Data Mining of COVID-19 Cases and Food Security in Nigeria

Dengle Yuniyus Giroh[†] and Ahmadu Abubakar Tafida[‡]

Abstract
The poor public health sector, inadequate welfare programme, state of insecurity coupled with the increasing COVID-19 cases in Nigeria had affected the wellbeing of her citizens. During the outbreak of COVID-19 pandemic, people living in poverty did not have welfare relief that could help them cope with the economic hardship at the time. In this paper, Data Mining of COVID-19 Cases and Food Security in Nigeria is examined using the data from the daily COVID-19 cases update released by the Nigeria Centre for Disease Control (NCDC) online database from February 28th, 2020 – 7th December 2020 and data on National Food Prices from National Bureau of Statistics. The data were subjected to descriptive and inferential statistics. Generalized Negative Poisson regression was selected based on Akaike Information Criterion (AIC) and Bayesian Information Criterion (BIC) and the result revealed that admitted and discharged cases had negative and inverse relationship with COVID-19 related deaths in the country while increase in laboratory confirmed cases had a positive and significant effect on the number of deaths. The pandemic had a negative impact on food prices thereby affecting food security of citizens.

Keywords: food security; COVID-19; basic food staples
JEL Classification Codes: L66, Q18

[†] Corresponding author, Department of Agricultural Economics and Extension, Modibbo Adama University of Technology, P.M.B.2076, Yola, Nigeria, Email: girohydengle@mautech.edu.ng
[‡] Department of Agricultural Economics and Extension, Modibbo Adama University of Technology, P.M.B.2076, Yola, Nigeria

1.Introduction

The corona virus was first reported in Wuhan, Hubei Province, China in 2019. The mode of primary transmission of corona virus was zoonotic. The virus was named "corona virus disease 2019" ("Covid-19"). (Ozili 2020). Recent statistics of COVID-19 cases in the world since 31st December, 2019 to 7th December, 2020 showed 66,818,738 cases with 1, 536,855 deaths. The number of 2,263,161 cases has been reported in Africa with South Africa having the highest number of 814,565 cases. Asia has 16, 274, 741 cases with India topping the list with 9,677,203. In America, a total of 28, 789, 827 cases have been reported where United States alone accounted for 14, 756,998 cases while in Europe, it was 19,491,009 cases with Russia having the reported cases of 2,488,912. Furthermore, data in Table 1 showed that America had the highest number of COVID-19 cases while African Continent is the least.

Table 1: COVID-19 Cases across Continents as at 7/12/2020

Continent	Number of Cases	Percentage of Total Cases
Africa	2,263,161	3.38
America	28,789,827	43.09
Asia	16,274,741	24.36
Europe	19,491,009	29.17
Total	66,818,738	100.00

Source: Authors own computation from various sources (2020).

COVID-19 case was first reported in Nigeria on 27th February 2020 in Lagos State which later spread to other parts of the country. The laboratory confirmed cases as at 7/12/2020, was 69,645 affecting all the states in the country. The discharged, admitted and deaths were 64, 947, 3, 5177 and 1,181(Table 2). From Table 2 it showed that Lagos State had the highest number of cases while Kogi State is the lowest in Nigeria. (www.covid19.ncdc.gov.ng). The Nigerian economy was affected as a result of uncertainty and fear among investors about how the pandemic would affect firms' profit. In Nigeria, banks' earnings are depressed thereby impairing bank soundness and stability and their reluctance to lend to more borrowers. The volatility in crude oil prices not only affected the national budget but Nigeria's foreign reserve. The national budget initially predicated on US$57 per barrel, was reviewed to US$30 per barrel. Nigeria as an import-dependent country also experienced low supplies of pharmaceuticals, spare parts, and finished goods from China as a result of global lockdown of the economy. The Nigerian stock market reported a loss of over ₦2.3 trillion (US$5.9bn) after the corona virus was confirmed and announced in the country. It was estimated that about 265 million people could be impacted by food insecurity in 2020; this is an increase of 96% compared to 135 million who experienced food insecurity before the crisis. The overall effect of the pandemic on agriculture is estimated at about US$3.7 billion (World Food Programme, 2020b).

Forsido *et al.*(2020) reported that hand washing ,observance of personal hygiene, hand sanitizers, use of face masks, coughing protocol and physical distancing were some of the recommended measures adopted to avoid the infection and spread of COVID-19. The restriction of movement imposed by both the Federal and State governments to control virus has affected virtually all

sectors of the economy with the exception of private security outfits, health sector, print and electronic media, energy and power and Information and communication technologies.

Table 2: COVID-19 Cases in Nigeria as at 7/12/2020

States Affected	No. of cases (Lab confirmed)	No. of Cases(on admission)	No. Discharged	No. of Deaths
Lagos	23,885	538	23,120	227
FCT	7,368	1,004	6,281	83
Plateau	3,914	145	3,735	34
Oyo	3,742	334	3,363	45
Kaduna	3,449	315	3,087	47
Rivers	3,055	120	2,876	59
Edo	2,723	30	2,581	112
Ogun	2,266	147	2,086	33
Delta	1,827	41	1,737	49
Kano	1,826	58	1,713	55
Ondo	1,728	103	1,585	40
Enugu	1,332	21	1,290	21
Kwara	1,125	57	1,039	29
Katsina	1,069	39	1,006	24
Ebonyi	1,055	6	1,019	30
Gombe	1,027	71	931	25
Osun	954	9	924	21
Abia	926	9	908	9
Bauchi	790	34	742	14
Borno	758	17	705	36
Imo	681	24	645	12
Nasarawa	531	193	325	13
Benue	501	30	460	11
Bayelsa	465	56	388	21
Ekiti	386	29	351	6
Akwa Ibom	362	29	324	9
Jigawa	336	17	308	11
Niger	298	4	282	12
Anambra	285	1	265	19
Adamawa	261	4	238	19
Taraba	181	14	161	6
Sokoto	172	5	150	17
Yobe	100	8	84	8
Kebbi	93	1	84	8
Cross River	90	3	78	9
Zamfara	79	1	73	5
Kogi	5	0	3	2
Total	**69,645**	**3,517**	**64,947**	**1,181**

Source: www.covid19.ncdc.gov.ng

Spillovers of the pandemic were felt in most developing countries that have poor health facilities and inadequate welfare policies that affected their citizens (Laborde *et al.*, 2020; Ozili and Arun 2020). This is in contrast to what was done in developed countries like USA and UK where palliatives in the forms of social welfare were paid to the people in addition to the loan reliefs to businesses.

In an effort to mitigate the effect of the pandemic, monetary and fiscal policy measures were adopted in Nigeria. There were extensions of loan moratorium on principal repayments, interest rate reductions on all intervention loan facilities from 9% to 5% which took effect from March 1, 2020. Also, ₦50bn (US$131.6m) targeted credit facility to hotels, airline service providers and health care merchants were offered by the government. Aref - Adib (2020) observed that the Federal Government's provision for cash transfers of ₦20,000 ($51.75) to vulnerable households was inadequate considering the large number of people living in poverty in Nigeria and many people will likely miss out on these transfers.

.

2. Literature Review

Calogero *et al.*(2013) defined food security as a situation where all people, at all times, have physical and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life. Availability, access, utilization and stability are the components of food security (Figure 1). The agricultural sector is the largest employer of labour providing jobs for more than one-third (86.4%) of the Nigerian labour force. It has the potentials for economic diversification. The sector has grown consistently at an average of 2.6% over the past three years. As at the first quarter (Q1) of 2020, agriculture accounted for about 22% of the Nigerian gross domestic product (GDP) compared to oil and gas (9.5%), manufacturing (9.7%), financial services (3.8%) and trade (16.1%). The lockdown of the country in phases for the containment of corona virus was a necessity with negative consequences on the farmers as most of them could not access their farms in other state locations. Procurements of farm inputs and food distribution were stifled. Also, post-harvest losses, reduced market supply and increase in food prices resulting to food insecurity were also experienced (Federal Ministry of Agriculture and Rural Development, FMARD).

Ozili (2020) reported that pandemic and epidemic outbreaks related to animals affecting food security were traced to the first poultry disease- Avian influenza of 1878; the Newcastle disease of 1926 and highly pathogenic avian influenza H5N1 of 1997. Forsido *et al.* (2020) stated that the measures adopted in containing the virus though necessary, but disrupted food supply chains especially in Africa. George (2020) reported continued increase in the number of COVID-19 cases in spite of the ease of lockdown in the country which put uncertainties in the coping strategies of households. He equally stated that Nigeria used to import large quantities of her food supplies which were affected by the closure of borders and many countries have started cutting down on exports. Ozili (2020) stated that during the outbreak, people living in poverty were affected as there was little or no support to cushion the effect was put in place by the government. Swinnen and MC Dermot (2020) reported disruption in food supply because of the lockdown which restricts movement of labour and food items causing increases in food prices and further aggravating food security situations among the people living in poverty in many developing countries of the world. The authors further stated that people who earn livelihood and incomes from food business (transportation, marketing, value addition) were displaced.

Famine Early Warning Systems Net (FEWSNET2020) blamed food price increase in Nigeria to deteriorating macro economy, increase in pump prices of petrol and security challenges. World Food Programme (2020b) envisaged increases in the prices of basic energy food requirements which were attributed not only to seasonal decline in household food stocks, but the pandemic and its rampaging effect on food security. The recommended quantity is 2,100 kilocalories percaput/ day. Increased demands without supplies will contribute to sustained increase in food prices in the country which will further hamper food access for the most vulnerable households who are already facing limited livelihood opportunities. Amare *et al.*(2020) also reported increases food prices in the country as a result of COVID-19. Food crisis will adversely affect those with irregular income; low income to reserve for precautionary purposes; those with poor health conditions; those living with stigma due to their social conditions (prisoners); the isolated; the internally displaced/homeless and orphans and vulnerable children. The paper was therefore conducted to examine COVID 19 cases in the country and its impacts on food security.

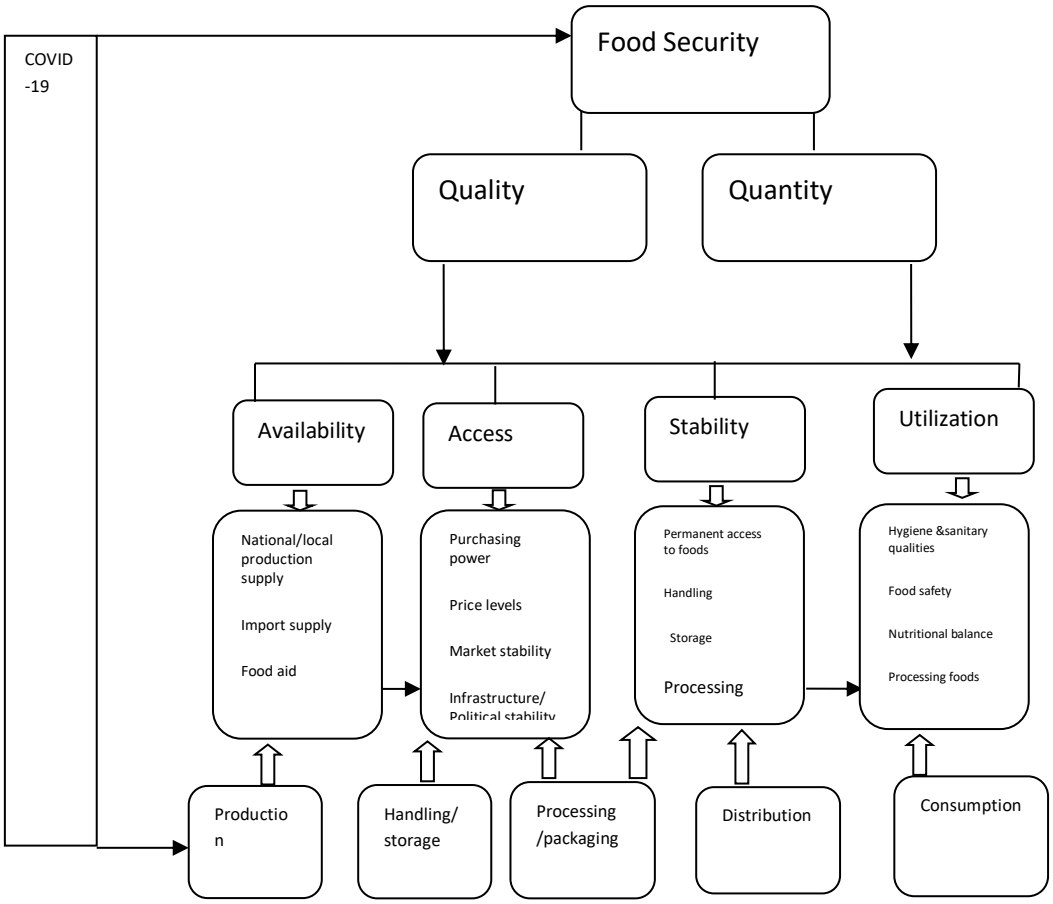

Fig 1: Conceptual Framework linking effects of COVID-19 on Food Security
Adapted with modifications from Forsido *et al*. (2020).

3. Methodology

3.1 The Data

Secondary sources of data were used for the study. These were obtained from Nigeria Centre for Disease Control (NCDC) online database (www.covid19.ncdc.gov.ng) from February 28th, 2020 to the 7th December, 2020. The data were on total deaths, admitted cases, discharged cases and total number of laboratory confirmed COVID-19 cases as released by NCDC. National Food Prices from 2019 to August 2020 were also obtained from National Bureau of Statistics.

3.2 Methods of data analysis

Descriptive and inferential statistics were used in analyzing the data collected. Mean, standard deviation, tables and percentages were the descriptive statistics used to examine the nature of the data. Inferential statistics such as T- test statistic was used to examine the impact of COVID-19 Cases on food prices while Poisson Regression, Generalized Negative Poisson Regression and Negative Binomial Regression were used in the analysis of COVID-19 data. To overcome the violation of the assumption of a Poisson distribution, Negative Binomial Regression (NBR) and the Generalized Negative Poisson Regression (GNPR) models were tried (Famoye, 1993).

3.3 Model specification

The rate at which COVID-19 death occurs in Nigeria is a random variable denoted by Y is said to follow a Poisson distribution with parameter $\lambda > 0$, the probability function is given by:

$$P(Y = y) = \frac{e^{-\lambda}\lambda^{n}}{y!} \quad (1)$$

Where n=1,2,3 is the number of occurrences of an event and λ is defined as $\lambda = E(Y)$. One of the useful properties of the Poisson distribution is that the variance depends on the mean and also the variance is equal to the mean. The Generalized Linear Model (GLM) can be stated as

$$g_i = \beta_0 + \beta_1 X_{i1+\cdots+} \beta_K X_k \quad (2)$$

The first function describes how mean, $E(Y_i) = \lambda i$ which depends on a linear predictor $\phi(\lambda_i) = g_i$ while the second functions describe how the variance, Var(Yi) (depends on the mean.

$Var(Y_i) = \phi var(\lambda_i)$ where the dispersion parameter ϕ is a constant, supposing Y_i is a Poisson distribution, then $Y_i \sim$ Poisson(λ_i), $E(Y_i) = \lambda_i$ and $Var(Y_i) = \lambda_i$, the variance function is given $Var(\lambda_i) = \lambda$ and the function must map from$(0, \infty)$. A natural log function is given as $\ell(\lambda_i) = \log_e(\lambda_i)$. The Poisson Regression model fitted to the number of deaths from COVID -19 cases in Nigeria is stated as:

$$\text{Log}(Y) = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 \quad (3)$$

where X_1 = Laboratory confirmed cases, X_2= critical or admitted cases and X_3= discharged cases while β represents expected change in the logarithm of the mean per unit change in the predictor variables(X_i) which were estimated using the maximum likelihood estimate methods(Samuel *et al.*, 2020).

3.4 Negative Binomial Regression (NBR)

Negative Binomial distribution was employed to deal with the problem of over-dispersion in count data. Overdispersion occurs when there is the presence of statistical variability in a data set. Over-dispersion is a very common characteristic in applied data analysis because, in practice, populations are frequently heterogeneous (non-uniform) as opposed to the assumptions implicit within widely used simple parametric models. The Negative Binomial regression model specified after Sha-Pin (1993) is expressed as:

$$p_r[Y_i = y] = \sum p_r(Y_i/\theta_i) f(\theta_i) d_{\theta i} = \frac{\Gamma\left(\left(y_1 + \frac{1}{\alpha}\right)\right)}{\Gamma(y_i+1)\Gamma\left(\frac{1}{\alpha}\right)} \left[\frac{1}{1+\alpha\mu_i}\right]^{\frac{1}{\alpha}} \left[\frac{\alpha\mu_i}{1+\alpha\mu_i}\right]^{y_i}, for\ i = 0,1,2.. \quad (5)$$

Where, mean is given as $\mu=E(Y_i)= V_i[e^{\sum \alpha x 1 j \beta}]$, for i= 1, 2,3.....,n while the variance of y_i is given as $var(yi)=(\mu+\alpha,\mu_i)^2$

Where $\alpha > 0$ the model would be referred to as a dispersion parameter, the Poisson regression model can be regarded as a limiting model of the Negative Binomial Regression model as α approaches 0. The Maximum Log-Likelihood function of the distribution is expressed as:

$$\text{Log}(\beta,\alpha) = \sum_i \left(\sum_{r=1}^{y_i} log(1+ar)\right) - y_i log(\alpha) - log(y_i!) + y_i\, log(\alpha\mu_i) - (y_i + \alpha^{-1}) log(1+\alpha\mu_1) \quad (5)$$

The parameter$(\beta, \alpha\ )$ can be estimated by a partial differential of the Maximum Likelihood function with respect to β and α. The negative Binomial Regression does not assume the equality of the mean and variance but it corrects for overdispersion that arises when the variance is greater than the conditional mean.

3.5 Generalized Poisson regression model

Over-dispersion and under-dispersion count data can be fixed by the Generalized Poisson Regression (GPR) which is useful in predicting a response variable affected by one or more covariates. The methods of maximum likelihood and moments are given for the estimation of parameters. Approximate tests for the adequacy of the model are considered.

Let Y_i be a count response variable that follows a generalized Poisson distribution after Famoye (1993), the probability density function given that i=1,2..n, then :

$$f(y_i, \mu_i^{\alpha}) = \left[\frac{\mu_i}{1+\alpha\mu_i}\right]^{y_I\left(\frac{1+\alpha y_i}{y_i!}\right)^{y_i-1}} \exp\left[\frac{V_i(1+\alpha y_i)}{1+\alpha\mu_i}\right], y_1 = 0, 1, 2\ldots \quad (6)$$

The generalized Poisson regression (GPR) model (1) is a generalization of the standard Poisson regression (PR) model. When the dispersion parameter $\varphi = 0$, the probability function in (1) reduces to the PR model. When $\varphi > 0$, the GPR model represents count data with overdispersion and when $\varphi < 0$, the GPR model represents count data with under dispersion.

Therefore, the GPR model shows more flexibility in modeling count data when the underlying data show varying degrees of dispersion. Since the parameter φ is restricted to $1 + \varphi\lambda_i > 0$ and $1 + \varphi y_i > 0$, the model is also called the restricted generalized Poisson regression model (Famoye 1993)

The mean of the response in the GPR model is given by $E(Y_i \mid \lambda_i, \varphi) = \lambda_i$ and the variance is given by $V(Y_i \mid \lambda_i, \varphi) = \lambda_i(1 + \varphi\lambda_i)^2$. Clearly, when $\varphi > 0$, the variance is overdispersed and when $-2/\lambda_i < \varphi < 0$, the variance is under dispersed. GPR model is very useful for modeling count data, especially when mean and variance differ. In the generalized Poisson Regression model, the parameters (β, α) can be estimated by taking the derivatives of the log-likelihood function of the model which means that the partial differentiation with respect to β and α of the logarithm function of the equation:

$$\text{LogL}(\alpha, \beta, y_i) = \sum_{i=1} \left\{ y_i log\left(\frac{\theta_i}{1+\alpha\theta_i}\right) + (y_i - 1) log(1 + \alpha y_i) - \frac{\theta_i(1+\alpha y_i)}{1+\alpha\theta_i} - log(y_i!) \right\} \quad (7)$$

3.6 Model Selection Criteria

The choice of the best model after specifying a regression is a major issue of concern to researchers. Akaike Information Criterion (AIC), Bayesian Information Criterion (BIC) and Chi-square -2log likelihood model selection criteria are usually used to address the problem. For the study, the specification of AIC and BIC as suggested by Akaike (1974) and Schwarz(1978) are stated thus:

$$AIC = -2lnL\left(\frac{\Omega}{y}\right) + 2p \quad (8)$$

and

$$BIC = -2lnL\left(\frac{\Omega}{y}\right) + plog(n) \quad (9)$$

where p is the number of free parameters in the defined model. The model with the smallest AIC or BIC value is selected as the best.

T – test statistics was used to evaluate the impact of COVID-19 on food prices and is given as:

$$T = \frac{ya - yb}{\sqrt{\frac{na}{sa} + \frac{nb}{sb}}} \quad (10)$$

Where: y_a = mean food price before COVID-19 , y_b = mean food prices during COVID- 19, S_a = standard error of food price before COVID-19 , S_b = Standard error of food price during COVID 19 , n_a = number of basic food items before COVID-19 and n_b = number of basic food items during COVID- 19.

4. Results and Discussion

4.1 Summary statistics of COVID-19 Cases

Analysis in Table 3 shows that the mean of total deaths was 32 and a standard deviation of 40.2046 while the minimum and maximum deaths were 2 and 227. The minimum and maximum laboratory confirmed cases were 5 and 23,885 with the mean and standard deviation of 1,882 and 4005.906. The mean and standard deviation of the admitted cases of COVID-19 were 95 and 190.2907.The maximum number of cases on admission was 1,004 whereas the mean of discharged cases was 1,755 with standard deviation of 3,845.61 with a minimum and maximum of 3 and 23, 120 discharged cases. From the analysis, one can infer that admitted cases and discharged cases are

the indicators that can flatten the curve of COVID-19 cases. As the curve flattens, there is a high chance in the reduction of mortality cases in the country.

Table 3: Summary of Descriptive Statistics of COVID-19 cases in Nigeria

Variable	Mean	Std. Dev.	Min	Max
Total deaths	31.91892	40.2046	2	227
Lab Confirmed cases	1882.297	4005.906	5	23,885
Admitted cases	95.05405	190.2907	0	1,004
Discharged cases	1755.324	3845.61	3	23,120

Source: Researchers' Computation, 2020 using STATA Version 11

Table 4: Value of Deviance and Pearson Poisson Regression Model

Criterion	Value	Df	Value/df
Deviance	100.660	33	3.050
Pearson Chi-square	94.925	33	2.876

Source: Researchers' Computation, 2020 using STATA Version 11

4.2 Poisson Regression Results of COVID-19 Cases

Result in Table 4 confirmed that there was the presence of overdispersion in the modeling of COVID-19 cases leading to biasness in the parameter estimates. This was corrected by using the Negative Binomial Regression and Generalized Negative Binomial Poisson Regression which can accommodate both dispersion and overdispersion parameters. Results of the various Poisson regression models are presented in Table 5, Table 6 and Table 7. Results as contained in Table 5 and Table 6 showed that all the parameters were statistically significant at 1% probability level. Table 6 was selected as the best model based on AIC, BIC and the Log likelihood criteria (Table 8). The analysis in Table 7 revealed that two of the variables of the COVID-19 cases in Nigeria were negative except the laboratory confirmed cases and were statistically significant at 1% probability level. The result on Analysis of COVID-19 cases in Nigeria indicated that a unit increase in laboratory confirmed COVID-19 case will lead to 8.88% increase in the number of COVID-19 related deaths. This result is in contrast to the finding of Samuel et *al.*(2020) who reported that confirmed cases had negative effect on the number of COVID- 19 related deaths.

Increase in the number of confirmed cases will have the potential of increasing the number of deaths in the country especially when there are no adequate health facilities and adequate health personnel to manage the increased cases. Muhammad *et al.* (2017) decried the state of poor public health sector in Nigeria with poor infrastructure such as poor emergency services, few ambulance services, ineffective national health insurance systems and insufficient primary health care facilities. Klantschnig and Huang (2019) estimated that informal drug sellers accounted for over 70% of the pharmaceutical market who import substandard and falsified drugs through informal channels. The country's high dependence on importation of active pharmaceutical ingredients from China with only 10% domestic production was reported by Ozili(2020) to affect the management of the pandemic. Its medical supplies from China were affected because of the closure of their borders and factories to control the deadly virus. Admitted cases had a negative coefficient of -0.8889424 and is statistically significant at 1% and has an inverse relationship with COVID-19 deaths. This shows that a 1% increase in the number of admitted cases of COVID-19 would lead to a decrease in the number of deaths by 8. 89 % *ceteris paribus*. The

coefficients for discharged and admitted cases were negative and significant at 1% probability level implying that they can reduce the number of COVID-19 related deaths by 8.86% and 8.89% when a 1% increase in their numbers occur. The more the number of admitted and discharged cases, the more the likelihood of flattening of the COVID-19 curve in the country.

Table 5: Poisson Regression (PR) Parameter Estimate and Performance Criteria of COVID-19 Cases in Nigeria

Parameters	Coefficient	Std.error	Z	P>|z|	LR Chi-Square	Log likelihood	AIC	BIC
Constant	2.325655	.0581612	39.99***	0.000	884.28***	-136.91606	281.8321	288.2758
Laboratory Confirmed cases	.0291558	.0015624	18.66***	0.000				
Admitted cases	-.029028	.0015602	-18.61***	0.000				
Discharged cases	-.029376	.0015821	-18.57***	0.000				

Source: Researchers' Computation, 2020 using STATA Version 11*** Significant at 1% level

Table 6: Negative Binomial Regression (NBR) parameter Estimate and Performance criteria of COVID-19 cases in Nigeria

Parameters	Coefficient	Std.error	Z	P>|z|	LRChi-Square	Log-likelihood	AIC	BIC
Constant	2.191501	.1024148	21.40***	0.000	68.55***	-301.9344	613.8689	621.9234
Laboratory Confirmed cases	.0349137	.0044253	7.89***	0.000				
Admitted cases	-.0347914	.0044364	-7.84***	0.000				
Discharged cases	-.0351933	.0044823	-7.85***	0.000				

Source**:** Researchers' Computation, 2020 using STATA Version 11 *** Significant at 1% level

Table 7: Generalized Poisson Regression (GPR) Parameter Estimate and performance criteria of COVID-19 cases in Nigeria

Parameters	Coefficient	Std.error	Z	P>|z|	LR Chi-Square	Log likelihood	AIC	BIC
Constant	.1662626	1.112181	0.15	0.88	57.31***	-124.5395	259.079	267.1336
Laboratory Confirmed cases	. 8881749	.0531112	16.72***	0.000				
Admitted cases	-.8889424	.0533171	-16.67***	0.000				
Discharged cases	-.8864576	.0538086	-16.47***	0.000				

Source: Researchers' Computation, 2020 using STATA Version 11*** Significant at 1% level

Table 8: Selection of Appropriate Count Data Model for COVID-19 Cases in Nigeria

Models	AIC	BIC	-2Log-likelihood
Poisson Regression	281.8321	288.2758	-136.91606
Negative Binomial Regression	613.8689	621.9234	-301.9344
Generalized Poisson Regression	259.079	267.1336	-124.5395

Source: Researchers' Computation, 2020 using STATA Version 11

4.3 COVID-19 Impact on Food Prices and Implication for Food Security

Table 9 shows major food items and their prices before and during the COVID-19 Cases in Nigeria. There were only six food items that had reductions in their prices during the pandemic namely beans brown, sold loose; beans: white black eye sold loose; catfish: dried; mudfish (*aro*) fresh, mudfish: dried and tilapia (*epiya*) fresh while the remaining 37 basic food items experienced variations in the prices. The country total food prices increase was 6.63%. Furthermore, the t-test statistic also revealed that COVID-19 had an impact on food prices at 5% level (Table 10). Hike in the prices of national food items during the pandemic is in conformity with authors like Swinnen and MC Dermot (2020) who reported disruption in food supply because of the lockdown which restricts movement of labour and food items causing increases in food and further aggravating food security situations among the people living in poverty in many developing countries of the world.

Amare *et al.*(2020) also reported increased food prices in the country as a result of COVID-19 cases. Ahmed *et al.* (2017) advocated the need for social welfare designed to meet the basic needs of the people. Ozili (2020) found out that the inability of the Nigerian government to have national social welfare programme became evident during the corona virus outbreak of 2020 where people had little to rely on and Nigerians living in poverty did not have welfare relief that could help them cope with the economic hardship. Livelihoods of the people were affected during the pandemic thereby affecting access to food which is an integral component of food security.

The Agricultural Promotion Policy (APP) introduced by the Federal Government and anchored by Federal Ministry of Agriculture and Rural Development (FMARD) sees food as a human right. Policy instruments for agricultural development was on the social responsibility of government in the areas of food security, social security and equity in the Nigerian society; recognition, protection and fulfilling the freedom of the people from hunger and malnutrition. The entire country is in focus with emphasis on rural areas especially vulnerable chronic food shortages. There are differences in geo political zones in terms of vulnerability, for instance, 56% were reported in the south west while it is 84.3% in north. Good as the policy on food security appears, it would not make any impact without any commitment on the part of the government to provide the enabling environment for major stakeholders to operate. The provision of a stable socio-economic and political environment at the national and sub national level is the principal determinant of food security since it will influence food production, food availability, stability of food supplies and access to food which in turn influence the amount of food consumed. Nigerian government inability to curtail security challenges facing most parts of the country has worsened food security of the citizenry. For example, Northern Nigeria is fraught with cattle rustling, armed banditry, terrorism and farmer- herder clashes whose resultant effects are the high number of

internally displaced persons in camps with limited food supplies whose limited incomes are adversely affected. Their livelihood activities are affected and may not have access to humanitarian services rendered by NGOs. Food production is a critical component of food security, but because of the security challenges, farmers abandoned their farms as not only farm produce are destroyed by the herders, but are either maimed, killed or kidnapped by armed bandits who will always demand for ransom running into millions of naira before the release of their victims. The rate of population growth outstripped the rate of food production.The country is still characterized by high reliance on food imports due to the above challenges in addition to adverse weather conditions associated with climate change and low productivity. To bridge the demand-supply gap brought about by low agricultural productivity, the country imports agricultural products such as wheat, palm oil, etc. In four years (2016-2019), Nigeria's cumulative agricultural imports stood at ₦3.3 trillion, four times more than the country's agricultural exports of ₦ 803 billion in the same period.

The results of the government's policies to reposition the agricultural sector have been mixed. The Agricultural Promotion Policy introduced by the Federal Ministry of Agriculture and Rural Development has various intervention programmes by the Central Bank of Nigeria for the achievement of the policy. One of the interventions is the Anchor Borrowers Programme which has led to transformation in the sector especially in the area of rice production but recorded poor performance in the attainment of self-sufficiency for key agricultural products. For example, annual wheat production which stands at 0.06 million metric tonnes cannot cover local demand of over 5 million metric tonnes despite the setting of 2018 as the target year in which the nation would have attained self-sufficiency in wheat production.

Table 9: Pre COVID-19 and COVID-19 Food prices in Nigeria

Food Items	Pre COVID 19 Price (₦)	COVID -19 Price (₦)	Price Differential (₦)	Percentage
Agricultural eggs (medium size)	468.94	478.9704	+10.0304	+2.13895
Agricultural eggs (medium size price of one)	41.17	42.77759	+1.60759	+3.90476
Beans brown,sold loose	355.0213	305.4343	-49.587	-13.96733
Beans:white black eye. sold loose	317.4413	274.8042	-42.6371	-13.43149
Beef Bone in	1002.974	1064.272	+61.298	+6.11162
Beef,boneless	1256.745	1339.737	+82.992	+6.60373
Bread sliced 500g	297.8038	312.7423	+14.9385	+5.01622
Bread unsliced 500g	272.7925	283.9741	+11.1816	+4.09894
Broken Rice (Ofada)	377.0575	429.8098	+52.7523	+13.9905
Catfish (obokun) fresh	1047.161	1056.583	+9.422	+0.89977
Catfish :dried	1759.508	1711.183	-48.325	-2.746506
Catfish Smoked	1524.223	1526.121	+1.898	+0.12452
Chicken Feet	715.6075	724.193	+8.5855	+1.19975
Chicken Wings	922.2363	940.1321	+17.8958	+1.94048
Dried Fish Sardine	1385.098	1466.655	+81.557	+5.88818
Evaporated tinned milk carnation 170g	160.5113	162.2257	+1.7144	+1.06809
Evaporated tinned milk(peak), 170g	188.9525	194.1099	+5.1574	+2.72947
Frozen chicken	1730.891	1948.124	+217.233	+12.5504
Gari white,sold loose	158.9975	224.5266	+65.5291	+41.2139
Gari yellow,sold loose	175.9713	253.0155	+77.0442	+43.7823
Groundnut oil: 1 bottle	570.9538	626.691	+55.7372	+9.76212
Iced Sardine	911.0163	1005.585	+94.5687	+10.3806
Irish potato	278.5288	320.4489	+41.9201	+15.0505
Mackerel : frozen	931.6488	997.0087	+65.3599	+7.01551
Maize grain white sold loose	147.2225	189.526	+42.3035	+28.7344
Maize grain yellow sold loose	150.6338	192.4348	+41.801	+27.7501
Mudfish (aro) fresh	1011.5	1002.446	-9.054	-0.895106
Mudfish : dried	1809.76	1742.482	-67.278	-3.71751
Onion bulb	225.4038	241.9749	+16.5711	+7.35174
Palm oil: 1 bottle	460.085	499.6666	+39.5816	+8.60311
Plantain(ripe)	224.5	242.7827	+18.2827	+8.14374
Plantain(unripe)	213.425	233.5008	+20.0758	+9.40649
Rice agric sold loose	317.1763	413.1326	+95.9563	+30.2533
Rice local sold loose	278.2288	375.0798	+96.851	+34.8098
Rice Medium Grained	312.7775	415.4294	+102.652	+32.8195
Rice,imported high quality sold loose	359.6013	501.7088	+142.108	+39.5181
Sweet potato	138.07	173.1078	+35.0378	+25.3768
Tilapia fish (epiya) fresh	866.6913	855.4969	11.1944	1.291625
Titus:frozen	945.9725	1022.695	+76.7225	+8.11044
Tomato	240.3188	289.8631	+49.5443	+20.6161
Vegetable oil:1 bottle	500.2638	583.7588	+83.495	+16.6902
Wheat flour: prepacked (golden penny 2kg)	667.1238	718.3923	+51.2685	+7.68501
Yam tuber	200.0013	256.0588	+56.0575	+28.0286
Grand total	25920.01	27638.66	+1718.66	+6.63061

Source: Researchers' computation from NBS food prices 2020

+ - denote increase and decrease in food price in naira and percentages

Wheat dominates Nigeria's agricultural imports and accounted for about 40.7% (or ₦ 390.6 billion) in 2019.

COVID-19 has affected the attainment of food security in Nigeria by increased prices in the cost of the basic food items. The recent withdrawal of subsidies on premium motor spirit and increase in electricity tariff announced by the government had further worsened food security situation in the country. For example, the closure of borders by the government to boost domestic food production though adjudged to be good but was ill-timed as the country has no enough domestic food supplies for her citizens as the food reserve silos are daily depleted by large number of people in internally displaced camps across the country.

Internally displaced people from various parts of the country were supported with 30,000 metric tonnes of grains from the strategic reserve silos. The additional release of 70, 000 metric tonnes from the strategic grain reserve as palliative measure by the government to cushion the effect of the pandemic was hoarded by the various state governments defeating the purpose of the release of the palliatives. The depletion of the country's food reserves is faster than its replenishment because of low productivity of the agricultural sector. Provision of credit facilities to farmers and the promotion of export of agricultural produce will mitigate food insecurity as observed by Okunlola and Akinlo(2021). The outbreak of COVID- 19 in Nigeria further aggravated the precarious and fragile food security in the country where there is no carefully planned welfare schemes for the country. The containment of the pandemic through lockdown imposed in the country resulted to the inability of the citizens to access the basic necessities of life especially food whose shortages will be more devastating than the COVID-19 itself because hunger will affect more in terms of population. The recent peaceful rally by Nigerian youths which later turned violent resulted to the destruction of palliative warehouses across the country except in few states where the governors were proactive in the distribution of the palliative which were done in a very transparent manner.

Table 10: T- test analysis of the impact of COVID-19 on Food prices

Variable	Mean Food price	Standard error	Mean dif	Df	T. value
Before COVID-19	602.79	495.0022	39.97	42	11.76**
COVID-19 period	642.76	498.0589			

Source: Author's computation, 2020. ** Significant at 5%

5. Conclusion

In the paper, Data Mining of COVID-19 Cases and Food Security in Nigeria was examined using the data from the daily COVID-19 cases and National Food Prices which were analyzed using descriptive and inferential statistics. Admitted and discharged cases flattened COVID-19 curve in Nigeria. There was significant impact on food price increase as a result of the pandemic. Short and long term policies to help them mitigate the negative effects of the pandemic are necessary. Government should intensify efforts in increasing the number of health personnel, medical facilities, and increase in the number of laboratories for testing, detection and treatment in order to reduce the number of mortality. Strategies such as the establishment of integrated, climate-smart production systems with food crops, cash crops and agro- forestry should be put in place to enhance livelihoods of the people in the country.

References

Ahmed, H. G., Alhassan, S. M. and Alshammari, F. D. (2017). Social welfare scheme; a neglected component of public health care services in Nigeria. *MOJ Public Health*, 5(3), 101-104.

Akaike H.(1974). A new look at the statistical Model estimation. IEE Trans. *Automat. Control* 19: 716-723

Aref-Adib, C. (2020): When a failure to diversify meets COVID-19: Implications for Nigeria. International Growth Centre.

Amare, M; Abay KA, Tiberti, L and Chamberlin J (2020): Impacts of COVID-19 on Food Security Panel Data Evidence from Nigeria. IFPRI Discussion Paper

Calogero, C., Alberto, Z and Raka, B(2013): Towards better measurement of household food security: Harmonizing indicators and the role of household surveys. *Global Food Security* 2: 30-40

FAO (2020): Northeastern Nigeria Adamawa, Borno and Yobe Situation Report

Famine Early Warning Systems Network, FEWSNET(2020): Nigeria Food Security Outlook Update.

Famoye, F., (1993).Restricted generalized Poisson regression model. *Commun. Stat. Theor Methods* 22:1335-1354

Forsido SF, Mitiku F, Lemessa F, Tolemariam T, Belew D, Berecha G, Garedew W, Bekele Y, Geda F and Eneyew A (2020): COVID-19 Probable Impacts on Ethiopian Agriculture and Potential Mitigation and Adaptation Measures: No Food- No Health- No Life. Jimma, Ethiopia: Jimma University

George, L. (2020): COVID-19 is exacerbating food shortages in Africa. World Economic Forum COVID

Klantschnig, G. and Huang, C. (2019): Fake drugs: health, wealth and regulation in Nigeria. *Review of African Political Economy*, 46(161), 442-458.

Laborde, D, Martin, W and Vos, R (2020): Poverty and food insecurity could grow dramatically as COVID 19 Spreads. *Science 3*69:(6503): 500-502

Muhammad, F., Abdulkareem, J. H., and Chowdhury, A. A. (2017): Major public health problems in Nigeria: a review. *South East Asia Journal of Public Health*, 7(1), 6-11.

Okunlola,O.C and Akinlo E.A.(2021): The Impact of Export Promotion on Agricultural Growth in Nigeria. *African Journal of Economic Review,* Volume IX, Issue 1: 60-86

Ozili, P.K. and Arun, T.G. (2020): Spillover of COVID-19: impact on the Global Economy. Working paper.

Ozili P K. (2020): Covid-19 pandemic and economic crisis: The Nigerian experience and structural causes

Schwarz, G. (1978): Estimating the dimension of a model . *Ann. Stat*.6: 461- 464

Samuel O A; Muhammad A B, Samuel OO, Haruna U Y and Rafiu O A (2020): Modeling COVID-19 Cases in Nigeria Using Some Selected Count Data Regression Models. *International Journal of Healthcare and Medical Sciences* 6(4): 64-73

Sha - Pin , M.(1993): The relationship between truck accidents and geometric design of road sections: Poisson versus negative binomial regression. Centre for Transportation Analysis, Energy Division Oak Ridge National Laboratory

Swinnen, J. and MCDermot J. (2020):COVID-19: Assessing impacts and policy responses for Food and Nutrition security. P1-5

World Food Programme (2020a): Borno and Yobe States Monthly Market Monitoring Report July 2020 - Issue 38:1-6

World Food Programme (2020b): COVID-19 will double number of people facing food crises unless swift action is taken. Retrieved from https://www.wfp.org/news/covid-19-will double-