KSÜ Tarım ve Doğa Derg 27 (4), 973-983, 2024
KSU J. Agric Nat 27 (4), 973-983, 2024
https://doi.org/10.18016/ksutarimdoga.vi.1329540

Per Capita Meat Consumption: The Trend and Macroeconomic Determinants in Nigeria

Sunday AKPAN[1]✉, Edet UDOH[2], Veronica NKANT[3]
[1]AKWA Ibom State University, Department of Agricultural Economics and Extension, Obio-Akpa Campus, Nigeria, [2,3]University of Uyo, Department of Agricultural Economics and Extension, Uyo, Nigeria.
[1]https://orcid.org/0000-0002-0458-028X, [2]https://orcid.org/0000-0002-4550-4320, [3]https://orcid.org/ 0000-0001-7035-7978.
✉: sundayakpan@aksu.edu.ng.

ABSTRACT
This study examined trends in per capita consumption of game meat, mutton, pork, and total meat and provided evidence of their correlation with key macroeconomic factors in Nigeria. Data from the Food and Agricultural Organization (FAO), the Central Bank of Nigeria (CBN), and the World Bank (WB) covering the period 1981-2021 were analyzed. The results showed that game meat, mutton, pork, and total meat consumption per capita recorded annual exponential growth rates of -0.87%, 2.05%, 2.08%, and -0.54%, respectively. The empirical results showed that the inflation rate, nominal exchange rate, GDP per capita, credit to the agricultural sector, and the capacity utilization rate in the meat industry influence the per capita consumption of game meat, mutton, pork, and the total meat consume in both the short and long-run periods. To increase the per capita meat consumption in the country, it is strongly recommended that appropriate macroeconomic measures should be adopted to reduce the current inflation rate and the nominal exchange rate (N/$). At the same time, concerted efforts should be made to increase Nigerians purchasing power through an increase in the per capita GDP.

Agricultural Economics

Research Article

Article History
Received : 20.07.2023
Accepted : 18.01.2024

Keywords
Meat
Trend
Macroeconomic
Nigeria

Kişi Başına Et Tüketimi: Nijerya'daki Trend ve Makroekonomik Belirleyiciler

ÖZET
Bu çalışma, av eti, koyun eti, domuz eti ve toplam etin kişi başına tüketimindeki eğilimleri incelemiş ve bunların Nijerya'daki temel makroekonomik faktörlerle korelasyonuna dair kanıtlar sağlamıştır. Gıda ve Tarım Örgütü (FAO), Nijerya Merkez Bankası (CBN) ve Dünya Bankası'nın (WB) 1981-2021 dönemini kapsayan verileri analiz edildi. Sonuçlar, kişi başına av eti, koyun eti, domuz eti ve toplam et tüketiminin sırasıyla -%0,87, %2,05, %2,08 ve -%0,54 oranında yıllık üstel büyüme oranları kaydettiğini gösterdi. Ampirik sonuçlar enflasyon oranının, nominal döviz kurunun, kişi başına düşen GSYH'nin, tarım sektörüne verilen kredinin ve et endüstrisindeki kapasite kullanım oranının her iki ülkede de kişi başına av eti, koyun eti, domuz eti tüketimini ve toplam et tüketimini etkilediğini göstermiştir. kısa ve uzun vadeli dönemler. Ülkede kişi başına et tüketiminin artırılması amacıyla, mevcut enflasyon oranının ve nominal döviz kurunun (N/$) düşürülmesine yönelik uygun makroekonomik önlemlerin alınması önemle tavsiye edilmektedir. Aynı zamanda kişi başına düşen GSYİH'yi artırarak Nijeryalıların satın alma gücünü artırmak için ortak çaba sarf edilmelidir.

Tarım Ekonomisi

Araştırma Makalesi

Makale Tarihçesi
Geliş Tarihi : 20.07.2023
Kabul Tarihi : 18.01.2024

Anahtar Kelimeler
Et
Akım
Makro ekonomi
Nijerya

Atıf Şekli: Akpan, S. B., Udoh, E. J., & Nkanta, V. S. (2023). Kişi Başına Et Tüketimi: Nijerya'daki Trend ve Makroekonomik Belirleyiciler. *KSÜ Tarım ve Doğa Derg 27* (4), 973-983. https://doi.org/10.18016/ksutarimdoga.vi.1329540.

To Cite : Akpan, S. B., Udoh, E. J., & Nkanta, V. S. (2023). The Per Capita Meat Consumption: The Trend and Macroeconomic Determinants in Nigeria. *KSU J. Agric Nat 27* (4), 973-983. https://doi.org/10.18016/ksutarimdoga.vi.1329540

INTRODUCTION
The Nigerian meat industry has recently been challenged by several factors and its production has been undermined by poor processing facilities and the unregulated market system, among others (Babatunde and Qaim, 2010; Agboola and Balcilar, 2012; Ogbeide, 2015; Akpan, 2022a). Despite the disadvantages, the production and consumption of meat in Nigeria offers

huge potential for both domestic and foreign investment. However, efficient and sustainable production and consumption of meat as well as other agricultural products are anchored, among other things, in a stable and favorable economic environment (Akpan et al., 2014, Akpan and Udo 2021, Akpan and Umoren, 2021). As the OECD (2023) notes, meat consumption is linked not only to macroeconomic uncertainties and GDP shocks, but also to living standards, nutrition, animal production, and consumer prices.

According to recent surveys, the demand for meat in sub-Saharan Africa especially in Nigeria is increasing (Reardon et al. 2021; FAO 2021). The increasing activities in the meat industry in Nigeria have provided food for millions of people and provide excellent livelihoods (OECD, 2023). The increase in youth population, improved human and social capital, personal income, and expanding cities and towns are some of the factors that have contributed to the increase in demand for meat and its derivatives (Akpan 2022a; Akpan and Nkanta 2022; OECD 2023). Despite the boom in meat and demand for meat derivatives in the country, the supply capacity is fundamentally small-scale and has a marginal annual production growth rate (Babatunde and Qaim 2010; Agboola and Balcilar, 2012; Ogbeide, 2015; Odoemena et al., 2020).

Given the country's current population of more than 200 million (NPC, 2023; Akpan and Ebong, 2021), there are enormous challenges in meeting citizens' recommended animal protein requirements. In addition, most of the country's livestock farmers are resource-poor and affected by climate change, conflict, and economic changes, among others (Bamaiyi, 2013; Akpan and Monday 2021). In addition, most of the country's population (which is young) quickly adapts to a diet rich in animal protein and its derivatives (Ogbeide, 2015; Akpan et al., 2015). As a result, the consumption of meat and its by-products in the country is increasing sharply. It is imperative to increase domestic production to prioritize the minimum animal protein consumption needs of Nigerians (Osazuwa-Peters, 2021; Odetokun et al., 2021, Akinsulu, et al., 2019; Arowolo, et al., 2021; Elegbede, et al., 2018).

The adequacy of meat consumption in the country is easily assessed using the index of meat consumption per capita. Meat consumption per capita represents the average amount of meat (in kilograms) available to a person at a given point in time in a well-defined area. It is calculated by dividing the total meat consumption (i.e. the sum of total domestic meat production, total imported quantity, and total game meat in kg) by the total population at a given point in time. The Meat Consumption Index per capita measures the availability of meat for all citizens of a country at any given time. In Nigeria, per capita meat consumption is roughly equal to per capita meat production as the country rarely exports meat products (FAO, 2023).

In Nigeria, the per capita meat consumption index is much lower than in most African countries. Between 2018 and 2020, the average African consumed 12.7 kg of meat per year (OECD/FAO, 2019). Chicken meat had the highest annual consumption on the continent at 5.77 kilograms per capita. Meanwhile, Africa had the lowest meat consumption per capita in the world for the same period. In 2019, according to OECD/FAO (2021a), the Seychelles had the highest per capita amount of meat available for human consumption in any country in Africa. The average meat supply on the African island was 65 kilograms per person. South Africa followed in second place with a supply of almost 64 kilograms per capita. In contrast, Burundi and the Democratic Republic of the Congo had the lowest annual meat stocks, at just 3.8 kilograms and 2.4 kilograms per person, respectively.

Furthermore, according to statistics, Nigeria's per capita meat consumption in 2021 was 8.30 kg per person per year, which is much lower than most African countries (FAO, 2023; OECD/FAO, 2021b). It is also well below the average consumption of 19.0 kg person-1 across the continent and the minimum consumption recommended by the World Health Organization for adults (0.830 g kg-1 body weight per day) (FAO, 2019; OECD/FAO, 2022). To address the problem of animal protein shortages in Nigeria, the three levels of government have implemented specific policies in line with the federal government's Livestock Transformation Framework. The livestock transformation program was designed to increase the production and consumption of animal protein sources to meet the average minimum protein requirement of most Nigerians in 2027 (Williams, 1989; Ojiako and Olayode 2008; Akpan 2022a). However, one of the expected outcomes of the livestock transformation program, which is an increase in meat consumption per capita, depends, among other things, on a sound macroeconomic and political environment (Udah et al., 2015a, Udah et al., 2015b; Akpan et al., 2015; Udoh and Akpan, 2019; Akpan and Umoren, 2021; Ecker and Hatzenbuehler 2022, Akpan 2022b). The literature has provided evidence that agricultural production and food consumption are strongly associated with macroeconomic fundamentals in developing countries (Akpan et al., 2012; Udah et al., 2015b; Udah et al., 2015c; Akpan et al, 2021; Akpan and Udo, 2021; Mekonnen et al. 2021; Ecker and Hatzenbuehler 2022).

Although there is little literature on this core topic, its contributions need to be validated and updated, especially given that unexpected economic downturns have bewildered the country in recent years. From the archive, Simo-Kengna et al. (2018) several factors affecting meat consumption in SEAFO countries. The results showed the price of meat, the country's GDP,

the rate of inflation, the amount of exports, and imports, and the size of urban areas. Similarly, Akpan and Udo (2021) made connections between the gross domestic meat and milk production indices and the macroeconomic fundamentals of Nigeria. The results show that the long-run determinants of milk and meat production are GDP per capita, nominal exchange rate, and land density, while the short-run determinants are income per capita, economic creditworthiness, and land density. In addition, Betru and Kawashima (2009) identified the factors affecting meat consumption in Ethiopia. Their results showed that cities and personal income had a significantly positive impact on meat consumption. James et al. (2009) examined beef demand drivers and opportunities for improvement in the United States. Their results showed that there was a significant positive relationship between consumer spending and beef consumption, and that beef price fluctuations had a negative and inelastic effect on consumer demand. Bascron et al. (2019) investigated red and white meat consumption and production trends in Egypt. The results showed an annual increasing trend of 1.40% and 2.87% per year for both variables. Akpan (2022a) again analyzed the relationship between ruminant meat production and several key macroeconomic factors in Nigeria. The results showed that the inflation rate, personal income, and exchange rate affect domestic meat production. Fatima et al. (2022) conducted a study investigating macroeconomic factors influencing red meat consumption in Saudi Arabia from 1980 to 2020. They used an autoregressive distributed lag model and found a significant negative correlation between domestic red meat consumption and the meat price index.

The literature indicates that there is no particular focus on per capita meat consumption in Nigeria. The importance of meat consumption to the well-being of Nigerians cannot be overstated given that the country is one of the poorest countries in the world. The meat sub-sector therefore needs policy recommendations to close the current consumption deficit gap. Additionally, Nigeria's macroeconomic environment has changed significantly over the past two decades, including the recent global COVID-19 pandemic, necessitating an update of meat consumption trends and their correlation with macroeconomic variables. Therefore, the study specifically examines:

a) the trends in annual per capita consumption of mutton, pork, game meat, and total meat in the country from 1981 to 2021, and
b) establish the relationship between the per capita meat consumption and some key macroeconomic fundamentals.

RESEARCH METHODOLOGY

Study Area and Data Source: The study took place in Nigeria, a country on the Gulf of Guinea in sub-Saharan Africa. Nigeria extends from 40 to 140 degrees north of the equator and from 30 to 150 degrees east of Greenwich. It covers a land mass of 923,769 square kilometers (or approximately 98.3 million hectares) and has 853 kilometers of coastline along the northern edge of the Gulf of Guinea. The country has a population of over 200 million (National Population Commission, 2023) and is rich in agricultural, mineral, marine, and forest resources. More than 60 percent of the country's population is engaged in the production of food crops such as corn, cassava, yam, rice, beans and vegetables, ginger, carrots, legumes, sorghum, onions, tomatoes, and melons. In addition, animal husbandry, aquaculture, and fishing are carried out on a large scale in all regions of the country. The main cash crops grown in Nigeria are cocoa, cotton, peanuts, palm oil, and rubber (Federal Ministry for the Environment, 2021). The study used secondary data from the WB (World Bank), FAO (Food and Agriculture Organization), and CBN (Central Bank of Nigeria). The data/information covered the period from 1981 to 2021.

Model Specification

The trends in per capita meat consumption

The explicit form of an exponential trend equation was adopted to analyze the trends in the per capita meat consumption in Nigeria. The specification is shown in Equation 1:

$$lnTMC_t = \lambda_0 + \lambda_1 t + \varepsilon_t \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (1)$$

Where TMC_t is the total per capita meat consumption measured in kg person-1, "t" is the annual trend. Note, that the per capita is computed as in equation 2.

$$Per\ capita\ meat\ consumption = \sum_{i=1}^{n} TM_t \Big/ \sum_{i=1}^{n} POP_t \quad \ldots\ldots\ldots\ldots\ldots\ldots (2)$$

Where TM_t is a specified meat in kg at period t while the POP_t is the country's population in period t. Hence, the dependent variables for this study are defined as:

(a) MMC_t = mutton per capita consumption (kg person-1) (meat from sheep)

(b) KMC_t = game meat per capita consumption (kg person-1) (meat from wild animal animals)

(c) PMC_t = pork per capita consumption (kg person-1) (meat from pig)

(d) TMCt = Total meat per capita consumption (kg person-1)

Therefore, the exponential growth rate from Equation 1 is expressed in Equation 3:

$$(\text{Growth rate}) = \left(e^{\lambda_1} - 1\right) * 100 \quad \ldots\ldots\ldots\ldots\ldots\ldots (3)$$

To determine whether the specified per capita meat consumption growth rate suggests an accelerated or decelerated trend, an exponential equation in

quadratic form was explicitly used in equation 4:

$$log_e TMC_t = \varphi_o + \varphi_1 t_1 + \varphi_2 t_1^2 + \varepsilon_t \ldots\ldots\ldots\ldots(4)$$

If the estimated coefficient φ_2 is positive and significant, it implies persistent long-run growth in the per capita meat consumption; but if φ_2 is negative and statistically significant, it means there is a significant long-run deceleration in the per capita meat production. Nevertheless, if φ_2 is not significant, it connotes dormancy or stagnation in the per capita meat consumption in the long run (Ojiako and Olayode 2008; Akpan and Okon 2019; Akpan 2019). Note equations 1-4 were estimated for all dependent variables.

The determinants of the per capita meat consumption

The relationship between the per capita meat consumption and some exogenous factors (i.e. macroeconomic fundamentals) was explicitly stated in a double -log form and is stated as:

$$LnTMC_t = \Psi_0 + +\Psi_1 LnFLT_t + \Psi_2 \mathrm{Ln}INC_t + \Psi_3 \mathrm{Ln}RET_t + \Psi_4 \mathrm{Ln}CRD_t + \Psi_5 \mathrm{Ln}CAU_t + U_t \ldots.(5)$$

Where,

TMC_t = the total meat per capita consumption in kg/person as described in equation 1

FLT_t = annual rate of inflation (%)

INC_t = annual GDP per capita (naira person-1)

RET_t = annual nominal exchange rate (Naira Dollar-1) (%)

CRD_t = annual domestic credit disbursed to the agricultural sector per GDP (%)

CAU_t = capacity utilization rate of the meat industry (%)

U_t = Stochastic error term and $U_t \sim$ IID $(0, \delta^2_U)$

Note Equation 5 was estimated for all the dependent variables listed in Equation 1. The study used the Engle and Granger two-step technique test to verify the presence of a long-run stable relationship between a specific per capita meat consumption and some key macroeconomic variables (Engle and Granger, 1987). The conditions for using the method required that all variables involved be integrated in the same order. The error correction model (ECM) was also estimated for the co-integrating equations. The estimated ECM is shown explicitly in Equation 6.

$$\Delta \mathrm{Ln}TMC_t = \pi_0 + \pi_1 \Delta LnTMC_{t-1} + \pi_2 \Delta LnFLT_t + \pi_3 \Delta LnINC_t + \pi_4 \Delta LnRET_t + \pi_5 \Delta LnCRD_t + \pi_6 \Delta LnCAU_t + \pi_7 ECM_{t-1} + U_t \quad (6)$$

Table 1. Descriptive Statistics of Variables
Çizelge 1. Değişkenlerin Tanımlayıcı İstatistikleri

Variable	Mean	Minimum	Maximum	Std. dev.	CV	Skewness
Total meat/capita (TMC_t)	8.3815	6.7380	10.2820	0.8642	0.1031	0.1373
Game meat/capita (KMC_t)	0.9872	0.8160	1.3302	0.1289	0.1306	1.1547
Mutton/capita (MMC_t)	0.7169	0.4051	1.0593	0.2221	0.3098	-0.0474
Pork/capita ((PMC_t)	1.2223	0.4820	1.4857	0.2890	0.2365	-1.4175
Inflation rate (FLT_t)	18.9490	5.3880	72.836	16.659	0.8792	1.8542
GDP/capita (INC_t)	1683.60	270.03	4471.10	1025.0	0.6088	0.3422
Exchange rate (RET_t)	108.170	0.6177	403.58	110.14	1.0182	0.9842
Domestic credit (CRD_t)	9.2506	4.9575	19.626	3.4678	0.3749	1.1862
Capacity utilization (CAU_t)	45.9710	12.700	75.750	14.450	0.3143	0.1553

Source: Computed by authors.

The coefficients (π_7) measure the deviation from the long-run equilibrium in the previous period. Also, equation 6 was estimated for all dependent variables specified in Equation 1.

RESULTS and DISCUSSION

The descriptive statistics of the given variables are presented in Table 1. The coefficients of variability are 10.31% for total meat consumption per capita, 13.06%, 30.98%, and 23.65% for per capita consumption of game, mutton, and pork, respectively. The results suggest that the Nigerian country experienced little variation in annual meat consumption per capita. The results suggest that annual meat consumption per capita in Nigeria has not changed significantly over the years. The skewness indices showed that the annual per capita meat consumption of individual types of meat changes only slightly. Nevertheless, the mean of the total meat consumption was 8.38 kg per person. This is well below the mean for Africa with 12.77 kg per person in 2019 and 2021. While Seychelles, South Africa, Gabon, Mali, and Ghana had 65.08 kg/person, 63.67 kg person-1, 61.76 kg person-1, 23.35 kg person-1, and 13.63 kg person-1 respectively in 2019. The mean for individual meat consumption is given as 0.99 kg/person for game meat, 0.72 kg/person for mutton, and 1. 22 kg per person-1 indicated for pork. These statistics revealed the great lack of individual meat consumption in the country compared to other countries in Africa. For example, the per capita consumption of poultry in Africa in 2020 was reported at 5.77 kg per person-1, mutton at 2.18 kg per person-1, and beef at 3.68 kg per person-1. However, the average per capita consumption of pork (1.22 kg person-1) in Nigeria was higher than the average reported for Africa (1.08 kg person-1) in 2021.

The descriptive tests performed on the macroeconomic

variables revealed significant fluctuations in the nominal exchange rate (RET), indicating its instability over the indicated study period. The inflation rate also showed large fluctuations and averaged 87.92% per year. On the other hand, the coefficient of variation was lowest for the capacity utilization variable of the meat industry and loans paid to the agricultural sector. This suggests that while financing of the agricultural sector and capacity utilization of the meat industry have evolved positively over the years, they have not changed significantly. The skewness index of macroeconomic fundamentals all showed positive signs, suggesting that they exhibited progressive patterns throughout the period of interest.

The Trends in annual meat per capita consumption in Nigeria

Table 2 shows estimates of exponential and quadratic trend equations for per capita game meat, mutton, and pork consumption and total meat consumption per capita in Nigeria. The results showed that the annual per capita consumption of mutton and pork was positively and significantly related to time. Annual exponential growth rates of approximately 2.05% and 2.08%, respectively, were achieved for mutton and pork. However, the squared-exponential trend estimates showed a slowdown in the growth rates of both meat sources over the long term.

Table 2: The exponential and quadratic trend equations for meat per capita consumption
Çizelge 2. Kişi başına et tüketimi için üstel ve ikinci dereceden trend denklemleri

	Game meat/capita		Mutton/capita		Pork/capita		Total meat/capita	
Exponential trend equation								
Variable	**Coeff.**	**t-value**	**Coeff.**	**t-value**	**Coeff.**	**t-value**	**Coeff.**	**t-value**
Constant	0.1623	7.64***	−0.8101	−11.16***	−0.2705	−4.47***	2.2345	86.00***
Time	−0.0087	−9.89***	0.0203	6.74***	0.0206	8.20***	−0.005	−5.02***
R-square	0.7148		0.5381		0.6328		0.3926	
F- cal. (1, 39)	97.748***		45.425***		67.217***		25.208***	
Exp. GR (%)	**−0.86713**		**2.0497**		**2.0799**		**−0.5410**	
Quadratic exponential trend equation								
Variable	**Coeff.**	**t-value**	**Coeff.**	**t-value**	**Coeff.**	**t-value**	**Coeff.**	**t-value**
Constant	0.2560	9.60***	−1.2353	−17.88***	−0.6300	−11.20***	2.1775	55.99***
Time	−0.0218	−7.44***	0.0796	10.50***	0.0708	11.45***	0.0025	0.59
Time Square	0.0003	4.61***	−0.0014	−8.07***	−0.0012	−8.38***	−0.0002	−1.92*
R-squared	0.8170		0.8297		0.8709		0.4463	
F- cal. (2, 49)	84.842***		92.536***		128.264***		15.313***	

Source: computed by authors. The symbols ***, **, and * represent different levels of statistical significance.

In addition, game meat consumption and total meat consumption per capita increased exponentially by -0.87% and -0.54%, respectively. This suggests that average game meat consumption and total meat consumption per person is decreasing over time. Further studies showed a significant acceleration and deceleration of game meat consumption and total meat consumption per person respectively over a long period. Several phenomena, including uncertainty in the macroeconomic environment, have been linked to the relationship between meat consumption per capita and time (Akpan, 2022). In addition, several studies on agricultural commodities in Nigeria have estimated a similar exponential growth rate, e.g. Ojiako and Olayode (2008), Baskhron et al. (2019), and Akpan (2022).

Figure 1 shows a graphical representation of the trend lines for different meats per capita consumed in Nigeria. The evolution of per capita consumption of mutton showed a gradual increase in per capita consumption of mutton from 1981 to 2010 with a clear trough in 2012 and a subsequent minimal acceleration until 2021. For game meat, there was a downward trend from 1981 to 2009. Beginning in 2010, per capita consumption of game meat assumed an accelerating pattern that later declined through 2021. Pork consumption per capita trend indicates a progressive trend from 1981 to 2021. This means that the consumption level of pork was mounting perhaps with the potential for more investments.

The trend in total meat per capita consumption fluctuates from 1981 to 2021. From 1981 to 1985, the country witnessed an increment in total meat consumption reaching a peak of 10.28kg/person in 1985. From 1986 to 1991 representing the period of the structural adjustment programme (SAP), (Kanayo et al., 2013; Ogbonna, 2012), the total meat consumption declined reaching the mark of 7.57kg/person in 1991. In 1988, an import ban was implemented for fresh and chilled as well as frozen meat to safeguard local producers, but it was unsuccessful following an adverse economic environment (Egwaikhide, 1997). Following the implementation of several agricultural policies to boost animal protein intake, the per capita meat consumption upsurge from 7.85kg/person in 1992 to 8.57kg/person in 2000. From the period 2001 to 2021, the country witnessed progressive declines in total meat per capita, being lower than most African countries. The index deteriorated to 6.87kg/person in 2020 which is far below the WHO recommended index

and average obtained for Africa. During this time, private investment in the meat industry significantly increased, but the sub-sector development was constrained by the rising instability of the underlying macroeconomic conditions (Akpan, et al., 2012; Ejedegba, 2023). In the post-SAP era, lasting from 1993 to 2021, new agricultural policies were implemented, including a restriction on frozen poultry meat imports, currency devaluation, and a significant increase in private participation in meat production, processing, and marketing (Akpan et al., 2012; Kanayo et al., 2013; Ogbonna, 2012). Although these incentives helped increase meat production somewhat, they had little impact on per capita meat consumption in the country given the growing population. This is reflected in the erratic decline in total meat consumption per capita between 2001 and 2021. Also, the emergence of the COVID-19 pandemic in 2020 and the increasing rise in feed prices made it difficult for total meat consumption to increase, thus contributing to the continued downward trend growth.

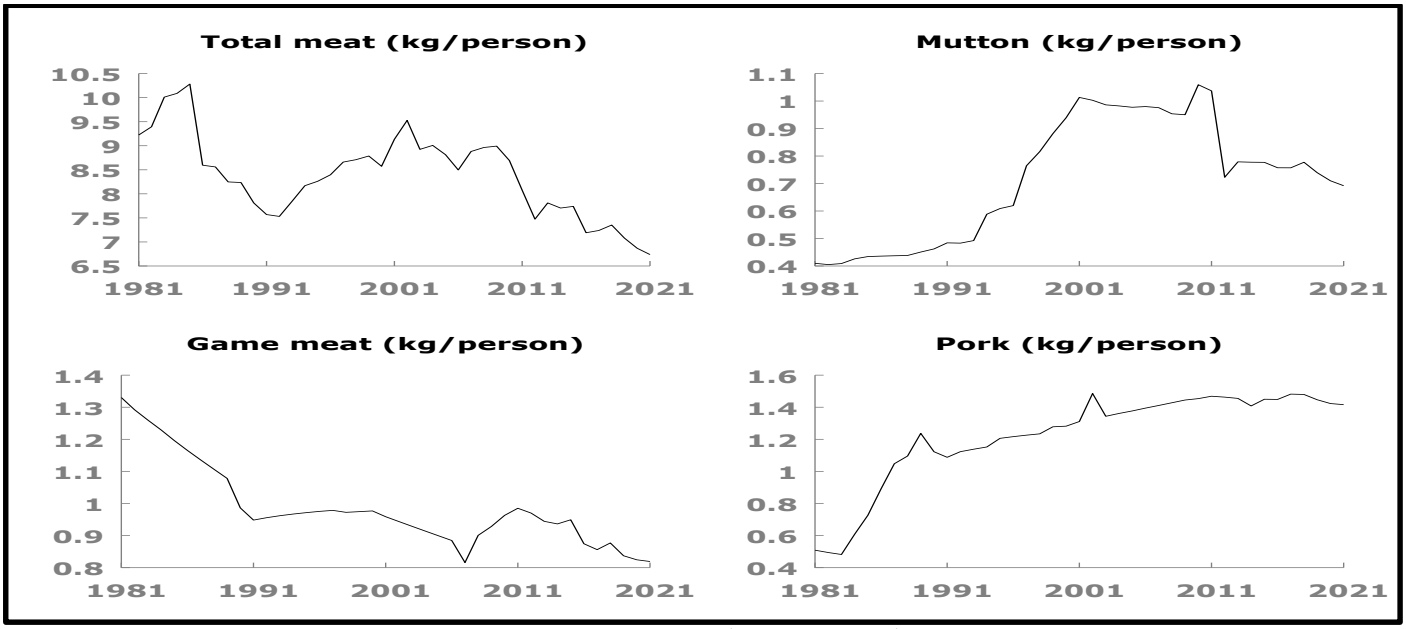

Figure 1. Trends in per capita meat production in Nigeria (1981 to 2021*).*
Şekil 1. Nijeryada kişi başı et tüketimindeki yönelimler (1981-2021)

Unit root test

The augmented Dickey-Fuller test was used in the study to confirm the unit root of the specified variables. The results shown in Table 3 confirm that the variables reported were not stationary at their levels but were at their first difference. This suggests that Engle Granger's two-step method can be used to examine the long-term relationship between the variables (Engle and Granger, 1987). However, to use this method, all variables must be stationary at the same level.

Test of cointegration

Engle Granger's two-stage method was used to investigate whether there was a cointegration between the variables mentioned. The results presented in Table 4 show that all equations presented showed evidence of cointegration. This suggests that there is a stable long-term relationship between some macroeconomic variables and per capita meat consumption of game meat, mutton, pork, and total meat in Nigeria.

The Short and the Long run determinants of per capita meat consumption in Nigeria

The results of analyses for the specified meat per capita consumption are discussed in the following sub-sections.

Determinants of per capita mutton consumption in the short and long runs

Table 5 shows estimates of the equations for per capita consumption of mutton in both the short and long run. The ECM adjustment coefficient is negative and significant, indicating a 28.18% convergence rate toward long-run equilibrium. Additional diagnostic tests confirmed the reliability and sufficiency of the estimates. The empirical results show that the inflation rate has a significant negative relationship with the per capita consumption of mutton in both the short and long term. In addition, there is a positive relationship between per capita income or GDP/capita and per capita mutton consumption in the short run, but a negative relationship in the long run. Furthermore, the capacity utilization coefficient increases with the per capita consumption of mutton in the short and long runs, while the exchange rate has a

positive correlation with the per capita consumption of mutton in the long run. These results are supported by previous studies by Simo-Kengne et al. supported. (2018), Akpan and Umoren (2021), and Akpan (2022).

Table 3. ADF unit root tests on variables
Çizelge 3. Değişkenler üzerinde ADF birim kök testleri

Variables	ADF unit root (without constant)				
	Level	**Lag**	**1st Diff.**	**Lag**	**Decision**
Total meat/capita (TMCt)	-0.5139	0	-5.7771***	0	1(1)
Game meat/capita (KMCt)	-1.7297	0	-5.0280***	0	1(1)
Mutton/capita (MMCt)	-1.8323	0	-5.6027***	0	1(1)
Pork/capita ((PMCt)	-1.7558	0	-3.7646***	0	1(1)
Inflation rate (FLTt)	-0.8074	0	-6.2809***	0	1(1)
GDP/capita (INCt)	-0.1086	0	-6.0466***	0	1(1)
Exchange rate (RETt)	1.9705	0	-4.3109***	0	1(1)
Domestic credit (CRDt)	0.2469	0	-5.7867***	0	1(1)
Capacity utilization (CUTt)	-0.4462	0	-6.5973***	0	1(1)

Source: Author's compilation and asterisks *** indicate a 1% significance level. Note that, variables are expressed in a natural logarithm and the significant level was defined at a 1% level only.

Table 4: Co-integration test of variables
Çizelge 4. Değişkenlerin eş bütünleşme testi

Equation residual	ADF test (without constant)	Order of integration	Remark
Total meat/capita (TMCt)	-2.5692**	1(0)	Co-integration
Mutton/capita (MMCt)	-2.3122**	1(0)	Co-integration
Game meat/capita (KMCt)	-2.8546***	1(0)	Co-integration
Pork/capita ((PMCt)	-2.8665***	1(0)	Co-integration

Source: Author's compilation and asterisks *** indicate a 1% significance level. Note that, variables are expressed in a natural logarithm and the significant level was defined at a 1% level only.

Table 5: Determinants of mutton per capita consumption in Nigeria
Çizelge 5. Nijerya'da kişi başına koyun eti tüketiminin belirleyicileri

ECM of mutton/capita				**Long run equation of mutton/capita**				
Variables				**Variables**				
	Coeff.	Std. error	t-value		Coeff.	Std. error	t-value	VIF
Constant	0.0107	0.0145	0.738	Constant	−0.7198	0.3954	−1.821*	-
Inflation rate	−0.0578	0.0243	−2.382**	Inflation rate	−0.0829	0.0406	−2.044**	1.237
GDP/capita	0.1445	0.0383	3.773***	GDP/capita	−0.0986	0.0372	−2.651**	1.371
Exchange rate	0.0179	0.0445	0.403	Exchange rate	0.1106	0.0194	5.699***	2.500
Credit disbursed	0.0321	0.0729	0.439	Credit disbursed	0.1707	0.1223	1.396	2.934
Capacity utilized	0.0607	0.0192	3.162***	Capacity utilized	0.1322	0.0596	2.218**	1.318
Mutton lag 1	0.2175	0.1249	1.741*					
ECM_{t-1}	**−0.2818**	**0.1036**	**−2.721*** **					
				Diagnostic test				
R^2	0.254			R^2	0.806			
F- cal. (7,31)	6.5073***			F- cal. (5,35)	29.1601***			
Normality test	5.3789 (0.6629)							
RESET test	0.6083 (0.4415)							
Breush-Pagan	2.3359 (0.8429)							
CUSUMSQ test	-1.27509 (0.2121)							
Durbin Watson	1.8755 (0.2697)							

Source: The author performed the computation. Symbols ***, **, and * represent significance levels of 1%, 5%, and 1%, respectively. Variables used in the error correction model (ECM) are expressed in log differences, while those used in the long-run equation are expressed in natural logarithms.

Determinants of short and long runs per capita game meat consumption

Estimates for game meat consumption per capita are presented in Table 6. The ECM coefficient has the appropriate sign and is statistically significant at the 1% probability level. This confirms the existence of a long-run equilibrium in the per capita game meat consumption model. Other statistical tests indicate that the estimated model is adequate. The empirical results showed that in the short-run model, GDP per capita and the previous value of per capita game meat consumption have a positive influence on the per capita game meat consumption, while loans disbursed to the agricultural sector showed a negative relationship. In the long-term model, the study found

a significantly positive correlation between per capita game meat consumption and GDP per capita and a significantly negative correlation with the nominal exchange rate. These results are supported by the work of Simo-Kengne et al. (2018), Akpan and Umoren (2021), and Akpan (2022a).

Table 6. Determinants of Game meat per capita consumption in Nigeria
Çizelge 6. Nijerya'da kişi başına av eti tüketiminin belirleyicileri

	ECM of game meat/capita				Long run equation of game meat/capita			
Variables	Coeff.	Std. error	t-value	**Variables**	Coeff.	Std. error	t-value	VIF
Constant	−0.0051	0.0055	−0.932	Constant	−0.0559	0.1178	−0.475	
Inflation rate	0.0054	0.0077	0.7018	Inflation rate	−0.0011	0.0121	−0.093	1.237
GDP/capita	0.0317	0.0132	2.405***	GDP/capita	0.0187	0.0111	1.692*	1.371
Exchange rate	−0.0139	0.0160	−0.871	Exchange rate	−0.0597	0.0058	−10.33***	2.500
Credit disbursed	−0.0507	0.0272	−1.866*	Credit disbursed	0.0185	0.0365	0.508	2.934
Capacity utilized	0.0189	00.0181	1.043	Capacity utilized	0.0208	0.0237	0.876	1.318
Game meat lag 1	0.2986	0.1551	1.926*					
ECM_{t-1}	−0.4466	0.1231	−3.627***					
R^2	0.422			R^2	0.876			
F- cal. (7,31)	3.2272**			F- cal. (5,35)	49.4499***			
Normality test	7.4404 (0.7518)							
RESET test	1.5835 (0.3039)							
Breush-Pagan	3.1809 (0.7158)							
CUSUMSQ test	0.3192 (0.7518)							
Durbin Watson	1.9968 (0.41084)							

Source: The author performed the computation. Symbols ***, **, and * represent significance levels of 1%, 5%, and 1%, respectively. Variables used in the error correction model (ECM) are expressed in log differences, while those used in the long-run equation are expressed in natural logarithms.

Determinants of short and long runs per capita pork consumption

Estimates for the per capita pork consumption equation are shown in Table 7. The ECM estimates achieve the expected results with a convergence rate to the long-run equilibrium of 25.30%. The empirical results show that the exchange rate, previous pork consumption, and per capita income have a significant positive or positive impact on per capita pork consumption in Nigeria in the short term. On the other hand, the capacity utilization coefficient has a significant negative impact in both the short and long runs. Furthermore, the long-run model shows a strong negative correlation between Nigeria's nominal exchange rate and per capita pork consumption. These results are supported by the findings of Simo-Kengne et al. supported. (2018), Akpan and Umoren (2021), and Akpan (2022a).

Determinants of short and long runs per capita total meat consumption

The results presented in Table 8 show a convergence rate of 31.70% in the long-run for total meat consumption per capita short-run equation. This supports the use of cointegration models. The stability of the estimated model over time is confirmed by the CUSUMSQ value. The error term follows a normal distribution, justifying the use of the ordinary least squares method. The RESET test and the Breush-Pagan test support the structural rigidity of the estimated short-run model and indicate a minimal influence of heteroscedasticity respectively. The error correction model shows a positive short-run relationship between total meat consumption per capita and GDP per capita as well as the capacity utilization of the meat industry in Nigeria. In addition, there is a significant negative short-term relationship between total meat consumption per capita and the inflation rate. In addition, the long-term estimates revealed significant negative correlations between total meat consumption per capita the rate of inflation, and the nominal exchange rate. On the contrary, there is a positive relationship between total meat consumption per capita and capita GDP as well as the capacity utilization of the meat industry. These results are consistent with research by Akpan and Umoren (2021) and Akpan (2022a).

CONCLUSION and RECOMMENDATIONS

The analyses have shown that meat consumption in Nigeria is completely inadequate. The results revealed that the average per capita consumption of game meat, mutton, and total meat in Nigeria is lower than the data for Africa in 2021. However, the pork meat per capita consumption in Nigeria was slightly higher than the average in Africa. The study estimated negative annual growth rates for per capita game meat and total meat, while positive growth rates were estimated for mutton and pork per capita consumption in Nigeria.

This has two implications. First, the country consumed far less animal protein compared to the recommended standard and most African countries. This means that the dietary composition of the majority of Nigerians is deficient in terms of nutrient balance and is therefore well below the minimum standard recommended by the World Health Organization. This is a serious challenge, especially given that the country is at the forefront of poverty, malnutrition, and insecurity.

Secondly, the current meat consumption situation in Nigeria offers numerous opportunities for domestic and foreign investment in the meat industry, benefiting from the large population of over 200 million people. The empirical results showed that changes in per capita income, credit to the agricultural sector, inflation rate, nominal exchange rate, and meat industry capacity utilization have significant effects on annual per capita meat consumption in Nigeria. This underscores the important role of the macroeconomic environment in agricultural commodity consumption. Therefore, based on these findings, it is recommended that the country effectively controls inflation, improves per capita income, implements exchange rate stabilization measures, improves agricultural credit disbursement, and increases resource capacity utilization in the meat industry as complementary strategies to improve meat consumption in the country.

Table 7: Determinants of pork per capita consumption in Nigeria
Çizelge 7. Nijerya'da kişi başına domuz eti tüketiminin belirleyicileri

	ECM of pork/capita				Long run equation of pork/capita			
Variables	Coeff.	Std. error	t-value	**Variables**	Coeff.	Std. error	t-value	VIF
Constant	0.0033	0.0104	0.314	Constant	0.6084	0.2565	2.372	-
Inflation	−0.0138	0.0150	−0.919	Inflation	−0.0161	0.0263	−0.613	1.237
GDP/capita	0.072	0.0262	2.746***	GDP/capita	0.0217	0.0241	0.901	1.371
Exchange rate	0.0933	0.0332	2.811***	Exchange rate	0.1585	0.0126	12.59***	2.500
Credit disbursed.	−0.0099	0.0510	−0.194	Credit disbursed	−0.0901	0.0793	−1.136	2.934
Capacity utilized	−0.0799	0.0344	−2.324**	Capacity utilized	−0.2477	0.0517	−4.795***	1.318
Pork lag 1	0.36433	0.1345	2.709**					
ECM_{t-1}	−0.2527	0.1086	−2.327**					
R^2		0.516		R^2		0.906936		
F- cal. (7,31)		4.7240***		F- cal. (5,35)		68.21673		
Normality test		1.3362 (0.2694)						
RESET test		1.5744 (0.3684)						
Breush-Pagan		9.0484 (0.2492)						
CUSUMSQ test		-1.0002 (0.2546)						
Durbin Watson		2.1219 (0.5526)						

Source: Significance levels are indicated by ***, **, and *, which represent 1%, 5%, and 1% respectively. Variables used for the ECM are expressed in log difference, while those used for the long-run equation are expressed in a natural logarithm.

Table 8: Determinants of total meat per capita consumption in Nigeria
Çizelge 8. Nijerya'da kişi başına toplam et tüketiminin belirleyicileri

	ECM of total meat /capita				Long run equation of total meat/capita			
Variables	Coeff.	Std. error	t-value	**Variables**	Coeff.	Std. error	t-value	VIF
Constant	−0.0005	0.0075	−0.062	Constant	2.0913	0.1992	10.50***	-
Inflation	−0.0343	0.0104	−3.298***	Inflation	−0.0401	0.0104	−3.856***	1.237
GDP/capita	0.0296	0.0090	3.282***	GDP/capita	0.0403	0.0187	2.154**	1.371
Exchange rate	−0.0335	0.0316	−1.058	Exchange rate	−0.0451	0.0098	−4.608***	2.500
Credit disbursed	0.0089	0.0399	0.222	Credit disbursed	0.0998	0.0616	1.620	2.934
Capacity utilized	0.0324	0.0164	1.976*	Capacity utilized	0.0846	0.0401	2.108**	1.318
Total meat lag 1	0.1053	0.1385	0.760					
ECM_{t-1}	−0.3169	0.1252	−2.532**					
R^2		0.224		R^2		0.496		
F- cal. (7,31)		5.2183***		F- cal. (5,35)		6.8872***		
Normality test		2.2309 (0.3731)						
RESET test		2.6263 (0.11557)						
Breush-Pagan		7.7222 (0.3564)						
CUSUMSQ test		-0.9907 (0.3298)						
Durbin Watson		1.9243 (0.3237)						

Source: Computed by the authors. Significance levels is indicated by ***, **, and *, which represent 1%, 5%, and 1% respectively. Variables used for the ECM are expressed in log difference, while those used for the long-run equation are expressed in a natural logarithm.

Researchers' Contribution Rate Declaration

The authors declare that they have contributed equally to the article.

Conflict of Interest Statement

The authors declare that there is no conflict of interest between them.

REFERENCES

Agboola, M. O., & Balcilar, M. (2012). Impact of Food Security on Urban Poverty: A Case Study of Lagos State, Nigeria. *Procedia - Social and Behavioral Sciences, 65,* 1225-1229.

Akinsulu, A. A., Ajijola, S., Odetola, S. K., & Awoyemi, D. O. (2019). Factors Influencing Meat Consumption in Ijebu-North Local Government

Area of Ogun States, Nigeria. *Journal of Marketing and Consumer Research, 52,* 10-16. DOI: 10.7176/JMCR.

Akpan, S. B. (2019). Oil palm fruit supply function in Nigeria. *Ife Journal of Agriculture, 31*(3), 11–26.

Akpan, S. B. (2022a). Contribution of the crop sub-sectors performance to the economic development of Nigeria: the ARDL model approach. *Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development, 22*(4), 39–48.

Akpan, S. B. (2022b). Trends in major ruminant meats production and the roles of the macroeconomic environment in Nigeria. *Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development, 22*(4), 49–62.

Akpan, S. B., & Monday I. (2021). Factors Productivity in small scale upland Vegetable Production in the South-South region of Nigeria. *Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development, 21*(1), 35–45.

Akpan, S. B., & Nkanta, V. S. (2022). Trend Analysis and Macroeconomic Variable Determinants of Egg Production in Nigeria. *Journal of Agricultural Production, 3*(2), 100-109.

Akpan, S. B., & Okon, U. E. (2019). Vegetable Consumption Paradox: Has Domestic Consumption Match the International Recommended Minimum Standard in Nigeria? *International Journal of Advances in Agriculture Sciences, 4*(3), 1–7.

Akpan, S. B., & Udo, U. J. (2021). Indigenous meat and milk gross production indexes and the dynamic macroeconomic fundamentals in Nigeria: ARDL model approach. *Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development, 21*(3), 97–110.

Akpan, S. B., & Umoren, A. A. (2021). Agricultural production indicators and the dynamic macroeconomic variables in Nigeria: ARDL model approach. *Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development, 21*(3), 111–124.

Akpan, S. B., & Ebong, V. O. (2021). Agricultural land use and population growth in Nigeria. The need for synergy for sustainable agricultural production. *Journal Agribusiness and Rural Development, 61*(3), 269–278. http://dx.doi.org/10.17306/J.JARD. 2021.01424.

Akpan, S. B., Edet J. Udoh, Ini-mfon V. Patrick, & Udoro J. Udo (2014). Seasonal Festive Periods and Meat Price Transmission and Market Integration in Akwa Ibom State, Southern Nigeria. *Asian Journal of Agricultural Extension, Economics & Sociology, 3*(4), 331–364.

Akpan, S. B., Ini-mfon V., Glory E., & Daniel E. (2012). Agricultural Productivity and Macro-economic Variable Fluctuation in Nigeria. *International Journal of Economics and Finance, 4*(8), 114–125.

Akpan, S. B., Samuel J. Udoka, & Inimfon V. Patrick (2015). Roles of Macroeconomic Variables on Agricultural Diversification in Nigeria. *American Journal of Economics and Business Administration, 7*(2), 77–93. DOI: 10.3844/ajebasp.2015.77.93.

Akpan, S. B., Udoka, S. J., & Patrick, I. V. (2021). Agricultural Sub Sectors' Outputs and Economic Growth in Nigeria: Implication for Agricultural Production Intensification. *AKSU Journal of Agriculture and Food Sciences, 5*(1), 56–68.

Arowolo, O. V., Oladejo, J. A., Oguntoye, T. O., Kabir, G. B., & Salako, B. A. (2021). Analysis of Meat Consumption Pattern in Ogbomoso North Local Government Area, Oyo State, Nigeria. *Appl. Sci. Environ. Manage., 25*(4), 555–559.

Babatunde, R. O., & Qaim, M. (2010). Impact of off-farm income on food security and nutrition in Nigeria. *Food Policy, 35*(4), 303–311.

Bamaiyi, P. H. (2013). Factors Militating against Animal Production in Nigeria. *International Journal of Livestock Research, 3*(2), 54–66.

Baskhron, R., Khalifa, A., Al-Sharqawi, S., & Al-Rasul, A. (2019). Production and consumption of red and white meat in Egypt. *Journal of Agricultural Economics and Social Sciences, 10*(12), 651–656. https://www.academia.edu/42795463/.

Betru, S., & Kawashima, H. (2009). Pattern and determinants of meat consumption in urban and rural Ethiopia. *Livestock Research for Rural Development, 21,* Article #143. Retrieved July 9, 2022, from http://www.lrrd.org/lrrd21/9/betr 21143. htm.

Ecker, O., & Hatzenbuehler, P. L. (2022). Food consumption–production response to agricultural policy and macroeconomic change in Nigeria. *Applied Economic Perspectives and Policy, 44*(2), 982–1002. DOI: 10.1002/aepp.13161.

Egwaikhide, F. O. (1997). Import Substitution Industrialization in Nigeria: A Selective Review. *The Nigerian Journal of Economic and Social Studies, 39*(2), 183–204.

Ejedegba, R. U. (2023). Macroeconomic Instability, Policy Uncertainty, and Investment Performance: The case of Nigeria. *International Review of Economics & Finance, 83,* 1–17.

Elegbede, V. A., Afolami, C. A., & Oyedepo, E. O. (2018). Determinants of meat consumption among students of the Federal University of Agriculture Abeokuta, Ogun State Nigeria. *Nigerian Journal of Agricultural Economics (NJAE), 8*(1), 127–136.

Engle, R. F., & Granger, C. W. J. (1987). Cointegration and error correction: representation, estimation, and testing. *Econometrica, 55,* 251–276.

FAO. (2019). The future of livestock in Nigeria. Opportunities and challenges in the face of uncertainty, African Sustainable Livestock, 2050, Rome.

Fatimah, M. A., Azharia, A. E., & Ishtiag, F. A. (2022). Nexus of Macroeconomic Indicators and Meat Consumption in Saudi Arabia: An ARDL Approach. *Universal Journal of Agricultural Research, 10*(3), 240–248. DOI: 10.13189/ujar.2022.100306.

Federal Ministry of Environment Document (2021). Retrieved on the 19th of February 2022 at: https://environment.gov.ng/.

James, M., Glynn, T., & Ted, S. (2009). U.S. Beef Demand Drivers and Enhancement Opportunities: A Research Summary, Kansas State University, Department of Agricultural Economics. Available at www.agmanager.info.

Kanayo, O., Nancy, S., & Maurice, O. U. (2013). A Review of Value Added in Nigeria's Pre and Post–SAP Agricultural Sector: Background and Issues. *Journal of Economics and Behavioral Studies, 5*(1), 44–56.

Mekonnen, D. A., Trijsburg, L., Achterbosch, T., Brouwer, I., Kennedy, G., Linderhof, V., Ruben, R., & Talsma, E. F. (2021). Food consumption patterns, nutrient adequacy, and the food systems in Nigeria. *Agricultural and Food Economics, 9*(16). https://doi.org/10.1186/s40100-021-00188-2.

National Population Commission document (2023). Retrieved on the 19th of May 2022 at: https://www.nationalpopulation.gov.ng/.

Odetokun, S. M., Borokinni, B. O., Bakare, S. D., Ghali-Mohammed, I., & Alhaji, N. B. (2021). A Cross-Sectional Survey of Consumers' Risk Perception and Hygiene of Retail Meat: A Nigerian Study. *Food Protection Trends, 41*(3), 274–283.

Odoemena, K. G., Walters, J. P., & Kleemann, H. M. (2020). A System Dynamics Model of Supply-Side Issues Influencing Beef Consumption in Nigeria. *Sustainability, 12*(3241), 1–22. http://dx.doi.org/10.3390/su12083241.

OECD/FAO. (2019). *OECD-FAO Agricultural Outlook*, OECD Agriculture statistics (database), http://dx.doi.org/10.1787/agr-outl-data-en.

OECD/FAO. (2021a). *OECD-FAO Agricultural Outlook*, OECD Agriculture statistics (database), http://dx.doi.org/10.1787/agr-outl-data-en.

OECD/FAO. (2021b). *OECD-FAO Agricultural Outlook 2021-2030,* OECD Publishing, Paris, https://doi.org/10.1787/19428846-en.

Ogbeide, O. A. (2015). Meat Industry Development in Nigeria: Implications of the Consumers' Perspective. *Mayfair Journal of Agribusiness Management, 1*(1), 59–75.

Ogbonna, B. C. (2012). Structural Adjustment Program (SAP) in Nigeria: An Empirical Assessment. *Journal of Banking, 6*(1), 19–40.

Ojiako, I. A., & Olayode, G. O. (2008). Analysis of trends in livestock production in Nigeria: 1970-2005. *Journal of Agriculture and Social Research (JASR), 8*(1), 114–120.

Organization for Economic Co-operation and Development (OECD) (2023), Meat consumption (indicator). doi: 10.1787/fa290fd0-en (Accessed on 15 June 2023).

Osazuwa-Peters, M. (2021). The local contexts of meat consumption: analyzing gratification in Nigeria. *Food, Culture & Society, 24*(5), 712–730. DOI: 10.1080/15528014.2021.1936788.

Reardon, T., Tschirley, D., Liverpool-Tasie, L. S., Awokuse, T., Fanzo, J., Minten, B., Vos, R., Dolislager, M., Sauer, C., Dhar, R., Vargas, C., Lartey, A., Raza, A., & Popkin, B. M. (2021). The processed food revolution in African food systems and the double burden of malnutrition. *Global Food Security, 28,* 100466. https://doi.org/10.1016/j.gfs.2020.100466.

Simo-Kengne, B. D., Dikgang, J., & Ofstad, S. P. (2018). Effect of marine protected areas and macroeconomic environment on meat consumption in SEAFO countries. *Agric Econ 6, 12,* 1–17. https://doi.org/10.1186/s40100-018-0105-5.

Udah, S. C., Nwachukwu, I. N., & Akpan, S. B. (2015). Performance Evaluation of Various Policy Regimes Towards Agricultural Growth in Nigeria. *International Journal of Agriculture, Forestry, and Fisheries, 3*(2), 57–63.

Udah, S. C., Nwachukwu, I. N., Nwosu, A. C., Mbanasor, J., & Akpan, S. B. (2015a). Determinants of Agricultural Export Growth in Nigeria. *International Journal of Agriculture, Forestry and Fisheries, 3*(3), 105–109.

Udah, S. C., Nwachukwu, I. N., Nwosu, A. C., Mbanasor, J. A., & Akpan, S. B. (2015c). Analysis of Contribution of Various Agricultural Subsectors to Growth in Nigeria's Agricultural Sector. *International Journal of Agriculture, Forestry and Fisheries, 3*(3), 80–86.

Udoh, E. J., & Akpan, S. B. (2019). Macroeconomic variables affecting fish production in Nigeria. *Asian Journal of Agriculture and Rural Development, 9*(2216–2230).

Williams, T. O. (1989). Livestock development in Nigeria: A survey of the policy issues and options. Network Paper No. 21, International Livestock Centre for Africa (ILCA), Addis Ababa, Ethiopia.