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PRICE TRANSMISSION AND MARKET INTEGRATION OF BANANA AND PLANTAIN IN OYO STATE, NIGERIA

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ABSTRACT

Agricultural marketing system plays an important role in determining the prices received by the farmers and those paid by the consumers. This study examined the trend in plantain and banana prices in urban and rural market of Oyo state, Nigeria. Secondary data on plantain and banana monthly prices spanning 2004/2007 were sourced from Oyo State Agricultural Development Project (OYSADEP). The data were analyzed using Augmented Dicker Fuller (ADF) test, granger causality test and index of market concentration. The maximum and minimum prices of banana in the rural area were found to be N95.09/kg and N39.60/kg, respectively. Similarly for urban banana, the maximum and minimum prices attained were N114.17/kg and N31.5/kg, respectively. Furthermore, the maximum price of a kilogram of plantain attained in the rural market was N169.14/kg against N236.39/kg that was obtained in the urban market between 2004/2007. Plantain and banana price were all integrated of order one I (1). Six market links rejected their respective null hypothesis of no granger causality (P>0.05), two of the market links exhibited bi-directional granger causality or simultaneous feedback relationship while four market links exhibited uni-directional granger causality at 5% and 10% level of significance. Urban plantain market occupies the leadership position in the commodity price formation and transmission in the markets investigated. The Index of market concentration (IMC) indicates that the markets exhibit low short run market integration. The study recommends that the leader markets should be the target for any planned government reform.

Keywords: price transmission, market integration, banana, plantain, granger causality, Nigeria.

INTRODUCTION

Majority of agricultural markets in African countries are inefficient and poorly integrated and agricultural marketing efficiency in Nigeria is dismally low (Onyuma *et al*., 2006; Phillips *et al*., 2008). Transport costs are high due to poor road conditions, limiting access to inputs, credit, and output markets, and reducing the transmission of key market information. The increase in population at a considerable higher rate than increase in food production has continued to widen the gap between domestic food supply and domestic demand.

Olayemi (1982) observed that food marketing is a very important but rather neglected aspect of agricultural development. Also, food marketing by farmers and their families, mostly in the immediate post harvest period usually involves a lot of costs. As pointed out by Ahmed and Rustagi, (1987) for the case of Nigeria, these costs are so high that lowering the costs through efficient marketing system may be as important as increasing agricultural production.

According to Abbott (2009) agricultural commodities price have experienced unprecedented fluctuations and continuous increases since 2002 until mid 2008. He argued that this has brought about price volatility, food inflation, poverty and hunger. Couple with inadequate market price transmission, high food prices has increased the levels of food deprivation, droved millions of people into food insecurity, worsening conditions for many who were already food insecure, and threatening long term global food security. This place a tremendous pressure on achieving the millennium development goal (MDG) on hunger by year 2015 (FAO, 2008).

Banana and plantain fruits have diverse uses to millions of Nigerians and they have always been important traditional staples food for both rural and urban populace in Nigeria (Phillips, 1995; Baiyeri, 1996). Plantain and other varieties of cooking banana provide 30 percent of the daily calorific intake of African poorest population. Nutritionally, their fruits contain minerals, amino acids and provide more than 25% of the carbohydrates and 10% of the calorie intake for approximately 70 million people in Nigeria (INIBAP, 1995). They produce fruits year round, and provide extremely valuable source of food during the hunger season[1]. Plantains are attractive to farmers due to low labour requirement for production compared with other food crops such as cassava, maize, rice and yam (Mari cot and Lancaster, 1998). Plantains status as a poverty alleviating crop is enhanced by the fact that the crops have extended period of harvest thus becoming more and more important as cash crops and in some cases providing the sole source of income to the rural population (Gold *et al*., 1991).

Effective coordination of different markets is critical to increasing the opportunities for exchange and interdependence that underlie growing and expanding economies. Market integration ensures that a regional balance occurs among food deficit, surplus and non-cash crop producing regions (Goletti *et al.,* 1995). According to Barrett (1996), studies on market integration provide information on market performance which is necessary for

[1] The hunger season is the period of time when all the food from the main staple crops are off season and cassava is difficult to harvest

proper policy formulation and macroeconomic modeling. If markets are not spatially or inter-temporally integrated it could be indicative that market inefficiencies exist as a result of, amongst others, collusion and market concentration which result in price fixing and distortions in the market. In such cases, cross-sectional or inter temporal aggregation of demand and supply loses its logical foundation (Barrett, 1996). The result is that agricultural producers will fail to specialize according to long run comparative advantages and gains from trade will not be realized (Baulch, 1997). Ladele and Ayoola (1997) in their study on food marketing and its role in food security in Nigeria concluded that an efficient food marketing system would reduce post harvest losses, ensure adequate returns to farmer's investment and stimulate expansion in food production thereby enhancing the level of food security in Nigeria.

The agricultural marketing system plays an important role in determining the prices received by the farmers and those paid by the consumers (FAO, 2003). The persistence of rural poverty and food insecurity in the wake of satisfactory agricultural growth and pervasive government intervention in the agricultural marketing system of Nigeria suggests the need for a thorough review of the current agricultural marketing policies and systems, and the identification of new initiatives for improving marketing practices and performance (FAO, 2003). Without spatial price analysis of the markets, price signals will not be transmitted from food deficit to food surplus area, prices will be more volatile, agricultural producers will fail to specialize according to a long term comparative advantage and the gain from trade will not be realized (Chirwa, 2000). However, little is known about the price transmission effects of horticultural crops between different markets in the deregulated environment in Nigeria as a whole and in Oyo state in particular. This study therefore analyzes the trend in price of some selected horticultural crops (banana and plantain) in the rural and urban markets as well as the level of integration between markets for these selected horticultural crops in Oyo state and determine the causal relationship between and among the series. We base our study on the assumptions that there is no causal relationship between rural and urban prices of selected horticultural crops and secondly we assume that there is no causal relationship between rural and urban prices of selected horticultural crops. The remaining sections are divided as follow: section two presents the theoretical framework, section three the methodology. Section four deals with results and discussion while section five is concerned with conclusion and recommendations.

METHODOLOGY

The study made use of a combination of analytical tools namely trend analysis, co integration and Granger causality procedures. The first step in carrying out a time series analysis is to check for stationarity of the variables (price series in this case) (Masliah, 2002). A price series is stationary if its mean and variance are constant over time. Non stationary stochastic series have varying mean or time varying variance. The price series in this study were first tested for stationarity. The purpose was to overcome the problems of spurious regression. A variable that is non -stationary is said to be integrated of order *d*, written *I(d)*, if it must be differenced *d* times to be made stationary. In the same way, a variable that has to be differenced once to become stationary is said to be *I(1)* i.e., integrated of order 1. The augmented Dickey Fuller (ADF) was adopted to test for stationarity. This involves running a regression of the form:

$$\Delta P_{it} = \partial P_{t-1} + \sum_{t=1}^{P} \beta_1 \Delta P_{t-1} + \ell_{it} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots (1)$$

Where Δ = first difference operator, ∂ = 0, implies the existence of a unit root in P_{it} or that the price series is non-stationary, i = commodity price series, i.e., banana or plantain, t = time indicator, e_{it} is the error term. The process is considered stationary if $/\partial/<1$, thus testing for stationarity is equivalent with testing for unit roots ($\partial<1$) under the following hypotheses:

H_o: $\partial = 0$ the price series is non stationary or existence of unit root

H_1: $\partial < 0$ the price series is stationary or there is white noise in the series

The second steps consist of carrying out the Johansen tests using a linear deterministic trend in order to know the number of co-integrating vectors. The Johansen testing procedures have the advantage that they allows for the existence of more than one co integrating relationship (vector) and the speed of adjustment towards the long-term equilibrium is easily determined (Bakucs and Ferto, 2005). The model is presented thus:

$$\Delta X_t = \mu_t + \sum_{t-1}^{k} \Gamma X_{t-1} + \Pi X_{t-k} + \varepsilon_t \quad \ldots\ldots\ldots\ldots\ldots (2)$$

where X_t is an (N x 1) vector containing the series of interest (banana and plantains spatial prices series), Γ and Π = matrices of parameters, K = number of lags, and should be adequately large enough both to capture the short-run dynamics of the underlying Vector Auto-Regressive (VAR) and to produce normally distributed white noise residuals, ε_t = vector of white noise errors. The Johansen test will give an insight into the number of estimation equations that can be fitted. The presence of at least one co integrating relationship is necessary for the analysis of long run relationship of the prices to be plausible.

The third and final steps involve the Granger causality test which was carried out to determine the direction of causality. When two price series are co-integrated and stationary, one may proceed to carry out the Granger causality test. This is because one granger causal relationship must exist in a group of co integrated series

(Chirwa, 2000). When Granger causality run one way (uni-directional), the market which Granger-causes the other is tagged the exogenous market. Exogeneity can be weak or strong. Hendry (1986) observed that weak exogeneity occurs when the marginal distribution of $P_{i\,(t-1)}$ and $P_{j\,(t-1)}$ was significant, while strong exogeneity occurs when there is no significant Granger-causality from the other variable. It could also be bi-directional which indicates that both series influence each other (e.g. X causes Y and Y also causes X). The Granger model used in this study can be represented by:

$$\Delta P_{it} = \sum_{i=1}^{m} a_i \Delta P_{i(t-1)} + \sum_{j=1}^{n} a_j \Delta P_{j(t-1)} + \ell_t \qquad (3)$$

Where *m* and *n* are the numbers of lags determined by a suitable information criterion[2]. Rejection of the null hypothesis indicates that prices in market j Granger-cause prices in market i. The hypotheses under the Granger causality can be stated as follow:

H_o: price of banana or plantain in one market does not determine (granger cause) the price in the other market

H_1: price of banana or plantain in one market does determine the price in the other market (not granger cause)

Index of market concentration

The index of market concentration was used to measure price relationship between integrated markets. Following Oladapo and Momoh, (2007) approach, the actual rural price is given by the equation bellow.

$$P_t = \beta_0 + \beta_1 P_{t-1} + \beta_2 (R_t - R_{t-1}) + \beta_3 R_{t-1} + \varepsilon_t \qquad (4)$$

Where:

R_t= urban price (in Naira)
P_t = rural price (in Naira)
R_{t-1} = lagged price for urban market (in Naira)
R_t - R_{t-1} = difference between urban price and its lag (in Naira)
E_t = error term
β_o = constant term
β_1= coefficient of rural lagged price
β_2= coefficient of R_t - R_{t-1}
β_3 = coefficient of urban lagged price

From the estimation of equation (4) above, the Index of Market Concentration (IMC) is given by:

$$IMC = \frac{\beta_1}{\beta_3} \text{ where } 0 \leq IMC \leq \infty \qquad (5)$$

If:

IMC < 1 implies high short run market integration
IMC > 1 implies low short run market integration
IMC = ∞ implies no market integration
IMC = 1 high or short run market integration.

Study area and data collection

Oyo State occupies an area of about 28,454 square kilometers and a population of 5,591,589 (National Population Commission, 2006). Oyo state is in latitude 6^o55^1 - 8^o45^1N and longitude 2.5^{o}E - 3^o56^1E in southwestern Nigeria, West Africa. The mean annual rainfall ranges from 100mm to 1500mm. The agricultural sector of the state is dominated by food crops as well as cash crops. The choice of Banana and Plantain is due to their importance in the diet and the daily variation in prices. Secondary data on monthly retail prices of selected horticultural crops from 2004 to 2007 were obtained from the Oyo State Agricultural Development Programme (OYSADEP)[3].

RESULTS AND DISCUSSIONS

Price trend analysis

The maximum price of banana in the rural area was found to be ₦95.09/kg which was obtained in July and August, 2007. However, the minimum price in the rural area was obtained in March 2004 at the rate of ₦39.60/kg depicting fluctuation in prices across the seasons. Similarly for urban banana, the maximum price attained was ₦114.17/kg in March 2007 whereas the minimum price was ₦31.5/kg recorded in March 2004 (Figure-1).

[2] These could be Akaike and Schwarz information criterion
Schwarz criterion

[3] The Agricultural Development Project (ADP) zones are established to promote agricultural development in the area. In Oyo state, they have locations in Ibadan, Ogbomoso, Oyo north and Ibarapa.

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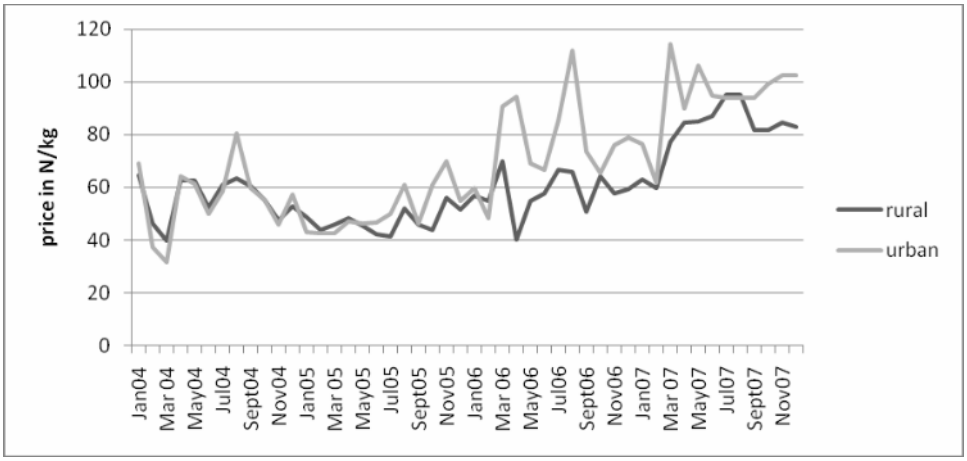

Figure-1. Trend in urban and rural prices of banana in Oyo State (2004 - 2007).

In the same vein, the maximum price of a Kilogram of plantain ever attained in the rural market of Oyo state was ₦169.14/kg in July 2007 as shown in the (Figure-2). The minimum price ever attained in rural market was ₦78.88/Kg in august, 2004. Furthermore, the highest price ever attained in plantain's urban market was ₦236.39/kg obtained in July, 2007 while the lowest price was obtained in July 2004 and was ₦98.30/kg, respectively (Figure-2).

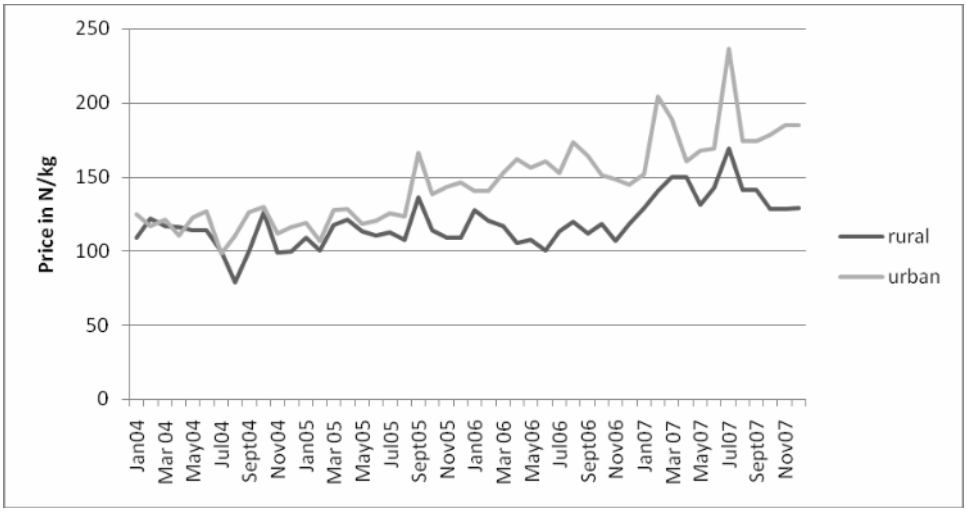

Figure-2. Trend in urban and rural prices of plantain in Oyo State (2004 - 2007).

The price of the horticultural crop was not stable across seasons. The peak of the price was always in the second and third quarters of the year while the least price was observed in the first and fourth quarter of the year. The reason for the variation in price can be attributed to the economic principle of supply and demand. The second and third quarters coincide with the period of high rainfall and the crop doesn't produce ripened fruits during this period and therefore the supply will be greatly reduced in the markets. Thus, these quarters of the year are regarded as off season and the resultant effect is the high prices of the fruits.

Stationarity test of banana and plantain in Oyo State

A variable is said to be non-stationary when the ADF t-statistics is smaller in absolute terms than the critical values. The non-stationary variable is said to be integrated of order 1, if it has to be differenced once to make it stationary and it is written as I(1). A variable that is stationary is integrated of order zero and it is written as I(0). The result in Table-1 shows the stationarity test for the horticultural crops using ADF procedure. The results indicate that all the variables are not stationary at their level. The values of the ADF t-statistics were smaller in absolute term than the critical value. This showed that the null hypothesis of non-stationarity could be accepted at the probability of 5 percent level of significance. Therefore, the null hypotheses of non stationary were accepted for all the variables at their level. The null hypotheses were however rejected at first difference for Rural and urban banana, rural and urban plantain. This agrees with the findings of Alexander and Wyeth (1994), Chirwa (2000),

Yusuf *et al.*, (2006) that commodity prices are stationary at the order of first difference. Thus, the test of co integration could be applied on the selected horticultural crop.

Table-1. Result of the stationarity test for selected horticultural crops in Oyo state.

Market	ADF (Level form)	Remark	ADF (first difference)	Remarks
Rural banana market	-1.21	Non stationary	-9.71***	Stationary
Urban banana market	-0.35	Non stationary	-9.09***	Stationary
Rural plantain market	-2.99	Non stationary	-8.57***	Stationary
Urban plantain market	-0.24	Non stationary	-7..04***	Stationary

*** significant at 1 percent level

Co-integration test for the selected horticultural crops

Co-integration test was carried out on all the variables to determine the existence of long-run relationship between the price variables. Table-2 presents the result of the co-integration test involving the use of Johansen Maximum Likelihood test to determine the number of co-integrating relations. The maximum Eigen value shows that out of the 2 market pairs investigated only one of them is co integrated at 5% level of significance. The null hypothesis of no co-integration was rejected at 5 percent significance level for only rural and urban banana while it was accepted for the rural and urban market of plantain, respectively. Therefore only the rural and urban bananas have their prices tied together in the long run.

Table-2. Results of johansen maximum likelihood test for rural and urban markets of banana and plantain in Oyo State (1994-2003).

Market pairs	Eigen value	Trace statistics	Critical value (5%)	Probability	Hypothesized No. of Co-integrating equation
RUMPB-URMPB	0.28 0.03	16.48 1.40	15.49** 3.84	0.04 0.24	None* At most 1
UMPP-URMPP	0.12 0.03	7.07 1.21	15.49 3.84	0.57 0.27	None At most 1

* Denotes rejection of the null hypothesis at 5% significance level

RUMPB is rural market price of banana; URMPB is urban market price of banana; RUMPP is rural market price of plantain and URMPP is urban market price of plantain

Granger causality test for banana and plantain prices in Oyo state

Twelve tomato market links were investigated for evidence of granger causality (Table-3). Six market links rejected their respective null hypothesis of no granger causality. From the result of the analysis, two of the market links exhibited bi-directional granger causality or simultaneous feedback relationship. Four market links exhibited uni-directional granger causality. Urban plantain market has a strong exogeneity over urban banana market. Furthermore, from the result of the analysis, few of the markets are spatially linked by trade. Therefore, there is low market integration between rural and urban market. This implies that price changes in one market are not manifested to an identical price response in other market (Goletti *et al.*, 1995, Barrett, 1996). There is also inadequate free flow of goods between markets and the markets are not linked by efficient arbitrage.

The Indices of Market Concentration (IMC)

The result of the indices of market connection (IMC) is presented in Table-4 below. For banana and plantain market pairs, the IMC were 2.12 and 1.94. The IMC for these market pairs were greater than one thus indicating low short run market integration. The results also show that price changes in the rural market do not cause immediate change in the prices in the urban market.

Table-3. Granger causality test for banana and plantain prices in Oyo state (2004 - 2007).

Null hypothesis	Observations	F-statistic	Probability
URBAN banana does not granger cause RURAL banana	46	0.82	0.45
RURAL banana does not granger cause URBAN banana		2.83	0.07*
RURAL plantain does not granger cause RURAL banana	46	2.92	0.07*
RURAL banana does not granger cause RURAL plantain		1.51	0.23
URBAN plantain does not granger cause RURAL banana	46	3.07	0.06*
RURAL banana does not granger cause URBAN plantain		1.92	0.16
RURAL plantain does not granger cause URBAN banana	46	3.84	0.03**
URBAN banana does not granger cause RURAL plantain		1.76	0.18
URBAN plantain does not granger cause URBAN banana	46	6.50	0.00**
URBAN banana does not granger cause URBAN plantain		4.05	0.02**
URBAN plantain does not granger cause RURAL plantain	46	1.24	0.30
RURAL plantain does not granger cause URBAN plantain		0.05	0.95

*significant at 10%, **significant at 5%

Table-4. Indices of market connection.

Market pairs	crops	R^2	Adjusted R^2	F statistics	DW	IMC classification
Rural and urban	Banana	0.77	0.75	47.39**	0.00	2.12 low short run market integration
Rural and urban market	Plantain	0.67	0.64	28.53**	1.94	1.95 low short run market integration

**coefficients significant at the rate of 1%

CONCLUSION AND RECOMMENDATIONS

The study examined price behavior of banana and plantain in rural and urban markets of Oyo State. The trend analysis showed that the prices of the crops in the markets studied moved in an upward trend from April to August of each year. This is due to the fact that prices were higher in those months compared to other months of the year. The stationary test indicated that the prices were not stationary at level form. However, at first difference prices became stationary thereby leading to the rejection of the null hypothesis of no stationary in the prices of the commodities. The result of the granger causality test confirmed urban plantain markets occupying the leadership position in price formation and transmission. The implication is that the leader markets should be the target for any planned government reform. With the indices of market connection, the banana and plantain market exhibit low short run market integration.

REFERENCES

Abbott P. 2009. Development Dimensions of High Food Prices. pp. 6-20.

Acharya S.S. 2003. Agricultural marketing in Asia and the Pacific: issues and priorities. Proceedings of the Mini Roundtable meeting on Agricultural Marketing and Food Security 1 to 2 November, 2001. Bangkok, Thailand. Food and Agriculture Organization of the United Nations Regional Office for Asia and the Pacific Bangkok, Thailand. p. 15.

Adekanye T.O. 1988. The markets for food stuffs in western Nigeria. Reading in Agricultural Marketing. Adekanye T.O (Ed). pp. 12-22.

Ahmed R and Rustagi N. 1987. Marketing and Price Incentives in African and Asian Countries: in Elz, D. (Ed), Agricultural Marketing Strategy and Pricing Policy, International Bank for Reconstruction and Development. Washington, USA.

Alexander C. and Wyeth J. 1994. Co-integration and Market Integration: An Application to the Indonesian Rice market. Journal of Development Studies. 30: 303-328.

Baiyeri K.P. 1996. Characteristics, correlation, path analysis and selection indices of Musa genotypes under different environments. A PhD Proposal, Department of Crop Science, University of Nigeria, Nsukka. pp. 1-12.

Bakucs L.Z and Ferto I. 2005. Marketing margins and Price transmission on the Hungarian Pork meat market. Agribusiness. 21(2): 273-286.

Barrett C.B. 1996. Market Analysis Methods: Are our enriched took kits well suited to enlivened markets? American Journal of Agricultural Economics. 78: 825-829.

Chirwa E. W. 2000. Liberalization of Food Marketing and Market Integration in Malawi. Final report of an AERC sponsored Research Work, presented at the Biannual Economic Research Workshop, Nairobi, Kenya. May 27, 2007.

Dittoh J. S. 1994. Market Integration: the case of dry season vegetable in Nigeria: Issues in African rural Development. pp. 89-101.

FAO. 2008. The state of food insecurity in the world. High food prices and food security threats and opportunities.

Gold C. S, M. W ogenga-Latigo, W. Tushemereirwe, I Kashaija and C. Nankinga. 1991. Former perception of banana pest constraints in Uganda: Results from a rapid rural appraisal, (Eds Gold C.S and B. Gemil), proceedings Res. Coord. Meeting for biological and integrated control of the highland banana pests and diseases in Africa. Cotonous, Benin, IITA Ibadan, Nigeria.

Goletti F, Ahmed R. and Farid N. 1995. Structural determinant of market integration. The case study of rice in Bangladesh. The development economics. Vol. (XXXII-2).

Greene William H. 2003. Econometric Analysis. 5th Edition.

INIBAP. 1995. Networking banana and plantain Annual Report. p. 48.

International Institute for Banana and Plantain. 2001. Annual Report of Plantain in West Africa.

Ladele A.A. and Ayoola G.B. 1997. Food Marketing and its Roles in Food Security in Nigeria. In: Shaib, B; Adedipe, N.O; Aliyu, A and Jir, M.M (Eds); Integrated Agricultural Production in Nigeria; Strategies and Mechanisms for Food Security. Proceedings of the National Workshop on Nigeria Position at the World Food Summit, Abuja, Nigeria. p. 88.

Maricot and Laancaster. 1998. Banana Physiology and Biochemistry of storage and ripening quality. Critical Review Food Sciences, Nutrition. 13: 42-88.

Masliah M.R. 2002. Stationarity and Non-stationarity Identification. Internet Publication.

Negassa A, Meyers R and Gabre-Maldhin E. 2003. Analyzing the grain market efficiency in developing countries: Review of existing methods and extensions to the parity bound model. Market trade and institutions division**.** Discussion paper. (63).

Nkendah R, Akyeampong E. 2003. Socio economic data on the plantain commodity chain in West and Central Africa, InfoMusa, 12 (1), International Network for the Improvement of Banana and Plantain. pp. 8-13.

NPC. 2006. National Population commission, Nigeria Census Results.

Oladapo M.O and Momoh S. 2007. Food price Differences and Market integration in Oyo State, Nigeria. International Journal of Agricultural Research. 2(1): 69-74.

Olayemi J. K. 1982. Improved Marketing as a Strategy for Generating Increased Food Production, A Nigeria Experience. West African Journal of Agricultural Economics. 1(1): 21-26.

Onyuma S. O, Icart E and Owuor G. 2006. Testing Market Integration for Fresh Pineapples in Kenya. Poster Paper prepared for presentation at the International Association of Agricultural Economist Conference, Gold Coast, Australia, August 12-18.

Phillip D, E. Nkonya, J. Pender and O. A. Oni. 2008. Constraints to Increasing Agricultural Productivity in Nigeria Strategy Support Program Brief No. 4 International Food Policy Research Institute.

Ravallion M. 1986. Testing market integration. American Journal of Agricultural Economics. 68: 102-107.

Yusuf S. A, Akanbi O. A and O. I. Y Ajani. 2006. Spatial Price Analysis of Cassava and its Products in Kwara State Nigeria, (1994-2006). Journal of Economics and Rural Development. 15(2): 103-112.