ASSESSMENT OF SESAME PRODUCTION AND ITS EXPORT VALUE IN NIGERIA

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Abstract
The study assessed sesame production and its export value in Nigeria. Time series data for the study were obtained from the Food and Agriculture Organisation (FAO, 2020). The data spanned from 1988 to 2021. The Augmented-Dickey Fuller test, Phillips-Perron test, Johansen-Juselius unrestricted cointegration rank test, vector-error correction model (VECM) for long-run relationship and vector autoregression (VAR) model for short-run relationship were employed by the study. The Augmented-Dickey Fuller and Phillips-Perron tests were conducted on the data. Both tests confirmed that the variables were integrated of order one. Both the trace and max-Eigen tests of the Johansen-Juselius unrestricted cointegration rank test predicted the existence of a long-run relationship between sesame production and its export earnings. While the VECM confirmed a statistically significant ($p<0.01$) and symmetric relationship between sesame production and sesame export earnings, the VAR model ascertained an asymmetric relationship between sesame production and its export earnings. It was recommended that the NEPC should avail sesame farmers of technologies that would enhance their productivity for increase exportation; and deploy its expertise and Export35 strategies to ensure higher growth rates of export volumes and earnings.

***Keywords*:** *Assessment, Production, Value, Sesame, export*

Introduction

Sesame *(Sesamum Indicum L.)* belongs to the plant family *Pedaliacea*. The crop is believed to have originated from tropical Africa, where the greatest genetic diversity exists and was later taken at a very early date to India, where a secondary centre of diversity developed (Samuel, Baba, Abba, and Enan, 2020). The crop is now grown in a wide range of environments, extending from semi-arid tropics and sub-tropics to temperate regions (Ali, Salawu and Sani, 2015). It is well known to small holder farmers and has a relatively short harvest cycle of 90 – 140 days allowing other crops to be grown in the same field (Samuel *et al.,* 2020).

Sesame seed is one of the most ancient oilseed crops known to mankind (Samuel *et al.,* 2020). It was widely grown in tropical countries in Africa, and it is not clear where the original domestication site was, but it is thuoght to have originated from Africa and spread to Western Asia, China, and in Japan. It was cultivated for its edible seeds which grow in a pod. Sesame is an oil plant that contains 50-60% oil and 25% protein in its seeds (Okadonye, Pinga, Joseph, Kennedy, Saidu, Otse and Apochi, 2023). This plant has been known to people since ancient times and is used in various ways. It is widely consumed in pastries such as bagels, cakes, donuts, or making candies. Sesame oil is one of the highest quality vegetable oils. However, since the use of this oil is not economical, its consumption in Nigeria has remained limited. At the same time, sesame is an important plant due to its lack of soil selectivity, low need for nutrients, drought tolerance, and no problems in marketing (Okadonye *et al.,* 2023). In 2020, 6.8 million tonnes of sesame were produced in an area of approximately 14.8 million hectares in the world.

Sesame cultivation areas are mostly in Sudan with 5.2 million hectares, India at 1.52 million hectares, Myanmar with 1.5 million hectares, Tanzania at 0.96 million hectares, Nigeria at 0.62 million hectares, Ethiopia with 0.45 million hectares of the world's total area harvested of sesame (FAO, 2020). Sudan (22.42%), Myanmar (10.9%), India (9.67%), Tanzania (10.4%), Nigeria (7.2%), and Ethiopia (3.8%) have significant shares in the world sesame production. The average sesame yield in the world is 51.8 kg/da. Yield per decare in India, Sudan, and China is 40.6 kg,

28.5kg, and 122.0 kg, respectively (FAO,2020).

World production of sesame was estimated to be 5,531,948 metrics tonnes produced on 9,983,165 hectares of land in 2017. Asia is the major producer (56.4%) of sesame in the world, followed by Africa (39.3%) and America (4.4%). The largest producer of sesame is India (665,566.67 tonnes) followed by China (616,004.96 tonnes) while Nigeria (192,295.96 tonnes) ranks 8th out of the ten (10) major producing countries in the world (FAO, 2018). Apart from foreign exchange earnings, the produce is locally processed and used in diverse forms such as local snacks and pap known as "*kantun ridi*" and "*kunun ridi*", respectively. Additionally, oil is extracted from the seed and the cake is made into "*kulikuli*", which together with the leaves are used to prepare local soup known as "*miyar taushe*". The oil is used for cooking and medicinal purposes such as the treatment of ulcers and burns. The stem and the oil extract are also used in making local soap. The young leaves are eaten in stews, and the dried stems can be used as a source of fuel (Okadonye *et al.,* 2023). Industrially, most sesame is processed directly into oil, but can also be sold at various stages of processing, for various uses such as meal, paste, confections, and bakery products. The oil can also be used as raw material for production of paints, margarine and varnishes.

Major sesame producing States in Nigeria are Nasarawa, Jigawa, Benue, Yobe, Kano, Katsina, Kogi, Gombe and Plateau States (Nigeria Export Promotion Council (NEPC, 2018). In Africa, Nigeria is the largest producer of sesame seeds, about 90% of sesame seeds produced in the country are exported. In the first quarter of 2018, it was reported that sesame was the most exported non-oil commodity, contributing 0.57% to the total export value and 36.39% of agricultural exports (NEPC, 2018). Nigeria has the highest untapped potential from sesame export estimated to be $170 million (NEPC, 2018). In recent times, more emphasis is now being placed on increased domestic supplies of agricultural products. One of the major factors responsible for low agricultural productivity in Nigeria is farmers' limited access to production inputs which are necessary for attaining a high level of profit. Okadonye *et al., (*2023), observed that crop farmers mostly carry out their production under conditions involving the use of inefficient tools and unimproved seed varieties and therefore, maximum profitability is elusive to them.

In the same vein, Sesame production has started to decline at all levels. At the world level, sesame production was reported to have declined from 6,270,708 metrics tonnes in 2014 to 5,531,948 metrics tonnes in 2017 with an area of 10,898,243 and 9,983,165 hectares respectively which has also led to slight decline in productivity from 0.57 tonns/hecatres in 2014 to 0.55 tonns/hectares in 2017 (FAO, 2018). In Nigeria, sesame production declined from 994,800 tonnes in 2012 to 550,000 tonnes in 2017, with an area of 499,100 and 500,000 hectares, respectively, while productivity had also declined from 1.99 tonnes/hectares in 2012 to 1.1 tonnes/hectares in 2017 (FAO, 2018). According to Olowe, (2007), there is a wide gap between potential and actual yields obtained. Godwin, Daniel and Stephen (2011) reported actual sesame yield of 300kg/ha against potential yield of between 700-1,000 kg/ha which is below the world average yield of 4,900kg/ha and four times lower than the average yield of other oil seed crops like groundnut and soybean. Fassil (2024) added that actual sesame yield was 0.55 tonnes/ha against a potential yield of 2 tonnes/ha with a yield gap of 264% for North-Central Nigeria. The decline in sesame production could be due to the fact that some farmers abandoned production of sesame for more remunerative crops like groundnut and soybean as a result of low profit. In addition, production decline could be due to inadequate institutional and technological framework put in place which reduces profit. While the production of sesame is on the decline in the study area, the demand for the commodity is growing strongly in all the major consuming countries.

Sesame is one of the important commercial crops grown in Nigeria. It is reported that 85% of small-scale farmers in Nigeria are involved in sesame production, processing and marketing in the area which indicates the potentials of the crop to uplifting the living standard of all the actors involved in its production, marketing and processing (Ali, Salawu and Sani 2015). The international price of sesame has been on the rise as a result of the increasing demand for the product in most parts of the world. However, this increase in the price of the product is being upset by the ever-rising cost

of the inputs in the nation which in return is reducing farmers' profit. As a result of its high demand, any quantity of the product offered to the market is easily sold. This increasing demand for sesame seed provides Nigeria an opportunity to increase its production to meet the international demand for the commodity. The realization of the potential of sesame production in the acquisition of foreign currency for the country makes production of the crop a prominent priority in the agricultural sector of Nigeria. This study assesses the long-run and short-run relationships between sesame production and its export value in Nigeria.

Methodology

The Study Area

The study area is Nigeria, Africa's most populous country. It is Africa's largest economy (Ismail & Kabuga, 2016), with an estimated population of 200 million. The country is located between latitudes 4°16' and 13°53' North and between longitudes 2°4' and 14°4' East. It also has a highly diversified agro-ecological climatic condition ""(Hamzat et al., 2006; Ogbanje & Salami, 2022). Agriculture remains the bedrock of the economy. Sesame is one of Nigeria's cash crops. Although, both the local and international markets have high demand for its seed and oil, the production system is generally characterized by the use of traditional technique (Rukwe et al., 2020). The major sesame producing States in Nigeria are Nasarawa, Jigawa and Benue. Other States producing significant quantities of sesame are Yobe, Kano, Katsina, Kogi, Gombe and Plateau. Overall, 26 States are involved in sesame production.

Data Collection

Time series data were obtained from the website of the Food and Agriculture Organization. The data spanned from 1988 - 2021. The data were on sesame production area and output as well as export quantities and values.

Variable specification/Model specification

The following variables were measured as follows:

i. Sesame area harvested was measured in hectares (ha)
ii. Sesame production was measured as output in metric tonnes per hectare (mt/ha)
iii. Sesame export quantity was measured in metric tonnes (mt)
iv. Sesame export value was measured in United States dollars

i) The VECM:

The Vector Error-Correction Model (VECM) estimates a long-run relationship among variables in a systems equation. It is usually run after a confirmatory JJ test. In the VECM, all variables are endogenous. The VECM model includes the error-correction term which must be negative and significant to signal the possibility of restoration to the short-run equilibrium (Chimaliro, 2018). This is represented as Lamda (λ). Following the works of ' , and " , the VEC model for this study was specified as follows:

$$\Delta \mathrm{LSEV}_t = \theta_1 + \sum_{i=1}^{k} \beta_{1i} \Delta \mathrm{LSEV}_{t-1} + \sum_{i=1}^{k} \delta_{1i} \Delta \mathrm{LSP}_{t-1} + \lambda_1 \Sigma_{t-1} + \mu_{1t}$$

$$\Delta \mathrm{LSP}_t = \theta_1 + \sum_{i=1}^{k} \beta_{1i} \Delta \mathrm{LSP}_{t-1} + \sum_{i=1}^{k} \delta_{1i} \Delta \mathrm{LSEV}_{t-1} + \lambda_1 \Sigma_{t-1} + \mu_{1t}$$

Where,

SP = sesame production
SEV = sesame export value
\

ii) The VAR model was specified as follows:

Vector autoregression (VAR) is a technique often used by macroeconomists to characterize the joint dynamic behaviour of variables without requiring strong restrictions. A VAR model contains a set of *m* variables, each of which is expressed as a linear function of *p* lags of itself and of all of the other *m* – 1 variable, plus an error term. In other words, a variable is a function of its lagged version "–(Gujarati, 2003; Mencet et al., 2006; Gujarati & Porter, 2009). The VAR model which is expected to establish the short-run relationship among the variables of this study was expressed as follows:

$$LAP_t = \sigma + \sum \beta_{1i} LAP_{t-1} + \sum \emptyset_{1i} LAC_{t-1} + \sum \varphi_{1i} LAL_{t-1} + \sum \gamma_{1i} LAF_{t-1} + \sum \alpha_{1i} LLB_{t-1} + \sum \rho_{1i} LIPD_{t-1} + \mu_{1t}$$

Results and Discussion

Summary Result of Stationarity Test

The result of the stationarity test of the variables in the sesame model is presented in Table 1. The variables were tested for unit root with the aids of ADF and PP approaches. The results show that none of the variables was stationary at level. The reason was that the absolute values of the series were less than their corresponding critical values at 5%, as shown in parentheses. This was the position of 'Ribaj & Mexhuani (2021), –'–'–Joshi et al. (2019) and Ee (2016) in their separate studies. However, after the first difference, the absolute value of every series became stationary or *I*(1). In other words, the ADF and PP values for all the variables were greater than their corresponding critical values at 5%, as shown in parentheses. The same approach was adopted by Ogbanje & Ihemezie (2021), Zehra et al. (2019) and Akinwale et al. (2018) in their earlier studies.

Table 1: Summary Result of Stationarity Test

Variables	Stationarity at levels [$I_{(0)}$]			Stationarity at 1st difference [$I_{(1)}$]		
	ADF	PP	Remarks	ADF	PP	Remarks
Lseq	-3.7906***	-1.8395	Stationary	-11.9604***	-12.1333***	Stationary
	(-2.9571)	(-2.9540)		(-2.9571)	(-2.9571)	
Lsev	-2.2137	-1.7223	Not	-3.0871***	-10.0460***	Stationary
	(-2.9810)	(-2.9540)	stationary	(-1.9550)	(-2.9571)	
Lspd	-0.9363	-0.8168	Not	-5.6234***	-6.9537***	Stationary
	(-2.9540)	(-2.9540)	stationary	(-2.9571)	(-2.9571)	
Lsy	-1.8664	-1.8664	Stationary	-5.4738***	-5.5892***	Stationary
	(-2.9540)	(-2.9540)		(-2.9571)	(-2.9571)	
Lexr	-4.1360***	-3.7641	Stationary	-3.8667***	-3.9190***	Stationary
	(-2.9540)	(-2.9540)		(-2.9571)	(-2.9571)	

Figures in parentheses represent the critical values at 5%; *I*(1) = Integrated of order one;
***, ** Statistical significance at 1% and 5% respectively

Johansen's Unrestricted Cointegration Rank Tests (Trace and Maximum Eigenvalue)

The results of the Johansen's unrestricted co-integration rank test for sesame production and export are presented in Table 2. The was conducted using Johansen-Juselius approach. The result shows that the 'none' and 'at most 1' null hypotheses could not be rejected because, at 5%, the trace statistic for each test was greater than the corresponding critical value. This result implies that there is long-run relationship among the series. This is in conformity with Ajayi et al. (2017), Oparinde et al. (2017) and 'Ogbanje & Tor (2022) who concluded that there was the possibility of long-run relationship as long as the 'none' hypothesis could not be rejected. It follows that there is one cointegrating equation for the systems equation in this study.

Table 2: Johansen's Unrestricted Cointegration Rank Tests (Trace and Maximum Eigenvalue)

Test	Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	Critical Value (5%)	P-Value
Trace Test					
	None*	0.473970	22.94017	15.49471	0.0031
	At most 1	0.071777	2.383452	3.841466	0.1226
Maximum Eigenvalue Test					
	None*	0.473970	20.55671	14.26460	0.0045
	At most 1	0.071777	2.383452	3.841466	0.1226

* denotes rejection of the hypothesis at the 0.05 level

Long-run relationship between sesame production and its export value

The results of the estimation of the long-run relationship between sesame production and its export value are presented in Table 5. The results show that the t-statistic (3.32) of sesame production was statistically significant ($p<0.05$). This is a confirmation of the long-run relationship between sesame production and its export value. The normalised coefficient of sesame production was positive. This implies that increase in sesame production was directly related to its export value in the long-run. This underscores the sustainable relevance of sesame as a source of foreign exchange in the long-run. In other words, sesame production would continue to attract foreign exchange in the long-run. This result places emphasis on either the volume of domestic production of sesame or the proportion or harvested sesame that is exported.

The need to increase sesame production for export earnings has been highlighted empirically by this model. It is axiomatic that agriculture remains the mainstay of the Nigeria's economy. The study supports the diversification of the economic base towards non-oil revenue drive as a viable alternative to the dwindling fortunes of the oil.

Table 3: Long-run relationship between sesame production and its export value

Variables	Coefficient	Normalised coefficient	Standard error	t-statistic
C	4.54		-	-
LSPD(-1)	-1.26	1.26	0.38	3.32**

** Statistical significance at 5% level

Short-run relationship between sesame production and its export value

The results of the short-run relationship between sesame production and its export value are presented in Table 4. The R-square of the model is 0.3089. This implies that sesame production alone accounted for 30.89% increase in sesame export earnings in the short. Production is the primary source of export and subsequently foreign exchange earnings. This is the reason the World Trade Organisation emphasizes on the principle of comparative advantage.

The results also show that the t-statistic (-3.34) was statistically significant ($p<0.01$). Thus, sesame production and sesame export are asymmetric in the short-run. In other words, increase in sesame production would lead to a decrease in its export value in the short-run. Much as increased volume could bring in more export revenue, short-run estimate is in tandem with the inverse relationship between supply and price of a commodity. This is the model that the OPEC imposes quota on its members for the major purpose of guaranteeing a given level of price. When sesame supply reduces at the international market, the resultant surge in demand would raise the price. Applying this sesame model in the short-run is good for raising foreign exchange.

Table 4: Short-run relationship between sesame production and its export value

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.244244	0.134106	1.821276	0.0806
D(LSEV(-1))	-0.602562	0.180304	-3.341925	0.0026
D(LSPD)	0.178863	0.405559	0.441029	0.6630
D(LSPD(-1))	0.122089	0.408546	0.298839	0.7675
ECT(-1)	-0.198952	0.129800	-1.532754	0.1379
R-squared	0.308915	Mean dependent var		0.143253
Adjusted R-squared	0.198341	S.D. dependent var		0.749109
S.E. of regression	0.670718	Akaike info criterion		2.190075
Sum squared resid	11.24656	Schwarz criterion		2.423608
Log likelihood	-27.85113	Hannan-Quinn criter.		2.264784
F-statistic	2.793751	Durbin-Watson stat		2.031208
Prob(F-statistic)	0.047963			

Conclusion and Recommendations

Conclusion

Based on the findings of the study, it was concluded that sesame production lagged behind the area harvested, implying low productivity and inefficiency. Sesame is an important cash crop which contributes over $93,000 worth of foreign exchange to Nigeria's economy on annual basis. In both the long-run and short-run, the production of sesame has reliable implications for export earnings.

Recommendations

From the empirical analysis of the study, the following recommendations have been advanced:

i. In the long-run, sesame production and export earnings moved together. It was recommended that the Federal Ministry of Agriculture and Food Security and NEPC should plan for increased production and exportation in the long-run; and

ii. In the short-run, sesame production and export earnings were asymmetric. The association of sesame farmers and NEPC should control sesame export supply in the short-run in order to attract increased foreign exchange.

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