Nigerian Agricultural Policy Research Journal (NAPReJ) Agricultural Policy Research Network (APRNet)
Vol. 12, Issue 01. Website: http://www.aprnetworkng.org ©2025

NAPReJ

ISSN 2536-6084 (Print) & ISSN 2545-5745 (Online)

Yield Response of Selected Tuber Crops to Producer Prices in Nigeria

Oraka, E. O.

Department of Agribusiness
Joseph Sarwuan Tarka University, Makurdi, P.M.B. 2373, Benue State, Nigeria.
email: oraka.evelyn@uam.edu.ng

Abstract

The study assessed the yield response of tuber crops to producer prices in Nigeria. This study analyzed time series data from 1981 to 2021 using a longitudinal documentary survey design. The study sourced its variable data from the Food and Agriculture Organization (FAO) database. Data analysis involved the Philips-Perron (PP) test, the Augmented Dickey-Fuller (ADF) test, and the impulse response function. All of the variables were determined to be integrated of order one and became stationary on first differencing, according to the results of the Augmented Dickey Fuller (ADF) test for unit root. The result of impulse response analysis indicated that cassava yield responded positively to shocks in producer price; potato yield and yam yield both responded well to producer price shocks over the course of the period, both in both the short and long terms. It was concluded that producer prices play in influencing farmers' production decisions. The study therefore recommended that Governments and agricultural policymakers should establish price support programs to stabilize producer prices and provide financial incentives for farmers.

Keywords: Tuber, Yield, Producer, Price, Response, Impulse

Introduction

Agricultural activities in Nigeria are mainly animal husbandry and crop production. The predominant crops grown are grains and tubers. One of the most significant food crops for human consumption is tuber, also generating revenue and raw materials for some industries. They are versatile staple crops that ensure the security of food and nourishment for millions of people. Tuber crops are relatively affordable, but are nutritionally rich staple foods that contributes protein, carbohydrate, vitamin-A, vitamin-C, iron, and zinc in the dietary demand of people (Sanginga and Mbabu, 2015).

Nigeria's primary root and tuber crops are cocoyam (Xanthosoma spp. and Colocasia spp.), yam (Dioscorea spp.), sweet potato (Ipomoea batatas), and cassava (Manihot esculenta). Carrot (Daucus carota), ginger (Zingiber officinale), and Irish potato (Solanum tuberosum) are also becoming more popular. (Ochoche *et al.*, 2022). They are grown in diverse agro-ecologies and production techniques contributing to more than 240 million tons annually on about 23 million hectares (International Institute of Tropical Agriculture [IITA], 2015).

According to IITA (2015), practically all output increases over the past three decades have come from expanding the land area planted rather than from notable yield increases, despite the fact that root and tuber crops have grown significantly in comparison to other crops. The crops are affected by various factors such as climate change, diseases and pests attack and low yielding varieties, constraining yield improvement and the quality of produce (Ochoche *et al.*, 2022).

In a competitive economic system, commodity prices signal to producers what type and quantity of goods to produce at specific times and locations (Reddy *et al.* in Abu, 2015). Price relationships significantly influence decisions regarding agricultural activities. Most people think that farmers react to producer prices (Ezekiel *et al.*, 2007). Low prices especially worry them since they may jeopardize their long-term survival and way of living if their income is insufficient to support their families or farm needs. The prices of most farm commodities fluctuate throughout the season, following regular seasonal patterns (Abu, 2015). Typically, seasonal prices are lowest during harvest and peak just before the new harvest, especially for storable products such as tubers and grains (Olukosi *et al.,* 2007).

Price cycles follow production cycles, which are a result of the biological nature of agricultural output. Production cycles are in opposition to this pricing cycle. Prices decrease when supply rises, while prices rise when supply lowers (Ejionueme & Nebo, 2014). Ajibade *et al.* (2018) opined that a unit increase in yam production brought about 0.8095 unit decrease in the price of yam. Increase in production may account for the observed lowered prices as a result of excess supply over demand. There are distinct times of high and low production for various commodities because agricultural output is influenced by weather conditions. Thus, prices vary proportionally based on the season, reaching their lowest level at harvest and their peak a few weeks to the next harvest (Olukosi *et al.,* 2007).

Increased prices of outputs are expected to elicit an increased supply, leading to allocation of more land to agriculture by producers, and increased investments to improve yield (OECD, 2008). Although increased prices could result in expanding cultivation to less fertile land, potentially reducing yields, it has been proven by empirical studies that the positive effects outweigh the negative (Haile *et al*., 2016; Miao *et al.,* 2016). Conversely, the volatility of crop price discourages production, since the price of output is uncertain. The allocation of resources and investment decisions made by producers are negatively impacted by this risk (Moschini and Hennessy, 2001). This problem is more severe for farmers in developing nations, who usually do not have the resources needed to cope with (Binswanger & Rosenzweig, 1986) and are affected by the impacts of price volatility (Miranda and Helmberger, 1988).

Based on input use and output pricing that are unknown at planting, farmers must decide on the best crop production practices. As a result, they base their decisions on anticipated output prices rather than actual ones. According to the literature, if farmers receive fresh and pertinent information at planting time, they might choose to grow a different crop (Just & Pope, 2001). To appropriately model farmers' price expectations, it is crucial to take price, price risk, and other pertinent data into account during the planting season. Furthermore, crop output and the amount of land allotted for cultivation are two ways that input prices might impact agricultural productivity.

For farmers producing single crops, increase in the prices of inputs, such as fertilizer discourages the use of these inputs, leading to a decline in production. For farmers involved in multiple crop production, increased price of inputs might prompt them to diversify input usage to crops that need less expensive inputs. Furthermore, if the cost of an input such as fertilizer increases, farmers may choose to use other inputs, such as land, instead of it. Therefore, the question of how input prices affect output is ultimately an empirical one.

Understanding the relationship between tuber crop yields and producer prices in Nigeria would enhance the knowledge base of various stakeholders, including farmers, policymakers, government officials, NGOs, agronomists, students, and researchers. Therefore, this study assessed the yield response of tuber crops to producer prices in Nigeria.

Research Methods

Study Area

Nigeria is the studied area. With a total land area of 923,768 square kilometers and a population of 210.87 million in 2021 (NBS, 2021), Nigeria is situated between latitudes 4º N and 14º N and longitudes 2º2' and 14º 30' East. The country shares borders with the Republic of Niger and Chad in the north, the Atlantic Ocean in the south, and the Republic of Cameroon and Benin in the east and west, respectively.
Nigeria comprises five major vegetation belts: mangrove forest, savannah, equatorial forest, semi-desert, and guinea savannah. Although the country has a diverse range of climates, it is typically hot and humid due to its tropical location, which is advantageous for environmental diversity, culture, cultivation, and human practices. The agricultural sector is particularly significant in terms of creating jobs and contributing to GDP and export

earnings. Nigeria is divided into 36 states with six geopolitical zones, including the Federal Capital Territory of Abuja.

Methods of Data Collection and Analytic Technique

Time series data from 1981 to 2020 were used in the study. Information on pricing and yields was gathered from the Food and Agriculture Organization's (FAO) databases. The Philips-Perron (PP) test, the impulse response function, and the Augmented Dickey-Fuller (ADF) test were used to examine the study's data.

Model Specification

Unit Root Test

To check for the presence of unit root (a sign of non-stationarity), the Augmented Dickey Fuller (ADF) test was used. The method's strength is its ability to manage auto regressive processes of both first and higher order.

$$\Delta Y_t = \alpha_0 + \alpha_1 t + \beta Y_{t-1} + \sum_{i=1}^{p} \delta_i \, \Delta Y_{t-i} + \varepsilon_1 \quad (1)$$

where Y is cassava yield or yam yield or potatoes yield or cassava price or yam price or potatoes price as the case may be.

α_0 is the constant,
α_1 is the coefficient of the trend series,
p is the lag order of the autoregressive process,
Y_{t-i} is the lag value of order one of Y_t and
ε_1 is the error term.
Δ is the change operator
t represents the variable time and
u_t is the white noise error.

The null hypothesis, which states that σ = 0, indicates that the time series is non-stationary or that there is a unit root in Yt. The hull hypothesis of the unit root is accepted if the calculated ADF statistics are greater than the critical at the designated level of significance; if not, it is rejected.

Impulse Response Function

The dynamic response of a model to a shock was investigated using impulse response analysis (Lutkepohl, 1993). It tracks how the present and future values of the endogenous variables are affected by a one-time shock to one of the innovations. Pasarin and Shin (1998) proposed that an unrestricted VAR of the form:

$$\mathrm{Y_t} = \sum_{i=1}^{p} A_i Y_{t-i} + \sum_{i=1}^{p} A_i P_{t-i} + U_t \quad (2)$$

With Y_t representing the endogenous variables (past values of cassava, yam, and potato yields and prices), Y_(t-i) and P_(t-i) representing the lagged values of the series being studied, U__t representing innovations, and A_i representing parameters deemed stable and represented by a moving average (MA) as follows:

$$\mathrm{Y_t} = \sum_{i=1}^{\infty} \Phi_i U_{t-i} \quad (3)$$

$$\mathrm{P_t} = \sum_{i=2}^{\infty} \Phi_i U_{t-i} \quad (4)$$

Where:

$$\Phi_i = A_1 \Phi_{i-1} + A_2 \Phi_{i-2} + A_3 \Phi_{i-3} \dots\dots\dots\dots\dots A_p \Phi_{i-p}. \quad (5)$$

The MA coefficient that measures the impulse reaction to a unit of exogenous innovation is represented by the parameter Φi. To be more precise, Φi is the reaction of Yt, Pt, to a unit impulse from one of the system's variables that happened i-th period ago. However, transformation techniques like Cholesky factoring are typically used to obtain orthogonalized replies in order to prevent issues related to linked innovations.

Results and Discussion

Unit root test

To ascertain if a variable is stationary and to ascertain the order of integration of the variable, the Philips-Perron (PP) test for unit root and the Augmented Dickey Fuller (ADF) test were utilized (Table 1). The findings of the Philips-Perron (PP) and Augmented Dickey Fuller (ADF) tests were used to make the decision because they were identical. According to the results, all of the variables—yam production, cassava yield, and potato price—were found to be integrated of order one and to become stationary at initial differencing. This suggests that either the variables' future values do not converge from their historical values or that they display random walk (unit roots).

Table 1: Result of ADF and PP Tests

Variables	Augmented Dickey-Fuller Test				Phillips – Perron Test				Decision
	ADF stat	Prob.	Critical value @ 1%	Order	PP Stat	Prob.	Critical value @ 1%	Order	
Cass yield	-7.7157***	0.0000	-3.6104	Δ I(1)	-8.0771	0.0000***	-3.6104	Δ I(1)	Stationary
Yam yield	-8.2184***	0.0000	-3.6104	Δ I(1)	-8.4441	0.0000***	-3.6104	Δ I(1)	Stationary
Potat yield	-6.7528***	0.0000	-3.6104	Δ I(1)	-6.7403	0.0000***	-3.6104	Δ I(1)	Stationary
Cass price	-10.741***	0.0000	-3.6104	Δ I(1)	-12.1692	0.0000***	-3.6104	Δ I(1)	Stationary
Yam price	-8.0724***	0.0000	-3.6104	Δ I(1)	-8.0952	0.0000***	-3.6104	Δ I(1)	Stationary
Potat price	-4.9092***	0.0003	-3.6104	Δ I(1)	-4.8783	0.0003***	-3.6104	Δ I(1)	Stationary

Source: Data Analysis, 2023 Δ = difference operator ***significant at 1% ($P < 0.01$) level of significance

Response of Tuber Crops Yield to Producer Prices in Nigeria

Response of Cassava Yield to Shocks in Producer Prices

Figure 1 displays the findings from the investigation of impulse response, and summarized in Table 2. findings indicated that the yield of cassava responded positively to shocks in producer price in the short and long runs over the period. The effect of this shock was higher during the first period where it peaked at 3.35%. However, the effect of the shock declined gradually in the long run till the 10th period where it dovetailed to 1.79%. This implies that the effect of shocks arising from one-standard-deviation innovation in producer price has the tendency of increasing cassava yield both in the short and long run *ceteris paribus*. Commodity pricing in a competitive economy provide producers with information about the kind and amount of goods that should be produced in a specific location at a specific time (Reddy *et al*. in Abu, 2015). In theory, higher prices encourage more land to be farmed, which raises yield (Haile et al., 2016; Miao *et al*., 2016). The farmer makes production decisions subject to expected output prices in order to maximize profits.It is suggested that producers base their decisions on the anticipated crop prices, as rational producers are predicted to increase their usage of inputs in reaction to rises in crop prices (Bor and Bayaner, 2009).

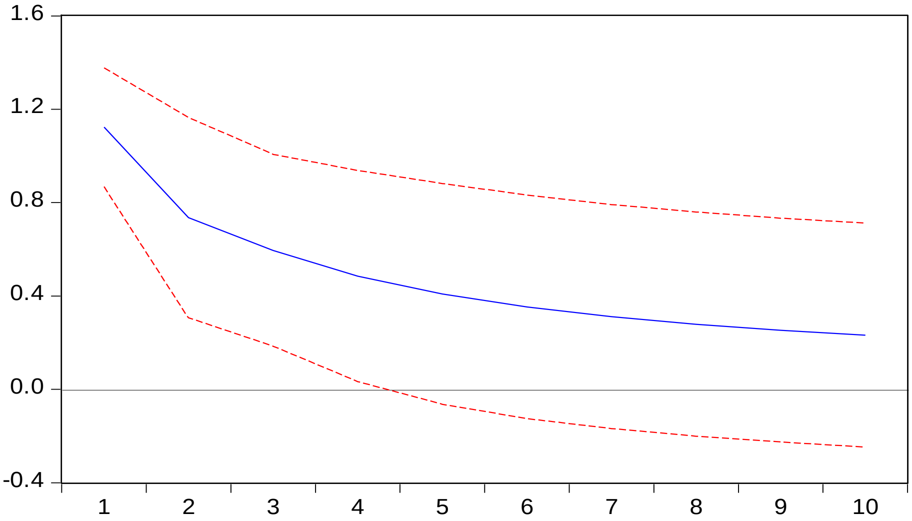

Figure 1: Impulse Response of Cassava Yield to Shocks of Producer Price

Source: Data Analysis, 2023.

Response of Yam Yield to Shocks in Producer Prices

The result in Figure 2 indicated that yam yield responded positively to shocks in producer price both in the short and long run over the period. Effects of the shock slowly retrogresses from 0.103% in the first period to 0.032% in the 10th period. This implies that the effect of shocks arising from one-standard-deviation innovation in producer price has the tendency of increasing yam yield both in the short and long run *ceteris paribus*. This is in line with recent research showing that output prices have a major positive effect on crop yields (e.g., Acharya, 2018; Miao *et al*., 2016). It is generally believed that farmers are responsive to producer prices (Ezekiel *et al*., 2007). The impact of producer prices on crop production fluctuates periodically based on other prevalent conditions because the majority of Nigerian crop producers are subsistence farmers with little access to modern inputs, market intelligence, and other yield-enhancing alternatives. Prices vary accordingly depending on the season, reaching their lowest during harvest and peak a few weeks to new harvest (Olukosi, Isitor and Ode, 2007).

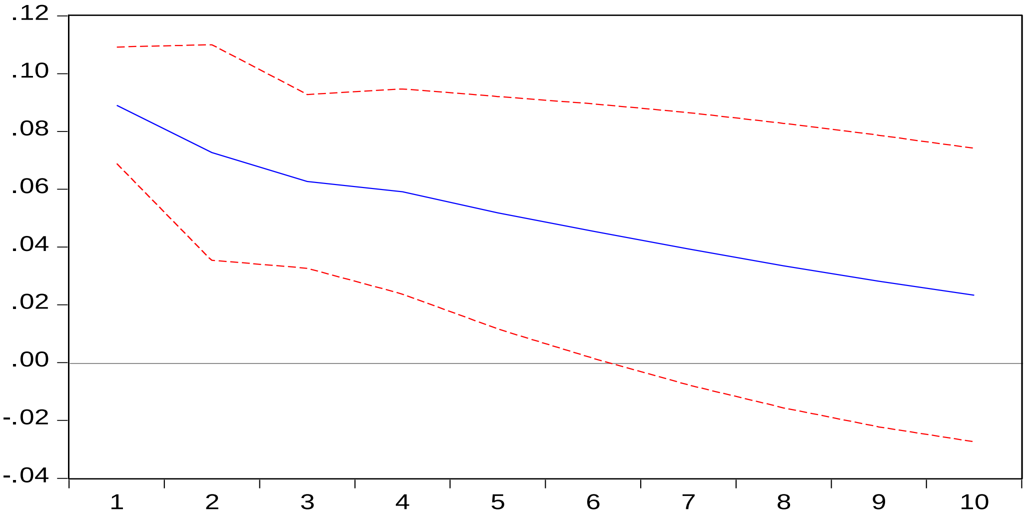

Figure 2: Impulse Response of Yam Yield to Shocks of Producer Price

Source: Data Analysis, 2023

Response of Potatoes Yield to Shocks in Producer Prices

Analysis of the impulse response function presented in Figure 3 indicated that potatoes yield responded positively to shocks in producer price both in the short and long runs over the period. The effect of this shock was higher during the first period where it climaxed at 1.123%. However, the effect of the shock declined gradually in the long run till the 10^{th} period where it ebbed to 0.232%. This implies that the effect of shocks arising from one-standard-deviation innovation in producer price has the tendency of increasing potatoes yield in the short and long run *ceteris paribus*. Haixiao and Madhu (2010) reported that crops yield respond positively to their own prices. This may be attributed to the fact that higher crop prices may serve as an incentive to farmers to cultivate more of such crop in the preceding farming season.

The impulse responses were significant in the short run and in the long runs over the period (impact period) since the bands (confidence interval) were non-negative during the period. Therefore, the null hypothesis which stipulated that yield of tuber crops does not respond to shocks from producer prices in Nigeria is hereby rejected and the alternative accepted.

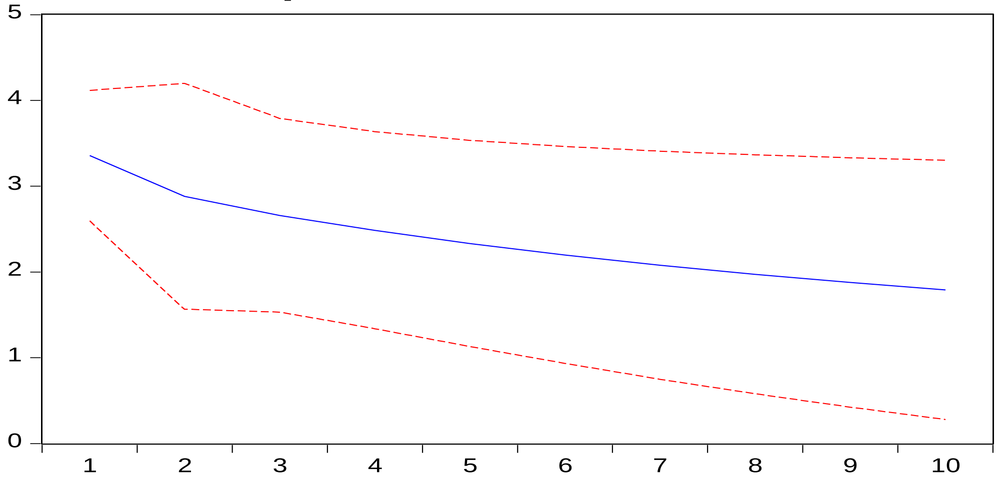

Figure 3: Impulse Response of Potatoes Yield to Shocks of Producer Price

Source: Data Analysis, 2023.

Table 2. Cholesky Ordering: Response of Tuber Crops Yield to Producer Prices

Period	Cassava Yield	Yam Yield	Potatoes Yield
1	3.356787	0.102873	1.123379
	(0.38008)	(0.01165)	(0.1272)
2	2.882729	0.071371	0.73563
	(0.65822)	(0.01888)	(0.21436)
3	2.659626	0.070834	0.595349
	(0.56505)	(0.0173)	(0.20564)
4	2.485755	0.067723	0.485319
	(0.57475)	(0.02086)	(0.22612)
5	2.331553	0.061172	0.40877
	(0.60125)	(0.02378)	(0.23637)
6	2.196856	0.055406	0.353086
	(0.63227)	(0.0261)	(0.23942)
7	2.077977	0.049221	0.311419
	(0.66474)	(0.02771)	(0.24005)
8	1.972059	0.043109	0.279198
	(0.69658)	(0.02871)	(0.24003)
9	1.876845	0.037267	0.253435
	(0.72609)	(0.02918)	(0.23994)
10	1.790522	0.031772	0.23217

	(0.75529)	(0.02917)	(0.23978)

Note: Figures in parenthesis are standard errors
Source: Data Analysis, 2023.

Conclusion

The study's impulse response analysis provides robust evidence that the yields of cassava, yam, and potatoes in Nigeria respond positively to shocks in producer prices in the short run and the long runs. Specifically, initial impact of a one-standard-deviation increase in producer prices leads to a significant boost in crop yields, with the strongest effects observed in the first period for cassava (3.35%), yam (0.103%), and potatoes (1.123%). Over time, these effects gradually diminish, stabilizing at lower levels by the 10th period, yet remaining positive at 1.79% for cassava, 0.032% for yam, and 0.232% for potatoes.

These findings underscore the critical role that producer prices play in influencing farmers' production decisions. Higher prices signal to producers the economic viability of increasing the acreage and inputs for specific crops, thereby enhancing yields. This behavior aligns with the economic theory that rational producers adjust their input usage based on expected output prices to maximize profits.

The study's findings offer some useful policy suggestions that are relevant to the Nigerian economy.

i. Governments and agricultural policymakers should establish price support programs to stabilize producer prices and provide financial incentives for farmers. This could involve setting minimum price thresholds or offering subsidies during periods of low market prices to ensure that farmers remain motivated to increase their crop yields.

ii. Improve the dissemination of market information to farmers through the use of mobile technology, extension services, and farmer cooperatives. Provision of timely and accurate price information to farmers can help them make informed production decisions.

iii. To improve market access and reduce post-harvest losses, there should be increased investment in rural infrastructure such as roads, storage facilities, and irrigation systems. Better infrastructure can help farmers get their produce to market more efficiently, thereby benefiting from higher prices.

iv. Enhance the capacity of agricultural extension services to provide farmers with the latest knowledge and technologies. Regular training and support can help farmers adopt best practices that respond effectively to market signals.

References

Abu, O. (2015). Long Run Relationship between Sorghum Yield, Rainfall and Producer Price in Nigeria. *International Journal of Food and Agricultural Economics*. 3(1): 77-86

Acharya, R.N. (2018). The Effects of Changing Climate and Market Conditions on Crop Yield and Acreage Allocation in Nepal. *Climate*, 6:32. doi:10.3390/cli6020032

Ajibade T. B., Ayinde O. E., Abdoulaye T. and Ayinde, K. (2018). Determinants of Price of Yam in Nigeria: A Times-Series Analysis. *Nigerian Journal of Agricultural Economics*. 8(1): 109-119.

Binswanger, H. P. and Rosenzweig, M. R. (1986). Behavioural and material determinants of production relations in agriculture. *The Journal of Development Studies*, 22(3), 503-539.

Ejionueme, N.G and Nebo, G.N (2014). Understanding Agricultural Marketing. Enugu: Immaculate Publications Ltd.

Ezekiel, A.A., Oladeebo A.O., Oladejo J.A., and Olapade F. (2007). Farm-gate and retail price relationship for selected foodstuffs: Implications for increased food production in Nigeria. *Agricultural Journal*, 2(5): 542-543.

Haile, M. G., Kalkuhl, M. and von Braun, J. (2016). Worldwide Acreage and Yield Response to International Price Change and Volatility: A Dynamic Panel Data Analysis for Wheat, Rice, Corn, and Soybeans. *American Journal of Agricultural Economics*, 98(1), 172-190.

Haixiao, H. and Madhu, K. (2010). An Econometric Analysis of U.S. Crop Yield and Cropland Acreage: Implications for the Impact of Climate Change. Selected Paper prepared for presentation at the Agricultural & Applied Economics Association 2010 AAEA, CAES, & WAEA Joint Annual Meeting, Denver, Colorado, July 25-27, 1-33.

International Institute of Tropical Agriculture [IITA] (2015). Root and Tuber Crops (Cassava, Yam, Potato and Sweet Potato). An action plan for African agricultural transformation. Feeding Africa, 21-23rd October, 2015. Abdul Diouf International Conference Centre, Dakar Senegal.

Just, R. E. and Pope, R. D. (2001). The Agricultural Producer: Theory and Statistical Measurement. In B. L. Gardner & G. C. Rausser (Eds.), *Handbook of Agricultural Economics*, vol. 1A (pp. 629-741). North-Holland, Amsterdam.

Lutkepohl, H. (1993). Introduction to Multiple Time Series Analysis, *Berlin: Springer-Verlag*. Pp 48.

Miao, R., Khanna, M. and Huang, H. (2016). Responsiveness of Crop Yield and Acreage to Prices and Climate. *American Journal of Agricultural Economic*s, 98(1), 191-211. doi: 10.1093/ajae/aav025

Miranda, M. J. and Helmberger, P. G. (1988). The effects of commodity price stabilization programs. The American Economic Review, 78(1), 46-58.

Moschini, G. and Hennessy, D. A. (2001). Uncertainty, risk aversion, and risk management for agricultural producers. Handbook of Agricultural Economics, 1(A), 88-153.

National Bureau of Statistics (2021). Annual Abstract of Statistics. Available online at www.nigerianstat.gov.ng

Ochoche, C.O, Abah, D. Biam, C.K. (2022). Trends, instability and decomposition analysis of root and tuber crops in Nigeria (1981– 2020): implications for food security. *Discovery Journal*, 58(319), 719- 727.

Olukosi, J. O., Isitor S. U. and Ode M. O. (2007*). Introduction to Agricultural Marketing and Prices: Principles and Applications*. Living Books Series, GU Publications, Abuja, Nigeria; ISBN 978-2022-23-3.

Organisation for Economic Co-operation and Development [OECD] (2008). Rising Food Prices: Causes and Consequences. Organisation for Economic Co-operation and Development (OECD). Paris, France.

Sanginga, N. and Mbabu, A. (2015). Root and Tuber Crops (Cassava, Yam, Potato and Sweet Potato). Feeding Africa: An action plan for African Agricultural Transformation.