TRENDS, INSTABILITY, AND DECOMPOSITION ANALYSIS OF CASHEW NUTS PRODUCTION IN NIGERIA (1981-2021)

Mahmud H U[1], Adebayo C O[2] and Elrasheed M.M[3]
[1]Department of Agricultural Economics and Extension Services, Kwara State University, Malete.
[2]Department of Agricultural Economics and Farm Management, Faculty of Agriculture. Federal University of Technology, Minna, Niger State.
[3]Department of Agribusiness and Consumer Science, College of Agricultural and Food Sciences, King Faisal University, KSA.
bilkisuhussaina@gmail.com ; 08037032199

Abstract

Nigeria is the largest producer of cashew nuts in Africa and consistently ranking within the five global producers. Despite the abundant opportunities, its productivity has remained far below its potential. Therefore, this paper analyzed the trend, instability, and decomposition of cashew nuts production in Nigeria for three periods namely Period I (1981-2021), Period II (1981–2001), and Period III (2002–2021). In Period I, harvested area, yield and production exhibited both quadratic and cyclical trend effects with an increasing trend. While both Periods II and III, exhibits a linear trend, harvested area, yield and production at an increasing rate for Period II and decreasing rate for Period III. Harvested area for the three periods was relatively stable, there was instability in the fluctuations of yield and production for the whole periods. The decomposition analysis revealed an increase in production which was largely due to expansion of harvested area for the three periods, while the interaction between area and yield effect declined production output by 0.348%,0.26% and 0.21%. The study also found that production output has the highest instability index (67.76). To further stabilize cashew production in Nigeria, there is need for efficient resources allocation, coupled with flexible production systems.

Keywords; Cashew nuts production, Trend analysis, Decomposition analysis, Nigeria, Agricultural sector

Introduction

Nigeria's involvement in cashew nut production dates back to the 1950s, when plantations were first established in several states, including Kogi, Anambra, Imo, Enugu, Oyo, and Osun. However, cashew nuts were not widely cultivated or commercially exploited until recently, as cocoa and palm oil were the dominant crops in the southwest and southeast regions, respectively, and received most of the attention. Nigeria is geographically located within the cashew belt, which stretches across several west African countries known for their cashew cultivation (Omoluabi *et. al.*, 2021).

Nigeria has vast land resources of approximately 25 million hectares of arable land of which only a fraction is currently utilised for cashew farming (Ogunniyi *et.al.*, 2020). It is said to be the 5th largest cashew producers in the world (Ozioruva, 2023). The production of cashew is estimated to about 100,000 tons of raw nuts per annum. About 60 to 70% of the local production is commercialized of which about 90% is exported in the form of raw nuts. The country has seen a consistent increase in cashew export volumes and earnings. According to the Nigerian Export Promotion Council (NEPC), cashew exports reached a peak of 260,000 metric tons valued at $402 million in 2019 (NEPC, 2020). Cashew nuts are a vital agricultural commodity in Nigeria, contributing significantly to the country's economy and export earnings. Nigeria is one of the largest producers of cashew nuts globally, with the industry playing a crucial role in poverty reduction, job creation, and foreign exchange earnings (FAO, 2021). The country has experienced a surge in foreign

exchange earnings from cashew exports. According to the Nigerian Export Promotion Council (NEPC), cashew export earnings increased from $152.26 million in 2015 to $402.05 million in 2019, indicating a compound annual growth rate of approximately 37% (NEPC, 2020). The 2022 non-oil performance report shows cashew ranked fifth amongst leading non-oil exportable in the country (NEPC, 2023). Currently, Vietnam is the largest export market for Nigerian cashew kernels, with annual exports worth $3.4 million. However, Vietnam is also Nigeria's main competitor globally. The German market presents the largest untapped potential, with an estimated value of $860,000 (NEPC, 2018).

Nigeria has favorable conditions for cashew production and has experienced significant growth in cultivation and export, making it a key player in the global industry (Omotesho *et. al.,* 2018). This growth presents opportunities for expanding cultivation and increasing productivity. Recent investments in processing plants have enhanced value addition and competitiveness (Shittu *et. al.,* 2019).

Despite the significance of cashew nuts as an important cash crop in Nigeria agricultural sector, limited studies have been conducted on the long-term trends and patterns of cashew nut production, the factors contributing to production instability, and the decomposition analysis of production growth. The specific objectives were to: analyze the trends of cashew nut production over the specified periods of time, identify the factors contributing to instability and fluctuations and decompose the variation components and determine the relative contribution of each factor to the overall fluctuations in cashew nuts production.

Empirical Review

Several studies have explored different aspects of cashew nuts production in Nigeria. Omonona and Lawal (2011) conducted a study on the determinants of cashew nuts production in Nigeria using panel data analysis. They found that factors such as land area, labor, fertilizer use, and credit significantly influence cashew nuts production. However, their study did not focus on the trend, instability, and decomposition analysis of cashew nuts production. Another study by Adegbola *et. al.,* (2016) assessed the profitability and competitiveness of cashew nuts production in Nigeria. They found that cashew nuts production was profitable and had a comparative advantage in the international market. However, their study did not analyze the trend and instability in cashew nuts production. Another study by Omokayode and Adejobi (2018) investigated the trends of cashew production in Nigeria from 1961 to 2014. They found a linear trend, indicating a consistent increase in cashew production over the years. The study revealed that the production levels were relatively low in the 1960s and 1970s but gradually increased from the 1980s onwards, with spikes in certain years. Furthermore, a study by Ezekiel *et. al.* (2017) examined cashew production in Nigeria from 1970 to 2012. This study discovered both linear and quadratic trends. They identified a linear trend during the initial period (1970-1985), followed by a quadratic trend in the later years, showcasing an accelerating growth rate until a certain point.

Interventions and policies in Nigeria on Cashew nuts production

During the 1970s and 1980s Nigeria has experienced a significant boost in cashew nut production. The favourable climate and suitable soil condition in many sparts of the states especially in the southwestern states contributes to the expansion of cashew nuts cultivation. The government encouraged cashew farmers by providing financial supports, training program and improved techniques to improve productivity. As a result, the country witnessed a steady growth during the period (this coincides with the Period II (1981-2001) of the study. However, in the early 2000s, the cashew industry witnessed a lot of challenges like inadequate

infrastructure, modern processing facilities and limited access to the international market. This led to the decline in both production and export quantity. To address these issues, by that time, The Nigerian government has initiated and implemented various policies and initiatives to support the growth of cashew production. In 2011, the Agricultural Transformation Agenda (ATA) was introduced to revitalize the agricultural sector, with a focus on enhancing cashew production and promoting high-value crops like cashew through increased investments in research and development, improved infrastructure and enhanced market development (Federal Ministry of Agriculture & Rural Development, 2011). This aimed to boost the overall agricultural sector and unlock the potential of cashew production in Nigeria. The National Cashew Association of Nigeria (NCAN) was established to provide coordination and support to cashew farmers. National Agricultural Investment Plan (NAIP) for 2010-2015, emphasized the importance of cashew nuts as a major agricultural commodity and aimed to increase the production capacity of cashew farmers. It provided technical support, access to improved seedlings, and capacity building programs to enhance the productivity and profitability of cashew farmers. Furthermore, the Nigerian government has shown a commitment to promoting cashew nut production through various agricultural policies and interventions. For instance, initiatives like the National Cashew Development Program (NCDP) have been implemented to enhance productivity, quality, and value addition in the cashew industry (Federal Ministry of Agriculture & Rural Development, 2016). This length of period represents Period III of the study.

Materials and Methods

This paper utilized secondary data from FAOSTAT and the Nigerian Export Products Council (NEPC) for the period between 1981 and 2021, focusing on cashew nuts production in Nigeria. The data included time series information on area, production, and yield. The analysis was divided into three distinct periods: The entire study period (1981-2021) which is Period I and Period II between 1981-2001 and Period III (2002-2021). This allowed for a comprehensive examination of trends and patterns in cashew nuts production over the years. The statistical techniques employed, includes trend analysis, instability analysis, and decomposition analysis. The trend analysis was used examine the long-term production patterns of cashew nuts in Nigeria over the study period, identifying any significant upward or downward trends and providing insights into the overall growth or decline of cashew nuts production. While the instability analysis assessed the volatility and fluctuations in cashew nuts production, highlighting periods of instability and identifying potential causes and the decomposition analysis was used to dissect the factors contributing to changes in cashew nuts production.

Analytical Tools

Compound Annual Growth Rate

Compound Annual Growth Rate (CAGR) can also be applied to analyze the growth of agricultural production over a specific period of time. CAGR in agricultural production refers to the annualized rate of growth in the output of crops, livestock, or other agricultural commodities. According to a study by Jayne et al. (2010), CAGR is a valuable tool for understanding the long-term trends and performance of agricultural production. It allows researchers and policymakers to assess the growth rate of agricultural outputs in a standardized manner, considering the compounding effect on production levels. To analyze the growth rate of cashew nuts in terms of area harvested, yield, and production, the compound annual growth rate (CAGR) was used instead of the linear growth rate (LGR). This is because LGR has limitations, such as not being suitable for comparing growth rates across different periods, failing to account for seasonal and cyclical fluctuations and ignoring the compounding effects in time series data as asserted by Dandekar (1980).

Instead, the compound annual growth function was used, which is specified as:

$X_t = ab^t$ …… … (1)
Log X_t = Log a + t log b ……..……..……(2)
B = (1 + r) / 100
Where, X_t = Area/Production/Yield of cashew nuts in the year 't'
t= time element which takes the value 1, 2, 3, ……n
a = intercept
b = regression coefficient

Compound growth rate was worked out as follows: CGR (r) = (antilog b -1) x 100 Student 't' test was used to test the significance of the CGR.

Instability analysis

This study used two measures to assess instability in cashew production: the simple coefficient of variation (CV) and the Cuddy-Della Valle index (CDVI). This approach was taken because standard deviation and CV can sometimes exaggerate risk, instability, and volatility in time series data (Gilbert and Morgan 2010). While CV and standard deviation are commonly used to measure risk and instability in agricultural production, they have limitations, as they can overestimate instability. To provide a more comprehensive analysis, both CV and CDVI were used. The CDVI, on the other hand, provides a more nuanced measure of instability, allowing for a more accurate assessment of variability in area harvested, yield, and production of cashew nuts. The instability and extent of variability in area harvested yield and production of cashew nuts was examined using Cuddy-Della Valle Index (Cuddy and Valle, 1978).Thus, this study deployed both coefficient of variation and Cuddy-Della Valle index (CDVI). The CV was calculated as:

$$CV = \frac{standard\ deviation}{mean}\ x\ 100 \quad \text{…….. ……..(3)}$$

While Cuddy and Valle (1978), CDVI is estimated as follows:

$$CDVI = CV = \sqrt{1 - R^{-2}} \quad \text{……..…… (4)}$$

Where:
IX= Instability index
CV = Coefficient of variation (in percent)
R^2 = Coefficient of determination from a time trend regression adjusted by the number of degrees of freedom.

Decomposition analysis

The production of a crop is essentially determined by two factors: the harvested area and the average yield. To understand the relative impact of these factors on cashew nuts production, a decomposition analysis model was employed. This model breaks down the changes in production into three components. These are, the contribution of changes in harvested area, the contribution of changes in average yield and the interaction between harvested area and yield. The decomposition analysis in this study was performed using the following equation as used by Verma et al., (2017) and Sharma et al., (2017).

$$\Delta P = (A^1 - A^0) \times \frac{Y^1 + Y^0}{2} + (Y_1 - Y_0) \times (A_1 + A_0)/2 + ((A_1 - A_0) \times (Y_1 - Y_0))/2$$ ……...(5)

Where:

- ΔP = change in production (‘000 tonnes)
- A_1 and A_0 = initial and final harvested area (‘000 tonnes/hectares)
- Y_1 and Y_0 = initial and final average yield (‘000 tonnes)

Results and Discussions.

Growth Trends in Cashew nuts Production in Nigeria

The analysis revealed a positive linear growth trend in cashew nuts production in Nigeria over the first period of the study, then a quadratic trend in the second study periods, while the third period exhibits a negative growth trend. This finding collaborates with the work of Ezekiel et al, (2017) and Awoyinka and Adeoye (2015), whose work reported both linear and quadratic trends. They identified a linear trend during the initial period, followed by a quadratic trend in the later years, showcasing an accelerating growth rate until a certain point. This pattern suggests that cashew production experienced rapid growth in the early years but slowed down in the later periods. The country experienced fluctuations in production levels, with both upward and downward shifts caused by various factors such as changes in weather patterns, market demand, and government policies. These instabilities have had significant implications on the cashew nuts industry, impacting the income and livelihoods of farmers, as well as the overall economic development of the country. The overall estimated trend growth for the study period (1981-2021) was given by quadratic trend equation viz:

$y = b_0 + b_1 + b_2 t^2$ ……(6)

$\Delta y/\Delta t = b_1 + 2b_2 t$ ……..…(7)

Therefore, the estimated trend growth equation for the entire period of study was,
Area =23892.29 – 1466.9t with R^2 of 76.1 % and highly significant at 1%
Yield = 1489.37 – 67.3t with R^2 of 52 % and highly significant at 1%
Production = 66115.7 – 2978t with R^2 of 55.5 % and highly significant at 1%
The trend in cashew nuts growth in Nigeria

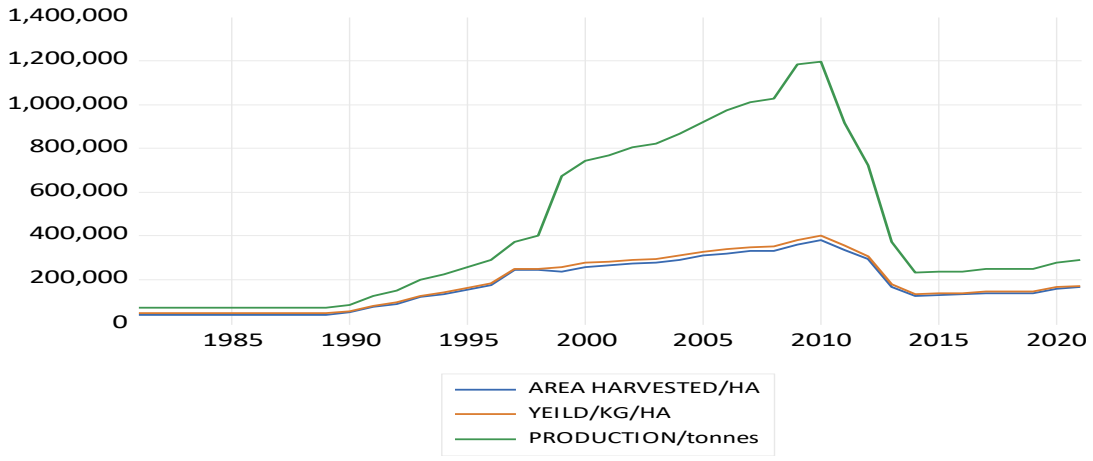


Fig. 1 Trend in cashew nuts production in Nigeria

Growth rate of cashew nuts production in Nigeria.

The CAGR of area, production, and yield of cashew nuts in Nigeria is presented in Table 1. The CAGR of area has decreased significantly from 12.8% percent in period II to -5.3% in period III. An overall growth rate of 4.6 percent in area was observed in overall period which was significant at one percent level. The period II witnessed significant higher growth in production of 16.9 percent which was attributed to significant increase in area (12.8%) and yield (3.6 %). While production, yield, and area growth during period III in the country has significantly declined by -11.9%, -7.0% and -5.3% respectively. It could be noted that despite the numerous interventions and policies on improving cashew nut production established during period III, the growth rates for area, production and yield were negative and statistically significant. This could be due to climatic change variability that recently plagued production of crops during this period, cashew nuts inclusive (cashew nuts production is extremely vulnerable to the adverse effects of changing weather patterns). Moreso, it was noticed that during the overall period (period I), the production of cashew nuts increased significantly at the rate of 6.4 percent. Invariably, this period depicts the growth in the overall periods, which also projects a steady upward growth.

Table 1. Compound growth rate (%) of area harvested, yield and production output of cashew nuts for the three study periods.

Study Period	Harvested Area (ha)	Yield(t/ha)	Production (MT)
Period I (1981-2021)	4.6***	1.7***	6.4***
Period II (1981-2001)	12.8***	3.6***	16.9***
Period III (2002-2021)	-5.3***	-7.0***	-11.9***

*** indicates 1% level of significance.

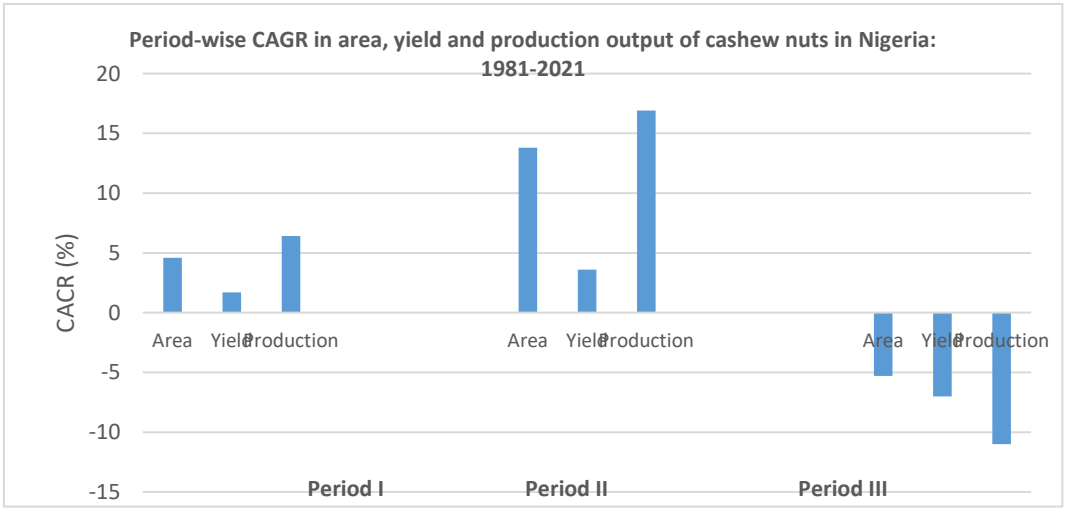


Fig.2. Shows the period wise CAGR in area, yield and production outputs of cashew nuts in Nigeria (1981-2021)

Instability in cashew nuts production

CDVI measures the degree of fluctuation or variation in a dataset or time series. It indicates the extent to which data points deviate from the average or mean value. A higher CDVI suggests greater variability,

indicating that the growth rate exhibits significant fluctuations or volatility.

Cashew nuts production in Nigeria for the period under study was plagued by instabilities and fluctuations in all the production indices observed. There tend to be a stability in instability for harvested area. It was noted that harvested area had the ability to maintain an overall level of stability despite the presence of instabilities and fluctuations. Though, unstable for the three periods, harvested area was relatively stable. Adversely, yield and productivity were highly volatile and unstable.

Table 2. Instability index for harvested area, yield, and production outputs of cashew nuts in Nigeria for the three study periods.

Study Period	Instability index (%)	Harvested Area (ha)	Yield (t/ha)	Production (MT)
Period I (1981-2021)	CV	78.85	74.46	101.58
	CDVI	35.52	52.60	67.76
Period II (1981-2001)	CV	87.46	73.53	115.04
	CDVI	34.65	51.99	77.51
Period III (2002-2021)	CV	62.07	65.81	83.32
	CDVI	35.70	31.70	45.63

Decomposition Analysis of cashew nuts production

Area contributed to increase in cashew nut production with about 95.14%, 87.68% and 98.28% respectively for the three periods. Only land (area) effect has extremely higher effect on production of cashew nuts, while the interaction between area and yield was extremely small (0.348%, 0.26% and 0.215% respectively) for the three periods under the study. This implied that increasing or decreasing area dedicated for cashew nuts production would not significantly influence the overall yield or productivity of the crop. This suggests a need to focus on optimizing other important factors and strategies to improve crop productivity rather than solely relying on expansion of the cultivated area. Thus, such factors like weather condition, soil quality, good agricultural practices (GAPs) and regeneration of older trees might have stronger influence on the yield compared to changes in the area cultivated. This collaborates with the work of Martin and Kasuga (1995) and Aliyu (2004) who worked on cashew production in Tanzania and Nigeria respectively and noted that all on-farm sites in their studies contained an appreciable proportion of very low-yielding trees. And suggest that in order to improve the productivity of smallholder cashew farms a combination of selective thinning of poor yielding trees and planting available spaces with improved material is required.

Table 3. Percentage contribution of harvested area, yield towards production of cashew nuts over the three study periods.

Effects	Period I (1981-2021)	Period II (1981-2001)	Period III (2002-2021)
Area	95.140	87.677	98.276
Yield	4.512	12.063	1.509
Interactive	0.348	0.260	0.215
Total	100	100	100

Conclusion and Recommendations

The study found that cashew nuts production in Nigeria has experienced significant growth over the past four decades, with a steady upward trend observed. However, there were periods of instability and fluctuations in production levels, influenced by various factors such as climate change, pests and diseases, and policy interventions. Furthermore, through decomposition analysis, the study identified the drivers behind the growth in cashew nuts production in Nigeria. It was found that expansion in harvested area played a critical role in driving the production growth, outweighing the influences of yield. This emphasizes the importance of land management, expansion of cashew orchards, regeneration of older trees and improving cultivation practices to harness the full potential of the industry.

Thus, these findings highlight the need for strategic planning and interventions in the cashew industry to ensure stable and long-term sustainable production. The following recommendations are made.

1. 1. As decomposition analysis showed that expansion in harvested area drove production growth, by prioritize sustainable land management practices, in order to ensure stable and expanded cashew orchards, regeneration of older trees, and improved cultivation practices.
2. Equally the analysis revealed that yield growth contributed less to production growth, therefore, focusing on improving yield through climate-resilient cashew varieties, best practices, and training programs for farmers will enhance cultivation practices and in turn reduce production instability, and increase overall production levels.
3. As policy interventions influenced production trends, government should encourage supportive policies that promote a stable and growing cashew industry, such as subsidies for farmers, research and development funding, and trade agreements that promote export expansion.

References

Adegbola, P. Y., Ogunniyi, L. T., & Oyediran, W. O. (2016). Profitability and competitiveness of cashew nut production in Nigeria. Journal of Agricultural Extension, 20(1), 1-11.

Aliyu, O. M. (2004). Characterization and compatibility studies in cashew (Anacardium occidentale L.) [Ph.D. thesis, University of Ilorin, Nigeria].

Awoyinka, Y., & Adeoye, A. (2015). Trend analysis of cashew nut production in Nigeria. Annual Research & Review in Biology, 8(4), 1-11.

Cuddy, J. D., & Vella, P. A. D. (1978). Measuring the instability of time series data. Oxford Bulletin of Economics and Statistics, 40, 79-85.

Dandekar, V. M. (1980). Introduction. Seminar on Data and Methodology for the Study of Growth Rates in Agriculture. Journal of Agricultural Economics, 35(2), 1-12.

Ezekiel, A. A., Ogunniyan, D. J., Oginni, B. A., & Gana, A. (2017). Analyzing the effect of climatic factors on cashew nut production in Ekiti State, Nigeria: A time series econometric approach. Journal of the Saudi Society of Agricultural Sciences, 16(4), 328-337.

FAOSTAT. (2021). Cashew production in Nigeria. Retrieved from http://www.fao.org/faostat/en/#data/QC/visualize

Federal Ministry of Agriculture & Rural Development (FMARD). (2011). Agricultural Transformation Agenda: Nigeria. Retrieved from http://extwprlegs1.fao.org/docs/pdf/nig126079.pdf

Federal Ministry of Agriculture & Rural Development (FMARD). (2016). The Agriculture Promotion Policy (2010-2020):Building on the success of the ATA, Closing Key Gaps, Abuja, Nigeria

Food and Agriculture Organization of the United Nations (FAO). (2019). Cashew Value Chain Analysis in Nigeria: Opportunities for Green Jobs Creation. Retrieved from

http://www.fao.org/3/ca4947en/CA4947EN.pdf

Food and Agriculture Organization (FAO). (2021). Cashew nuts. Retrieved from http://www.fao.org/faostat/en/#data/QC/visualize

Gilbert, C. I., & Morgan, C. W. (2010). Food Price Volatility. Philosophical Transactions of the Royal Society B, 365, 3025-3039.

Jayne, T. S., Rashid, S., Wanzala, M. N., Nelson, G. C., & Diao, X. (2010). Africa's Evolving Role in International Cashew Trade: Implications for the Development of Cashew Industry. Working Paper No. 81, Michigan State University, Department of Agricultural, Food, and Resource Economics.

Martin, P. J., & Kasuga, L. J. (1995). Variation in cashew tree yield in Southeast Tanzania and the implication for management of cashew smallholder farmers in Tanzania. Experimental Agriculture, 72, 261-268.

Nigerian Export Promotion Council (NEPC). (2018). www.nepc.gov.ng | Published: July 2018 HS Code: 080132.

Nigerian Export Promotion Council (NEPC) (2020). Annual performance report 2019 and outlook 2020. Retrieved from https://www.nepc.gov.ng/wp-content/uploads/2016/04/NEPC-Annual-Performance-Report-2019-And-Outlook-2020.pdf

Nigerian Export Promotion Council (NEPC) (2023) NEPC launches organic cashew certification for export. Retrieved from https://www.nepc.gov.ng/blog/2023/04/13/298515/.

Ogunniyi, L. T., Fabusoro, E., Fayomay, K. A., & Afolami, C. A. (2020). Determinants of technical efficiency of smallholders' cashew farms in Nigeria. Cogent Food & Agriculture, 6(1), 1832906.

Omokayode, O., & Adejobi, A. (2018). Analysis of time trends of cashew nut production in Nigeria. Journal of Economics and Sustainable Development, 9(13), 103-112.

Omoluabi, P. F., Egbedun, B. V. O., Odedara, O. O., & Adebayo, M. A. (2021). Comparative analysis of cashew nut (Anacardium occidentale L.) performance under agroforestry and open field systems in Nigeria. Journal of Plant Breeding and Crop Science, 13(2), 79-86.

Omonona, B. T., & Lawal, J. O. (2011). Determinants of cashew nuts production in Nigeria: A panel data analysis. Journal of Agriculture and Social Research, 11(2), 1-12.

Omotesho, O. A., Ogunniyi, L. T., & Ayodele, S. O. (2018). Comparative analysis of technological innovations in cashew production by smallholders in Nigeria. Journal of Agriculture and Rural Development in the Tropics and Subtropics, 119(2), 245-256.

Ozioruva A (2023, January 24). Only 10% of exported cashew from Nigeria processed - FG. The Vanguard. Retrieved from https://ww.vanguardngr.com/2023/01/24/

Sharma, H., Parihar, T. B., & Kapadia, K. (2017). Growth rate and decomposition analysis of onion production in Rajasthan State of India. Economic Efficiency, 62(1), 157.

Shittu, M. O., Adepoju, A. A., Adepoju, O. T., & Oladele, O. I. (2019). Impact of processing technologies on cashew nut quality: A case study of Oyo State, Nigeria. Information Processing in Agriculture, 6(1), 174-182.

Verma, S., Gulati, I. A., & Hussain, A. (2017). Doubling agricultural growth in Uttar Pradesh: Sources and drivers of agricultural growth and policy lessons (Working Paper No. 335).