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Analysis of the Trend and Determinants of Cassava Consumption in Nigeria (1970 – 2020): Implications for Food Security Goal of the Nation

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Abstract:
Considering the rate at which the country's population increases, there is need to match the level of food production with the population growth of the nation. Hence, assessing the trend and determinants of cassava consumption is an important step towards achieving the food security goal of the nation. This study therefore analyzed the determinants of cassava consumption in Nigeria from 1970 – 2020 with the aim of providing empirical results of the trend and determinants of cassava consumption in the country. Time series data collected, spanning from 1970 – 2020 were tested for stationarity using ADF unit root test and analyzed using trend and regression analyses and the Error Correction Model (ECM). The ADF test showed that only per capita income was stationary at level, I (0), other variables were stationary at first difference, I (1) while population was stationary at second difference, I (2). The trend analysis showed that cassava consumption was generally on the increase over the period of study. The coefficients of population, per capita income, cassava production and exchange rate were positively related to cassava consumption and statistically significant at 1% probability level while the ECM shows that the coefficient (-0.9359) was negative and statistically significant at 1% probability level (P < 0.01), which indicates a long run relationship between the variables in the model and cassava consumption. The study therefore concludes that there was a general increasing trend in cassava consumption over the period of study and that the major determinants of cassava consumption in Nigeria were population growth, per capita income, price of cassava and cassava production. Based on the research findings, it was recommended that cassava being one of the priority crops on the Agricultural Transformation Agenda (ATA) should be given priority in order to increase the level of production of the crop.

Keywords: *Cassava, consumption, food security, stationarity, trend*

1. Introduction

Food is a basic necessity for life, and everyone needs it for survival. Agriculture is the most important activity for human survival as it produces the necessary food for the world's population under rain-fed and irrigated conditions (Akinpelu *et al*., 2011). The agricultural sector of Nigeria provides food for the growing population and income for millions of smallholders. Agriculture feeds people, produces basic commodities for society, and provides gainful employment for the majority (Ojemade, 2017). It provides employment for about 65 percent of the labour force for industrial development and also raw materials for industries (Muhammed *et al.,* 2013).

Nigerian cassava production, with about 45 million metric tonnes, is by far the largest in the world. It is three times the production of Brazil and almost double the production of Indonesia and Thailand. Its cassava transformation is the most advanced in Africa (International Fund for Agricultural Development (IFAD), 2014). Total world cassava demand would reach 275 million tons by 2020 while Africa now produces about 62 percent of the total world production, with Nigeria being the largest producer of the crop in the world with an output level of 54 million tons in 2013 (Food and Agriculture Organization Statistics, (FAOSTAT), 2015). Nonetheless, less than 5% of the output produced in Nigeria is used in industries, while about 95% is used for human consumption (NISER, 2013). Industrial users of cassava products in the country consisted mainly of bakeries, flour mills, livestock, and pharmaceutical firms.

Inadequate planning of Nigeria's agricultural sector to cope with the growing population has led to widespread food shortage in the country (West African Rice Development Association (WARDA), 2013). Despite its leading position of Nigeria in cassava production, the country still imports significant quantities of cassava products such as starch, flour, and sweeteners that can be derived from cassava. This is because agriculture has not really supplied adequate raw materials to the industrial sector. Over the years, enormous foreign exchange resources have been utilized for the importation of food and various raw materials for the manufacturing sector (Sanusi, 2012), which constituted a drain on the foreign exchange resources of the country. The impact of this act on development has been low welfare capacity, low employment, high inequality, and hence high multi-dimensional poverty. Also, an overwhelming proportion of cassava produced in Nigeria goes to human consumption, while a very low proportion goes to industry and foreign trade. Thus, the foreign exchange-generating capacity of the crop still remained largely unexploited. While many useful genetic and agronomic characteristics of cassava have been identified through research (IITA, 2014; WARDA, 2013), not much appears to be known about the determinants of cassava consumption in Nigeria, where more than 84% of people consume cassava, and cassava-based products at least every day (Onyemauwa, 2010). This is because many food policy analysts consider cassava as an inferior food because it is assumed that its per capita consumption will decline with increasing per capita income.

It was against this backdrop that this study, therefore, sought to provide answers to the following research questions:

- What is the trend of cassava consumption in Nigeria?
- What are the determinants of cassava consumption in Nigeria?
- What is the long-run and short-run effect of economic variables on cassava consumption in Nigeria from 1970 – 2020?

The aim of the study was to analyze the trend and determinants of cassava consumption in Nigeria from 1970 – 2020. The specific objectives were to:

- Analyze the trend of cassava consumption in Nigeria,
- Analyze the determinants of cassava consumption in Nigeria, and
- Estimate the long-run and short-run effect of economic variables on cassava consumption in Nigeria from 1970 – 2020

1.1. Hypotheses of the Study

- There is no significant trend in cassava consumption from 1970 – 2020
- Cassava consumption in Nigeria is not significantly influenced by income, population, own price, and other variables
- There is no long-run relationship between income, population, and own price of cassava and cassava consumption throughout the study

2. Methodology

2.1. The Study Area

The study was conducted in Nigeria. Nigeria is a Sub-Saharan African (SSA) country in the Western part of Africa, which shares a land border with the Republic of Benin to the West, Chad, and Cameroon to the East, Niger Republic to the North, and the Atlantic Ocean to the South. It is located between Latitudes $4^0 14'$ North of the equator and Longitude $2^0\ 15'$ East of the Greenwich meridian line, with a land area of about 923769 km2, a North-South length of about 1,450 km, and a West-east breadth of about 800km. It comprises 36 States and the Federal Capital Territory, located in Abuja. It is the most populous country in Africa, accounting for approximately one-sixth of Africa's people with an estimated population of about 182.2 million people in 2015, which was projected to be about 204.9 million people in 2020 at 2.5% growth rate (National Bureau of Statistics (NBS), 2020). The common cash crops and food products in Nigeria are: yam, rice, cassava, millet, sweet potato, groundnuts, palm oil, sheep, cattle, pig, shea butter, cotton, gum, rubber, and cocoa.

2.2. Methods of Data Collection

The longitudinal survey design was adopted for this study. Time series data spanning from 1970 – 2020 were collected for the following variables: Population, quantities of cassava production and consumption, price of cassava, exchange rate, per capita consumption of cassava, per capita income as well as Gross Domestic Product (GDP).

2.3. Data Analytical Technique

Different analytical tools were used to analyze the data collected in line with the stated objectives. Objectives i, ii, and iii were analyzed using trend analysis, regression analysis, Johansen co-integration test, and Error Correction Model (ECM), respectively.

2.4. Stationarity Test of Variables

As the first step in the analysis involving time-series data, investigating the presence of unit roots in the data is very important because it helps ensure that the variables used in the regression are not subject to spurious regression. The ADF unit root test was carried out on the data to test for the stationarity of each time series data set. The test also enables the determination of the order of integration of the series, which is the number of times a series has to be differenced for it to become stationary.

2.5. Co-Integration Test

After determining the order of integration, the co-integration test was applied. The test for co-integration is based on the framework developed by Johansen (1991), and it determines the number of co-integrating equations. This number is called the co-integrating rank. According to Johansen (1995), the variables are not co-integrated if the rank is zero, but if the rank = r, then there exists possible independent linear combinations (co-integrating vector).

2.6. Model Specification

Augmented Dickey-Fuller (ADF) Unit Root Test:

$$\Delta Y_t = \alpha_0 + \alpha_2 t + \beta_1 Y_{t-1} + \sum_{i=1}^{p} \beta_2 \Delta Y_{t-1} + e_t \quad \text{..... (1)}$$

Where:

- Y_T = current value of cassava consumption,
- t = time trend variable,
- Δ = change operator,
- P = optimal lag length,
- α_0 = constant, α_2, β_1,
- β_2 = coefficient to be estimated, and
- e = error term

Decision Rule: Stationarity is confirmed if the ADF statistic is greater than the critical value at a specified level of significance; otherwise, the series is non-stationary.

2.7. Regression Analysis

A regression model specified as a consumption function was estimated as in equation 2 to analyze the determinants of cassava consumption in Nigeria:

$$C = \beta_0 + \beta_1 + POC + \beta_2 PCI + \beta_3 EXC + \beta_4 TQP + \beta_5 POP + \text{□} \quad \text{..... (2)}$$

Where:

- C = Quantity of cassava (tons),
- POC = Price of cassava (₦/ton),
- PCI = Per capita income (₦),
- EXC = Exchange rate (₦/$),
- TQP = Total quantity of cassava produced (tons),
- POP = Population (number), and
- □ = error term

The Error Correction Model (ECM) to determine the long-run relationship among variables is specified as follows:

$$\Delta \ln C = \beta_0 + \sum_{i=1}^{p} \beta_1 \Delta \ln POP_{t-1} + \sum_{i=1}^{p} \beta_2 \Delta \ln PCI_{t-1} + \sum_{i=1}^{p} \beta_3 \Delta \ln POC_{t-1} + \sum_{i=1}^{p} \beta_4 \Delta \ln TQP_{t-1} + \text{□}_t \quad \text{.. (3)}$$

Where:

- ln = natural log,
- β_0 = constant,
- $\beta_1 - \beta_4$ = coefficients to be estimated,
- Δ = change operator,
- p = optimal lag length,
- C = quantity of cassava consumed (tons),
- POP = population (number),
- PCI = per capita income (₦),
- POC = price of cassava (₦/ton),
- TQP = total quantity of cassava produced (tons), and
- □ = error term

3. Results and Discussion

3.1. Determination of Time Series Properties of Data Employed for Analysis

As a first step in the analysis involving the use of time series data, the stationarity of the variables is required. The properties of the time series data were tested using Augmented Dickey-Fuller (ADF) test to determine the stationarity of the variables under consideration, as presented in table 1. The ADF unit root test shows that the population was not stationary at the level and first difference but became stationary at the second difference with an order of integration, I (2). On the other hand, other variables were non-stationary at levels but became stationary at the first difference with an order of integration 1, I (1).

Variable	Level	1st Difference	2nd Difference	Order of Integration	Critical Value (5%)
Exchange rate	-0.725 (0.9715)	-4.486*** (0.0050)		I(1)	-3.524
Per capita income	-2.020 (0.5906)	-4.513*** (0.0014)		I(1)	-3.524
Cassava per capita consumption	-2.263 (0.4545)	-5.193*** (0.0001)		I(1)	-3.524
Population	7.678 (1.0000)	-2.876 (0.1704)	-12.047*** (0.0000)	I(2)	-3.524
Cassava consumption	-1.129 (0.9241)	-5.883*** (0.0000)		I(1)	-3.524
Cassava production	-2.519 (0.3184)	-7.824*** (0.0000)		I(1)	-3.524
Price of cassava	-1.456 (0.8439)	-5.651*** (0.0000)		I(1)	-3.524

Table 1: Augmented Dickey-Fuller (ADF) Unit Root Test of Variables
Source: Data Analysis, (2021)
**** And ** Implies Significant at 1% and 5% Probability Levels Respectively*

3.2. Trend of Cassava Consumption in Nigeria (1970 – 2020)

Figure 1 presents the result of the trend of cassava consumption in Nigeria from 1970 to 2020. The result showed that there was a steady and continuous increase in cassava consumption during this period. The trend increased from 1970 to 2009, followed by a drop in 2010. This was followed by a sharp increase from 2011 and continuously to 2020. This could be attributed to rapid growth in population and the rising demand for the product for various uses in the local and international markets.

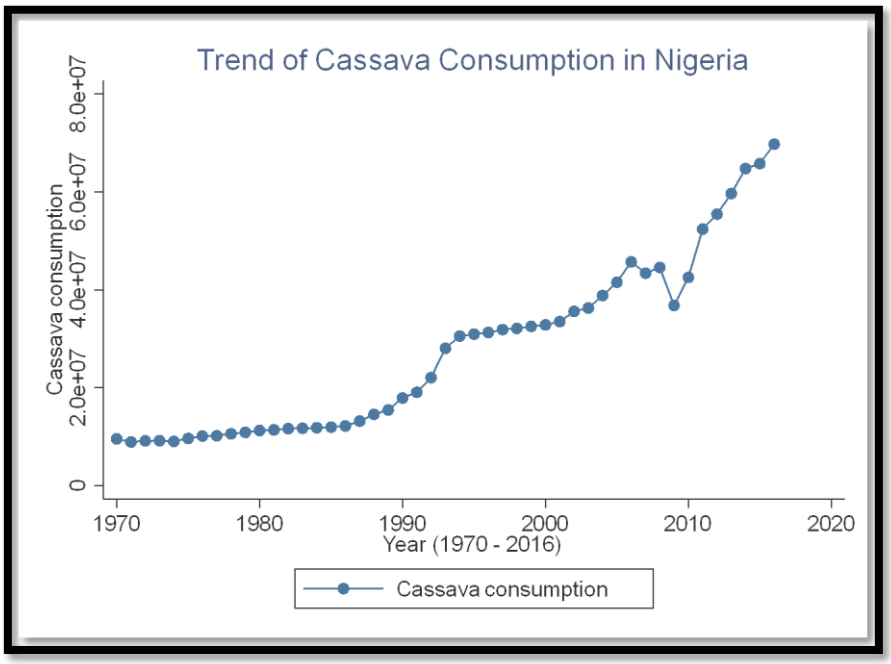

Figure 1: Trend of Cassava Consumption in Nigeria (1970 – 2020)

3.3. Determinants of Cassava Consumption in Nigeria

The result of the determinants of cassava consumption in Nigeria from 1970 to 2020 is presented in table 2. The coefficient of determination, R^2, was 0.9840. It implies that about 98% of the variation in cassava consumption was explained by the explanatory variables included in the model, while the remaining 2% was explained by the error term and other variables not included in the model. The F- ratio was 438.31 and statistically significant at 1% probability level. This shows a goodness of fit for the regression model and an indication that the entire model was significant. The coefficients of population, per capita income, cassava production, and exchange rate were positively related to cassava consumption and statistically significant at 1% probability level. The implication is that a unit increase in these variables will lead to a corresponding increase in cassava consumption by the coefficients of these variables and vice versa. Therefore, the major determinants of cassava consumption in Nigeria were: population growth, per capita income, cassava production, and exchange rate.

Variable	Coefficient	Std. Error	t – statistics
Constant	969079.2	8363497	0.12
Price of cassava	9599.045	48106.73	0.20
Population	27.99814	7.075649	3.96***
Per capita income	1942.67	645.0641	3.01***
Cassava production	0.8273007	0.2035922	4.06***
Exchange rate	60024.7	18523.77	3.24***
Per capita consumption	-3.50e+08	1.23e+09	-0.28
R – squared	0.9840		
F – statistics	438.31***		

Table 2: Determinants of Cassava Consumption in Nigeria
Source: Data Analysis, (2021).
****, ** and * Implies Significant at 1%, 5% and 10% Probability Level Respectively*

3.4. Long and Short-Run Effect of Economic Variables on Cassava Consumption

The result of Johansen co-integration test, as presented in table 3, shows a trace statistic of 150.1464 which is greater than the critical value of 69.8188 at 5% level of significance ($P < 0.05$). The result shows that there was one co-integration equation among the variables. Therefore, based on the decision rule, the null hypothesis of no co-integration among the variables, such as cassava consumption, population, per capita income, price of cassava, and cassava production, was rejected. This implies that there is a long-run relationship among cassava consumption, population, per capita income, price of cassava, and cassava production in Nigeria.

Hypothesized No. of CE(s)	Eigen Value	Trace Statistics	Critical Value (5%)
None*	0.913641	150.1464	69.81889
At most 1	0.389611	42.37953	47.85613
At most 2	0.297194	20.65856	29.79707
At most 3	0.085951	5.140892	15.49471
At most 4	0.026607	1.186583	3.841466

Table 3: Co-Integration Test of Variables
Source: Data Analysis, (2021).
** Denotes Rejection of Null Hypothesis at 5% Significant Level*
Based on Mackinno-Haug-Michelis (1999) P-Value

3.5. Vector Error Correction Model

In the long run, the results of the Error Correction Model (ECM) show that the ECM coefficient (-0.9359) was negative and statistically significant at 1% probability level ($P < 0.01$). This indicates a long-run relationship between the variables used in the model (population, per capita income, price of cassava, and cassava production) and cassava consumption during the period under study. The result also shows that the coefficient of the population (0.5836) and cassava production (0.2950) were found to be positively related to cassava consumption and statistically significant at 1% ($P < 0.01$) and 5% ($P < 0.05$) probability level, respectively. This implies a direct relationship which means that a unit increase in these variables will lead to a corresponding increase in cassava consumption by the coefficients of these variables and vice versa. This result agrees with the findings of Oni (2016). He analyzed the socio-economic determinants and profitability of cassava production in Nigeria and asserted that the level of cassava production and population growth influenced cassava consumption. Also, the coefficient of the price of cassava (-2.4881) was found to be negatively related to cassava consumption and statistically significant at 10% ($P < 0.10$) probability level. This is an inverse relationship, implying that a unit increase in cassava price will result in a 2.49 unit decrease in cassava consumption and vice versa. This finding corroborates with that of Adeniyi (2014), who studied the determinants of cassava consumption in the Asa local government area of Kwara State, Nigeria, and found that the price of cassava was a significant factor to consider in cassava consumption.

In the short run, the ECM coefficient for cassava consumption, as presented in table 4, was -0.00139, which indicates a low speed of adjustment of population, per capita income, price of cassava, and cassava production towards equilibrium. This implies that the speed of adjustment at which the variables used in the model will be in equilibrium with cassava consumption is at the rate of 0.1%. The coefficient of determination R^2 was 0.8626, which implies that about 86% of the variation in cassava consumption was explained by population, per capita income, price of cassava, and cassava production as included in the error correction model, while the remaining 14% was accounted for by the error term and other variables not included in the model.

Variable	Coefficient	Standard Error	t-statistics
Long Run			
ECM (-1)	-0.9359	0.3388	2.76***
POP (-1)	0.5836	0.1438	4.06***
PCI (-1)	1141.441	1486.808	0.77
POC (-1)	-2.4881	0.2825	8.81***
CPRO (-1)	0.2950	0.1708	1.73*
Constant	609298.8	542621.3	1.12
Short Run			
ECM (-1)	-0.00139	0.00732	0.19
POP (-1)	2.0531	7.7823	0.26
POP (-2)	0.7156	0.3873	1.85*
PCI (-1)	0.0008	0.0032	0.23
PCI (-2)	209.8972	814.792	0.25
POC (-1)	2.38e-12	8.14e-12	2.93***
POC (-2)	0.5011	0.4875	1.03
CPRO (-1)	9.02e-09	5.33e-07	0.02
CPRO (-2)	542.3742	256.926	2.11***
Constant	-0.3765	1.1718	0.32
R-squared	0.8626		
Adj. R-squared	0.7429		
F-statistics	100.89***		
AIC	29.8309		
HQIC	30.7354		
SC	32.0660		

Table 4: Estimates of the Vector Error Correction Model for Cassava Consumption
Source: Data Analysis, (2021).
****, ** and * Implies Significant at 1%, 5% and 10% Probability Level Respectively*

- CCON = Cassava consumption
- POP = Population
- PCI = Per Capita Income
- POC = Price of Cassava
- CPRO = Cassava production
- AIC = Akaike information criterion
- HQIC = Hannan Quinn Criterion
- SC = Schwarz criterion

3.6. Test of Hypotheses

3.6.1. Hypothesis I

- H_{01}: There is no significant trend in cassava consumption in Nigeria from 1970 – 2020.

The result of the trend analysis for cassava consumption shows that the trend coefficient was statistically significant at 1% probability level ($P < 0.01$), which indicates accelerated growth in cassava consumption in Nigeria from 1970 – 2020. Therefore, hypothesis I, which stated that there is no significant trend in cassava consumption in Nigeria from 1970-2020, was rejected.

3.6.2. Hypothesis II

- H_{02}: Cassava consumption in Nigeria is not significantly influenced by per capita income, population, price of cassava, and other variables.

The result of the regression analysis shows that cassava consumption was significantly influenced by per capita income ($P < 0.01$), population ($P < 0.01$), and cassava production ($P < 0.01$). Therefore, hypothesis II, which stated that cassava consumption in Nigeria is not significantly influenced by per capita income, population, price of cassava, and other variables, was rejected.

3.6.3. Hypothesis III

- H_{03}: There is no long-run relationship between cassava consumption, per capita income, population, and price of cassava throughout the study.

The ECM result shows that the likelihood ratio (197.2964) was greater than the critical value (69.81889) at 5% ($P < 0.05$) probability level. Therefore, hypothesis III, which stated that there is no long-run relationship between cassava consumption, per capita income, population, and price of cassava, was rejected.

4. Conclusion and Recommendations

This study analyzed the determinants of cassava consumption in Nigeria from 1970 to 2020 and concluded that:

- There was a generally increasing trend in cassava consumption throughout the study, and
- The major determinants of cassava consumption were population growth, per capita income, exchange rate, price of cassava, and cassava production

Based on the research findings, it was, therefore, recommended that cassava, being one of the priority crops on the Agricultural Transformation Agenda (ATA), should be given priority to increase the level of production of the crop since there was a general increase in the trend of cassava consumption in Nigeria from 1970 to 2020.

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