ability to distribute a commodity at prices that are both profitable to the producers and affordable to the consumers. Thus, market prices are the most important determinant of market performance, since they are more readily available and adequately reflect market situation, (Li and Barret 1999). Therefore, using market integration as a measure of performance, it is seen as a situation where there is synchronous movement of price in different markets.

There are three types of market integration: Spatial integration, Inter-temporal integration and Vertical integration. While spatial integration is the integration of markets across space, inter-temporal and vertical integration refer to integration over time and over form changes respectively. This study looks at spatial integration. According to Golleti *et al*, (1995), spatial integration is the co movement of price, that is the transmission of price signals and information across spatially separated markets. Measures of market integration using commodity prices include correlation analysis, Law of One Price (LOP), Granger Causality approach, Ravallion model and Co Integration tests.

## 3. METHODOLOGY

The study area is Oyo State, Nigeria from which four markets–two rural and two urban markets were chosen. The rural markets are Ago-Are and Ogbooro in Northern Oyo State, while the Urban markets are Bodija and Sango markets. The urban markets witness the influx of a lot of agricultural commodities and can be seen as wholesale markets for other markets within the State. Bodija market is especially a major commodity market in Oyo State, where farmers from all over the State and beyond bring in their produce for sale or distribution to other markets. The rural markets in Oyo North are notable as farm gate markets of the agricultural producing Northern Oyo State. They also serve as markets for processed agricultural commodities which are not produced in the area

### Source and Scope of Data

The data for this study was a secondary data sourced from the Rural Sector Enhancement Programme (RUSEP). Implemented by the International Institute for Tropical Agriculture, (IITA), the data was developed in conjunction with the Federal Ministry of Agriculture and Rural Development and the United States Agency for International Development (USAID).

The study area used in this study covered two urban and two rural markets for dry fish in Oyo State. The data is a time series data covering a period of weekly price data between 2001 and 2003.

**Data Analysis**

The following are the models to be use to test the hypotheses and carry out the objectives of the study.

**Unit Root Test of Stationarity**

The unit root test determines the stationarity of time series data such as the price data being used in this study. It is important to know the stationarity of price series in order to ascertain the effects of shocks such as inflation and seasonality on the series. A stationary series is one that returns to its mean and variance constantly, with broad amplitudes in fluctuations around the mean values. Thus, it is not permanently affected by shocks. A non stationary series is however one that has its means and variance varying over time, with an infinite variance; it is more likely to be affected permanently by shocks. A non stationary series is said to be integrated of the order'd',, i. ei (d); d, is the number of times the series has to be differenced to become stationary. The Augmented Dicker Fuller (ADF) test is used in this study and is given as:

$$\Delta P_t = \beta_1 + \beta_{2t} + \delta_{it-1} + \alpha \sum \Delta P_t^i + e_{it} \text{.....(1)}$$

The ADF critical values test the hypothesis that a series has a unit root. ADF statistics are always negative, thus a stationary series has an ADF less than (more negative) the critical value. If $\Delta P_t^i \sim I(0)$, then $P_{it}$ is integrated of the order Zero. If it is not at a stationary level, then it is ; $\Delta P_t^i \sim I(1)$, and $\Delta P_t^i \sim I(2)$, if first and second differenced respectively.

**Dynamic Spatial Pricing: Bivariate Auto Regressive Model**

The multiple vector auto regressive model is the basis for this analysis; and is given as:

$$\Delta P_t^i = \sum_{p=1}^{n} \left[ Ap_1 \Delta P_{t-p}^i \right] + \sum_{q=1}^{m} \left[ Bq_1 \Delta P_{t-q}^j \right] + \varepsilon_t^i \text{ .....(2)}$$

However, the study will use the autoregressive model developed by Mendoza and Rosegrant, (1995), which solves for the problem of multicolinearity. This is given thus:

$$\Delta P_t^i = \sum_{k-1}^{n} \alpha_k \Delta P_{t=k}^i + \sum_{l=0}^{m} \Delta P_{t-1}^j + e_t \text{ .....(3)}$$

$\Delta P_t^i$ and $\Delta P_t^j$ are the contemporaneous price changes in markets I and J respectively, i≠j.

The model above is assumed linear in all cases following previous studies.
The price changes were calculated by obtaining the first difference of their natural logarithm and then multiplying by 100 to void scaling problem. The differenced series eliminates the probability of first order correlation.

**Index of Market Concentration**

The Timmers index is used in this study to determine the type of integration that exists in markets for dry fish.
IMC= Absolute β0/β2 , for each market

$$\text{IMC} = \frac{\text{Coefficient of lagged own price ,}}{\text{Coefficient of lagged price of independent market,}}$$

$\Delta P_{t\,k}^i$, $\Delta P_{t\,l}^j$ are lagged own price and lagged price of independent markets respectively.

The IMC values test for whether there is low or high level market integration. The values of IMC range between 0 and ∞, such that :
IMC<1: Low market integration
IMC>1 : High Market Integration
IMC=∞': Market Segregation.

The study exclusively made use of the prices of the dry fish within the time period of 2001-2003. Contemporaneous prices ($\Delta P_{t-k}^i$), are the prices of the dry fish given per week. The lagged prices ($\Delta P_{t-l}^j$), are the prices of the dry fish lagged by each length to be specified.

**Hypotheses**

1. Market Integration
   H0: Dry Fish markets are independent and inefficient
2. Instantaneous price adjustments
   H0: there is no Instantaneous price adjustment between the dry fish markets
3. Price Matching with Delayed Response
   H0: there is no delayed adjustment in the dependent market response to a price change in the independent market.
   H0: $\beta_o = 0$

Rejecting the above hypotheses suggests an integrated, non collusive and hence competitive market system.

## 1. Results and Discussion

### Unit Root Test of Stationarity

The results of the Augmented Dicker Fuller Unit root tests are presented in table 1. The table shows the dry fish price series for Bodija, Ago Are and Ogbooro markets were stationary at their levels, first difference and second difference at 1%, 5% and 10%; while Sango dry fish market was stationary only at first and second difference. This implies that the prices of dry fish in the Bodija, Ago Are and Ogbooro markets are more stable than those of Sango markets, although all prices eventually become stable.

**Table 1: Unit Root Test in Dry Fish Markets**

| Market Price Series | Price Level of ADF, I(0) | First Differenced level, I(1) | Second Differenced Level, I(2) |
|---|---|---|---|
| Bodija | -6.540490(4)$^{S}$ | -5.707463(8)$^{S}$ | -6.242148(9)$^{S}$ |
| Sango | -1.969540(0)$^{NS}$ | -3.900992(0)$^{S}$ | -4.935147(1)$^{S}$ |
| Ago Are | -11.1.3268(0)$^{S}$ | -5.961927(9)$^{S}$ | -6.240913(10)$^{S}$ |
| Ogbooro | -7.924555(1)$^{S}$ | -5.097670(9)$^{S}$ | -5.589160(10)$^{S}$ |

*Source:* ***Computer Analysis of Data (RUSEP 2003)***

*Note: values of test statistic less than the specified critical values indicate a rejection of the hypothesis of unit root, i.e the series is stationary.*
*Numbers in parentheses are the lag length specified by the Akaike Information Criterion.*
*S and NS mean Stationary and Non Stationary respectively.*

### Dynamic Spatial Pricing

The dynamic spatial pricing analysis presents the results of the Bivariate autoregression the pricing conduct analysis and the results of the contemporaneous and lagged price effects.

Table 2 shows the result of the bivariate regression. The result shows that the model is appropriate from the diagnostic tests of the R2, and the Durbin Watson statistics. The Durbin Watson statistics for all the market pairs, except for Sango markets indicates the absence of serial correlation. This implies that the Akaike information criterion is capable of capturing every irregularity in the original price series, thus reducing the error term to white noise.

**Table 2: Bivariate Autoregressive Analysis in Dry Fish Markets**

| | Exogenous Variables | | | |
|---|---|---|---|---|
| **Endogenous variables/$R^2$** | **Bodija** | **Sango** | **Ago Are** | **Ogbooro** |
| **Bodija** | - | 0.37 | 0.30 | 0.25 |
| **Sango** | 0.002 | - | 0.03 | 0.03 |
| **Ago Are** | 0.17 | 0.09 | - | 0.44 |
| **Ogbooro** | 0.22 | 0.11 | 0.44 | - |

| Exogenous Variables | | | | |
|---|---|---|---|---|
| **Durbin Watson** | | | | |
| **Bodija** | - | 1.94 | 2.1 | 2.1 |
| **Sango** | 1.1 | - | 1.2 | 1.1 |
| **Ago Are** | 1.98 | 2.1 | - | 2.1 |
| **Ogbooro** | 2.0 | 2.1 | 1.97 | - |

***Source: Computer Analysis of Data, (RUSEP 2003)***
*Adjusted $R^2$ measures the goodness of fit of the equation; DW close to or equal to 2 indicates absence of serial correlation*

Table 3 presents the results of the pricing conducts of the spatial markets as indicated in the hypotheses. The hypothesis of independent pricing was rejected by only two of the market pairs, showing that there is spatial price discrimination. Thus, there is a low degree of market integration in the Oyo State dry fish markets.

The hypothesis of instantaneous pricing was rejected by all but one of the market pairs, indicating the absence of cartels or organized pricing arrangements. Thus, contemporaneous price changes do not occur instantaneously. This is intuitively correct as price changes have to travel through space and time through the presently inadequate and inefficient transformation and market information system.

The hypothesis of perfect price matching was accepted for all the market pairs, indicating a time lag between price changes between and among the market pairs.

**Table 3: Pricing Conducts Analysis in Dry Fish Markets**

| Market Pairs Py←Px Dep←Indep | Independent Pricing | Instantaneous and Perfect Cooperation | Perfect Price Matching with Offsetting Lags |
|---|---|---|---|
| **Bodija← Sango** | 0.21 | 112.87* | 0.0079 |
| **Sango←Bodija** | 3.01 | 5.95 | 0.014 |
| **Bodija←Ago Are** | 3.36 | 223.94* | 0.0048 |
| **Ago Are← Bodija** | 6.72** | 6.29** | 0.003 |
| **Bodija ←Ogbooro** | 0.68 | 258.22** | 0.011 |
| **Ogbooro←Bodija** | 8.03** | 11.73** | 0.00015 |
| **Sango←Ago Are** | 3.34 | 12.29** | 0.014 |
| **Ago are←Sango** | 0.00 | 219.00* | 0.00078 |
| **Sango←Ogbooro** | 0.00 | 22.08** | 0.0137 |
| **Ogbooro←Sango** | 0.25 | 237.65* | 0.00031 |
| **Ago are←Ogbooro** | 0.00 | 19.73* | 0.0004 |
| **Ogbooro←Ago are** | 2.16 | 230.97* | 0.003 |

*Source:* ***Source: Computer Analysis of Data, (RUSEP 2003)***
**, **: significant at |Prob|>|Fi| =0.001 and 0.005 respectively, Fi is the critical value.*

**Contemporaneous and Lagged price effects**

Contemporaneous and lagged price effects are presented in Table 4, to further verify the second and third hypotheses of the study. The results reveal that the F statistics were not significant for all the market pairs; implying that contemporaneous price changes in the dependent markets is actually affected by the independent markets. The results also show that distance is not a prerequisite for market integration in dry fish markets in Oyo State. This is seen in the very high magnitudes of the β for the market pairs of Ago-are to Bodija and Sango to Ago Are.

Lagged price coefficients were not significant as well; this indicates that lagged prices affect contemporaneous prices in the dependent markets. The magnitude of lagged own price shows that lagged own price has greater impact on contemporaneous price of dependent markets than even the lagged price of the independent markets.

**Table 4: Contemporaneous and Lagged Price Effects on Price Response in Dry Fish Markets**

| Market Pairs Py←Px Dep←Indep | Lagged own price (with lag lengths) | | Contemporaneous price effect | Lagged Price Effect (with lag lengths) | |
|---|---|---|---|---|---|
| Bodija← Sango | -0.304805$^{ns}$ | 5 | 0.000728$^{ns}$ | 0.224009$^{ns}$ | 4 |
| Sango←Bodija | 0.046504$^{ns}$ | 1 | 0.269301$^{ns}$ | -0.889934$^{ns}$ | 1 |
| Bodija←Ago Are | -0.383881$^{ns}$ | 3 | 0.069033$^{ns}$ | 0.098949$^{ns}$ | 2 |
| Ago Are← Bodija | -0.178108$^{ns}$ | 2 | 0.347898$^{ns}$ | 0.567089$^{ns}$ | 2 |
| Bodija ←Ogbooro | 0.329700$^{ns}$ | 3 | -0.011482$^{ns}$ | -0.001641$^{ns}$ | 2 |
| Ogbooro←Bodija | -0.183885$^{ns}$ | 2 | -0.087343$^{ns}$ | -5.67661** | 2 |
| Sango←Ago Are | -0.212481$^{ns}$ | 1 | 0.130509$^{ns}$ | -0.465954$^{ns}$ | 1 |
| Ago are←Sango | -0.34268$^{ns}$ | 1 | 0.032750$^{ns}$ | - | - |
| Sango←Ogbooro | -0.010613$^{ns}$ | 1 | -0.046641$^{ns}$ | - | - |
| Ogbooro←Sango | 0.214610$^{ns}$ | 2 | -0.028200$^{ns}$ | -0.141019$^{ns}$ | 1 |
| Ago are←Ogbooro | -0.141925$^{ns}$ | 3 | -0.564581$^{ns}$ | -0.027280$^{ns}$ | 2 |
| Ogbooro←Ago are | -0.122399$^{ns}$ | 2 | -0.632446$^{ns}$ | -0.195715$^{ns}$ | 1 |

*Source:* **Computer Analysis of Data, (RUSEP 2003)**

**Classification of Market Integration**

The Timmer index of market integration is presented in table 5. The result shows that about 50% of the market pairs showed low market integration, while two market pairs showed total market segmentation. Thus, we can conclude that there is more low level market integration in dry fish markets in Oyo State.

**Table 5: Index of Market Integration**

| Market Pairs; Py←Px (Dep←Indep ) | IMC (Absolute β0/β2 |
|---|---|
| Bodija← Sango | 1.361 |
| Sango←Bodija | 0.052 |
| Bodija←Ago Are | 3.880 |
| Ago Are← Bodija | 0.314 |
| Bodija ←Ogbooro | 200.914 |
| Ogbooro←Bodija | 0.0324 |
| Sango←Ago Are | 0.456 |
| Ago are←Sango | ∞ |
| Sango←Ogbooro | ∞ |
| Ogbooro←Sango | 1.522 |
| Ago are←Ogbooro | 5.2 |
| Ogbooro-Ago are | 0.625 |

*Source: Computer Analysis of Data, (RUSEP 2003)*

## 1. Summary, Conclusion and Policy Recommendations

The study investigated the extent of market integration in dry fish markets in Oyo state, using time series data from the Rural Sector Enhancement Programme. The study tested three hypotheses–market integration, instantaneous price adjustment and price matching with lags.

The results showed that dry fish markets are segregated and therefore inefficient. Instantaneous pricing does not occur; and thus there is the absence of cartels within the dry fish market system. Price matching with delayed response showed that dependent markets responded more to own lagged prices than lagged prices of independent markets.

The study concludes that dry fish markets in Oyo State are largely inefficient, with the high level of market segregation discovered. This could be a result of various factors such as inefficient pricing system and low level market infrastructural facilities. Information and transportation facilities are especially serious constraints as shown in the delayed response to price matching between the dependent and independent markets.

The study therefore recommends the following to improve the efficiency of dry fish markets and hence bring about the development of the economy;

- Development of an improved market information system. This will ensure that price data are collected to and from market pairs without delay in transmission. Efficient market information also provides supply information which helps bring about effective arbitrage between the markets.

- Provision of effective road network between and among the markets. Effective transportation system and road network will ensure that agricultural commodity is moved from surplus to deficit areas, while also transmitting price information. There will also be an overall decrease in the transportation costs, spoilage and risks associated with bad road networks and this translates to reduced costs of marketing.
- Market finance and insurance schemes need to be developed in a way that makes market infrastructure readily available to the dry fish marketers. One result of low integration is the increase in risks faced by marketers, especially when commodities are perishable. An effective finance and insurance scheme built on group ownership towards provision of credits to marketers, especially small scale marketers, will help in the prevention of collusion and hence ensure efficient market system.

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