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Modelling the Impacts of Agricultural Outputs and its Components on Human Mortality Rate in Nigeria

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Abstract

Does agricultural activity affect human mortality? This research paper provides an empirical analysis on this important question by separately regressing agricultural outputs and its components on human mortality rate in Nigeria over the period 1981–2019. Employing the autoregressive distributed lag estimator, a long run relationship exist between agricultural outputs and human mortality rate in Nigeria. Regarding the parameter estimates, findings showed that the indirect relationship between agriculture outputs and mortality is statistically insignificant in the long run. More so, in the short run, the current level of agriculture outputs reported a significant positive coefficient whereas the first lag has a significant negative parameter. Concerning the agriculture components, in the long run, fishing activity negatively and significantly influenced human mortality whereas forestry activity directly impacted on human mortality rates. The influence of both crop and livestock productions on mortality rate is not statistically established in the long run. The study therefore suggests the need for government to adopt pro-poor policies that is capable of improving investments in agricultural activities by both public and private sectors so as to curtail human mortality rate in the country.

Keywords: Agricultural outputs; Mortality rate; Inflation; Exchange rate; Nigeria

JEL Classifications: Q1; Q18; Q19

Introduction

Over the years, food prices due to low output of agriculture produce have stayed high, particularly since the peak of the global food crisis of 2008, which has exacerbated food shortage and undernourishment around the world. Vulnerabilities to these low agriculture produce are diverse across households and societies around the globe. Compton, Wiggins and Keats (2010) classified some countries in sub-Saharan Africa in accordance with their degrees of vulnerability* to food prices spikes due to low agriculture produce. Nigeria alongside other 18 SSA countries is classified as *highly vulnerable*. Various studies have been conducted to appraise the impacts of low agriculture outputs using different approaches, with many of them presenting divergent views on the nature and magnitude of these impacts. Many of these studies only offer a qualitative rather than a quantitative assessment of these impacts. While a given number of the earlier studies submitted that the impact is negative, few others contended that the impact could still be positive (Tiffin and Xavier, 2006; Ehui and Tsigas, 2009; Diao, Fan, Kanyarukiga and Yu, 2010; Ewubare and Eytotope, 2015; Alimi and Alese, 2017; Sertoglu, Ugural and Bekun, 2017). In spite of the apparent ubiquity and severity of the effect of the agriculture output and in Nigeria, its effects on human development like low human mortality rates has not been explicitly provided in the literature using a quantitative approach.

The agriculture sector is an important industry in the Nigerian economy with high potentials for human welfare development of the nation. This is because apart from the provision of sufficient food, drinkable water, safe refuge and energy, a hale, hearty and protected environment, a well-informed public, agriculture provides employment for current and future generations (Matthew and Mordecai, 2016) as well as low mortality rates. Consequently, to achieve increase agricultural output and to make the sector play its role in the development of the country, conscious effort have been put in place by various government. In spite of these effort, the sector's productivity estimates for Nigeria reveals although the sector employs approximately 60 percent of laborers, agriculture output in Nigeria has remained abysmally low and stable at between 30% and 42% (Central Bank of Nigeria, 2019). Besides, the share of agriculture output in Nigeria's GDP have fluctuated 19% and 25% within 1981-2019 (Central Bank of Nigeria, 2019; Food and Agriculture Organization, 2019).

Furthermore, the poor output growth and sharp annual fluctuations in agricultural output hinder the ability of the sector to reduce unemployment and poverty which are important for human development in the short-run and long-run. In the short-run, the sector is likely to create massive employment since the Nigerian economy relies heavily on agriculture which is a key development objective. Notwithstanding, the fact that oil sector has been the major driver of Nigeria in the last three decades, the agricultural sector has a key role in ensuring development in the country. The reason for this is that the oil sector is capital intensive and may not create the much needed job for citizens of the country to reduce mortality rates. Therefore, increase agriculture output is important in reducing macroeconomic instability, which is necessary to raise the living standard and reduce human mortality (Food and Agriculture Organization, 2019).

This study therefore investigates the effects of agricultural activities on human mortality rates in Nigeria within the period 1981-2019. The justification for conducting this research study is to fill the gap in existing body of knowledge by adopting relevant variables to unravel how agricultural activities affect human mortality rates in Nigeria with specific emphasis on agricultural policies during pre- and post- Structural Adjustment Programme (SAP) eras. Apart from the introductory, the remaining parts of the research paper are divided into four. Section two contains the review of relevant literature, while the sources of data, methodology and model specification are presented in section three. The fourth part presents the data analysis and discussion of results, while the last section is devoted to the conclusion and policy implications.

Literature Review

The development of the agriculture sector is the end product for improving productivity, economic growth and development and for mitigating poverty. Specifically, the provision of adequate food to the young ones is expected to impact positively on the future of individuals, societies and nations as it tends to reduce mortality rates. Thus, a society's income per capita coupled with low mortality rates is considered pre-requisites for the long-standing socioeconomic advancement of an economy and her main pointers of development. More

* The vulnerability of countries is based on a Global Vulnerability Index and High Price Risk Index compiled from 30 sub- indicators.

so, researchers have reached consensus that the declining agricultural output is not an impermanent hump but rather a structural change and a continuous move to a fresh and greater plateau for food security. Thus, this study is relevant because agricultural development is crucial for achieving high income per capita and low mortality rates (still missing in the body of literature) which are central to attaining the sustainable development goals and economic development.

On the empirical front, the searchlight beam on eclectic range of studies carried out by various researchers over time and cross the borders. Based on a time series data spanning through 1986-2007, Izuchukwu (2011) investigated how agriculture impacted on economic growth in Nigeria. The author adopted multiple regression analysis. The author found that income vis-à-vis government expenditure and domestic savings are positively related with foreign direct investment and agriculture between the periods under review. The value of the R-square shows that 81% of the systematic variation in GDP is explained by the explanatory variables. Yuen (2013) employed a panel data set for the period 1995-2011 to analyse the importance of rural government spending towards enhancing productive investment of rural households in eastern, central and western regions of China. The author found although the characteristics of rural household is important in determining the performance of productive investments, specifically rural public spending in telecommunication, transportation, infrastructures, and electricity.

Saungweme and Matandare (2014) analysed the impacts of government expenditure on agricultural sector growth as well as how the agricultural sector performance affect economic activities in Zimbabwe. The authors found that agriculture spending prior to 2000 significantly drive agricultural production and strengthened the forward and backward economic linkages. However, the author found that the land reform programme of 2000 and the successive neglect of the sector add enormously to the economic crises in Zimbabwe subsequently.

Ijirshar (2015) empirically analysed the role of agricultural exports in economic growth of Nigeria for the period 1970-2012. The author employed an annual time series data and the series used are income growth, real agricultural exports, real exchange rate, trade openness and inflation. The unit root test result showed that trade openness and inflation rate are of order zero whereas those integrated at order one are income, exchange rate and agricultural exports. The co-integration test reported a long-run equilibrium relationship among the variables. The error correction model result showed that agricultural export has a positive impact on income growth in Nigeria. Fang, Lyatuu and Nie (2015) stressed the importance of agriculture by analyzing the influence of agriculture on income growth and poverty reduction in Tanzania for the period 1980-2014. The authors found that population growth measured by the size of household in rural centers and inadequate rural public services exacerbate poverty and promote movement from agriculture to non-agriculture activities mainly among the educated youth.

Matthew and Mordecai (2016) investigate the extent to which agricultural output impacted on economic development in Nigeria using an annual time series data between 1986 and 2014. The author employed variables such as economic development captured with per capita income, public agricultural expenditure and agricultural output. The Vector Autoregressive (VAR) method of estimation was employed in the study. They found that a lot of the lags of the regressors are not statistically significant in explaining the economic development. The study concluded that agriculture plays an important role in achieving economic development in Nigeria. The variance decomposition result indicated that large contributors to shocks in economic development came from shocks in agriculture.

It is evident from the empirical review that there is a plethora of studies on the link between agriculture outputs on income growth in Nigeria. Similarly, studies also exist that have examined the government agriculture expenditure on economic growth. There is dearth of studies on the impact of agriculture on human mortality rates which are key to achieving economic development. Besides, the recent decline in the global oil price present the need to diversify the Nigerian economy from oil and make the agricultural sector play the leading role to the economy development of Nigeria. Furthermore, among the studies on agricultural output, less attention have been accorded to disaggregated components namely crop production, livestock, forestry and fishing of agriculture on economic development. The need to emphasis these components of agriculture is based on the role that agricultural components play in increasing per capita income and lowering mortality rates.

Research and Methodology

Empirical Model and A’priori Expectation

To investigate the effects of agriculture output on mortality rates, the study adapted the model of past studies (Mostafa and van Ginneken, 2000; Cutler, Deaton and Lleras-Muney, 2006; Lawn *et al.*, 2006; Soares, 2007; Aldrich and Sawada, 2015; Ajide and Alimi, 2020; Alimi and Ajide, 2020) by modeling mortality rate as a function of agricultural output, industrial output, including the relevant control variables i.e. interest rate, inflation and exchange rate. The baseline model of this objective is specified below as:

$$MRT_t = f(AGO_t, IND_t, INT_t, EXR_t, INF_t) \quad (1)$$

Where: *MRT* denotes mortality rates; *AGO* is a vector of agriculture output components i.e. crop production (*CRP*), livestock (*LIS*), fishing (*FSG*) and forestry (*FRT*) and overall output of the agriculture sector; *IND* represents industrial output; *INT* denotes interest rate, *EXR* represents exchange rate; *INF* is inflation rate; and *t* is time periods.

In econometrics form, it is stated as:

$$MRT_t = \pi_0 + \Psi AGO_t + \pi_1 IND_t + \pi_2 INT_t + \pi_3 EXR_t + \pi_4 INF_t + v_t \quad (2)$$

Where: *MRT* denotes mortality rate; *AGO* is a vector of agriculture output components i.e. crop production (*CRP*), livestock (*LIS*), fishing (*FSG*) and forestry (*FRT*) and overall output of the agriculture sector; *IND* represents industrial output; *INT* denotes interest rate, *EXR* represents exchange rate; *INF* is inflation rate; π_0, Ψ, π_{1-4} are parameters; *t* denotes time period; and *e* represents stochastic term. The inclusion of agriculture output in a vector form is stated in order to avoid chances of running into multicollinearity problem. Concerning the a’priori expectation, the study presumes that an increase in agricultural output growth has a negative impact on mortality rate in an economy. It implies that an improvement in the agricultural sector have an higher chances of lowering mortality rates of people in an economy. Likewise, industrial output growth is expected to reduce mortality rates. This means that agricultural output growth will have an indirect relationship with mortality rates in an economy. As inflation and interest rate increases, there are higher chances of having increasing mortality rates of people in an economy. Thus, a direct relationship is presumed among inflation and interest rate and mortality rates. However, the impact of exchange rate on mortality rates can either be positive or negative. The summary of the a’priori expectations of the variables are presented in Table 1.

Table 1: A’priori Expectation

Dependent Variable: Mortality Rate (MRT)		
<i>AGO</i>	Agricultural output	$\frac{\partial MRT}{\partial AGO} < 0$
<i>IND</i>	Industrial output growth	$\frac{\partial MRT}{\partial IND} < 0$
<i>INT</i>	Interest rate	$\frac{\partial MRT}{\partial INT} > 0$
<i>EXR</i>	Exchange rate	$\frac{\partial MRT}{\partial EXR} > / < 0$
<i>INF</i>	Inflation rate	$\frac{\partial MRT}{\partial INF} > 0$

Source: Authors’ compilation (2021).

Estimation Strategies

The research study employed the Augmented Dickey Fuller test approach to examine the stationarity level of the times series data so as to avoid the problem of bias that data stationarity may pose if they are not checked. The estimation test was carried out because in the empirical literature most time series variables are non-stationary and using non-stationary variables in the model might lead to a spurious regression. In the unit root test, a constant and trend term is included and the optimal lag length of each case is chosen using the Akaike Information Criteria (AIC) after testing for higher order serial correlation residuals. Afterwards, the study used the autoregressive distributed lag (ARDL) to estimate the short-run and long-run estimates of the existing relationship between agricultural output and mortality rate. Shahbaz *et al.* (2013), Mesagan *et al.* (2019) and Ogbuji *et al.* (2020) identified three advantages of the ARDL estimators, which are: (i) small sample data (ii) variables with mixed stationarity level either I(0) or I(1) and (iii) both long- and short-run estimates can be derived simultaneously. The lag length is selected using the Akaike information criteria (AIC). The calculated F-statistic value is used to make the decision about the cointegration. The significance of our calculated value is compared with the two tabulated values (upper bound and lower bound) (Narayan, 2004). The decision criteria support cointegration if the calculated value is greater than the upper bound value; no cointegration if the value is lesser than the lower bound value; and inconclusive if the value lies between the two bounds values (Alimi, 2017).

Findings

Summary Statistics and Correlation Analysis

The summary statistics presented in Table 2 shows the mean (average), standard deviation (degree of dispersion) minimum and maximum values of the variables as well as the skewness and Kurtosis. The results in the table provided some insight into the nature of the variables used in the study. The average value of mortality rate is 384.06 per 1,000 people. The standard deviation value is 17.986, which is highly dispersed as indicated in the minimum and maximum values of the variables. On the part of the principal variable, the mean of agricultural output per capita is ₦41,229.9. It shows that agricultural output per capita grew at an average of ₦41,229.9 from ₦226.03 in 1981 to ₦158,755.8 in 2019. Regarding the components of agriculture, crop production per capita remain the dominant component with an average growth rate of ₦36,469.7. The variable had a minimum value of ₦169.90 and a maximum of ₦140,806.2 during the period under study. The dominant of the sector reflect that crop production still remain the major types of agriculture practiced in Nigeria.

Table 2: Descriptive Statistics of the Variables

Variables	Measurements	Mean	Std Dev.	Max.	Min.	Kurtosis	Skewness	Obs.
MRT	Mortality rate, adult, (per 1,000 adults)	384.06	17.986	411.6	340.19	0.264	-0.889	39
AGO	Agriculture output per capita (₦)	41229.9	47404.7	158755.8	226.03	-0.385	0.933	39
CRP	Crop production per capita (₦)	36469.7	41984.8	140806.2	169.90	-0.402	0.921	39
LVP	Livestock per capita (₦)	3318.5	3669.90	10494.16	33.470	-0.699	0.889	39
FRT	Forestry per capita (₦)	443.99	488.74	1422.54	15.056	-0.858	0.819	39
FSH	Fishing per capita (₦)	997.71	1358.8	6032.9	6.468	4.238	1.947	39
IND	Industrial output per capita (₦)	44075.6	54476.0	198442.4	596.56	0.567	1.246	39
INT	Lending interest rate (%)	17.696	4.794	31.65	8.917	1.030	0.256	39
INF	Inflation, consumer prices (annual %)	19.146	17.063	72.836	5.388	2.451	1.856	39
EXR	Exchange rate (₦ per US\$1)	94.143	92.822	306.92	0.618	0.005	0.843	39

Source: Author's compilation (2021).

From the table, livestock production per capita has a mean value of ₦3,318.5 per annum during the period under study. The variables showed a minimum and maximum value of ₦33.470 and ₦10,494.16 respectively. Similarly, fishing per capita has an average value of ₦997.71 during the period under review. The variable shows a standard deviation of ₦1358.8 as well as a lower and higher value of ₦6.468 and ₦6,032.9 respectively. The large standard deviation from the mean suggests that the variable is highly volatile. During the period under review, forestry per capita shows an average value of ₦443.99 with a trough of ₦15.056 in 1981 and a peak of ₦1422.54 in 2019. The poor performance in the sector reflects that this type of agriculture is still less practiced in Nigeria.

Regarding other controlling variables, industrial output per capita grew by an average of ₦44,075.6 throughout the period under study with a minimum of ₦596.56 and a maximum of ₦198,442.4. Inflation and lending interest rates have a mean of 19.15% and 17.7% with the former increasing more than the later. From the table, exchange rate has a mean of ₦94.14/US\$1 with a minimum and maximum of ₦0.618 and ₦306.92 respectively. Also, all the variables are rightwardly skewed except mortality rate which is negatively skewed. In terms of peakedness, only fishing output per capita is leptokurtic while the remaining variables are platykurtic. This implies that the variables are not normally distributed.

Table 3: Correlation Analysis

	AGO	CRP	LVP	FRT	FSH	IND	INT	INF	EXR
MRT	-0.815	-0.613	-0.617	-0.609	-0.638	-0.640	0.275	0.155	-0.671
AGO	1	0.999	0.991	0.994	0.957	0.782	-0.072	-0.349	0.747
CRP		1	0.990	0.994	0.957	0.782	-0.072	-0.350	0.747
LVP			1	0.998	0.929	0.768	-0.064	-0.345	0.735
FRT				1	0.930	0.772	-0.072	-0.359	0.740
FSH					1	0.766	-0.087	-0.298	0.719
IND						1	-0.092	-0.325	0.712
INT							1	0.375	0.055
INF								1	-0.351

Source: Authors' compilation (2021).

The result of the correlation analysis is presented in Table 3. The correlation result shows that an inverse level of association exists between mortality rates and agricultural output per capita. This implies that as the developmental level of the agricultural sector develops, it reduces the mortality rates in the country. Furthermore, interest rate and inflation positively correlated with mortality rates. The reverse is the case for exchange rate as it negatively correlates with mortality rates. More so, the correlation result revealed that there is a high correlation between the components of agriculture. Thus, the variables are separately included in the model to avoid multicollinearity problem. In terms of the explanatory variables, the result indicates that

there is weak correlation among the variables. Hence it can be concluded that the specified regression model for the study do not have multicollinearity problem.

Preliminary Analysis (Unit Root and Cointegration Tests)

Table 4 reports the results of the stationarity tests at levels and first difference for all the variables. The results shows that the ADF statistics of fishing output per capita and inflation rate are greater than the ADF critical values in absolute terms at levels. This means that we do not reject the null hypothesis that the series contain a unit root in the process at level. It implies that fishing output per capita and inflation rate are stationary at levels. However, the results shows that the ADF values of mortality rates, agriculture output per capita, crop production per capita, livestock per capita, forestry per capita, industrial output per capita, interest rate and exchange rate are less than the ADF critical values in absolute terms at level, thereby, accepting the null hypothesis that these series contain a unit root in the process at level. Afterward, the first difference was conducted and each series were found stationary. Consequently, it can be concluded that the series (income per capita, life expectancy, mortality rates, agriculture output per capita, crop production per capita, livestock per capita, forestry per capita, industrial output per capita, interest rate and exchange rate) are integrated of order one I (1).

Table 4: Augmented Dickey Fuller (ADF) Test (Trend and Intercept)

Variables	ADF value at Level	ADF value at 1st Difference	Order of Integration	Remark
MRT	-1.0742 (1) [-3.5366]	-3.7113 (0) [-3.5366]**	I(1)	Reject H ₀
AGO	-0.1228 (0) [-3.5331]	-4.2817 (0) [-3.5366]**	I(1)	Reject H ₀
CRP	-0.1885 (0) [-3.5331]	-4.5855 (0) [-3.5366]**	I(1)	Reject H ₀
LVP	-0.2183 (4) [-3.5485]	-4.7664 (8) [-3.5742]**	I(1)	Reject H ₀
FRT	-1.7698 (8) [-3.5684]	-6.7913 (9) [-3.5806]**	I(1)	Reject H ₀
FSH	-3.7934 (6) [-3.5578]**	-	I(0)	Reject H ₀
IND	-1.4531 (0) [-3.5331]	-4.3528 (1) [-3.5403]**	I(1)	Reject H ₀
INT	-2.2780 (0) [-3.5331]	-5.6384 (1) [-3.5403]**	I(1)	Reject H ₀
INF	-4.0198 (1) [-3.5366]**	-	I(0)	Reject H ₀
EXR	-1.2525 (0) [-3.5331]	-5.6089 (0) [-3.5366]**	I(1)	Reject H ₀

Note: ** indicate level of significance at 5%

Source: Authors' compilation (2021).

The long-run relationship between the agricultural output, mortality rates and other controlling variables using the autoregressive distributed lag (ARDL) bound cointegration tests is reported in this section. The ARDL bound estimator is employed because it is appropriate for series at different integration order. The F-statistics estimate for testing the existence of long-run relationship between agricultural output and its components, mortality rates and other controlling variables in Nigeria is presented in Table 5.

From the table, comparing the estimated F-statistics of the normalized equations, they are higher than the lower and upper critical bound at 1% significance level. It means that the null hypotheses of no long-run relationship are rejected at 1% significance level. This means that agricultural output and its components, control variables (such as industrial output, inflation, interest rates and exchange rates) and mortality rate, all have equilibrium condition that connect the variables together in the long-run. Thus, there exists a long-run relationship between agricultural outputs and mortality rates in Nigeria.

Table 5: Cointegration Test of Agricultural Output and Mortality Rates

Test Statistic	Value	K
F-statistics (mrt ago, ind, int, inf, exr)	4.7329	5
F-statistics (mrt crp, ind, int, inf, exr)	4.7786	5
F-statistics (mrt lvp, ind, int, inf, exr)	5.8441	5
F-statistics (mrt frt, ind, int, inf, exr)	25.461	5
F-statistics (mrt fsh, ind, int, inf, exr)	26.006	5
Critical Value Bounds		
Significance	I0 Bound	I1 Bound
10%	2.08	3.00
5%	2.39	3.38
2.5%	2.70	3.73
1%	3.06	4.15

Source: Authors' computation (2021).

Short-run and Long-run Estimation Results

In this section, it presents the empirical result of how agricultural output affect mortality rates in Nigeria. It examines both the short-run and long-run relationship estimates of agricultural outputs and other controlling variables in Nigeria using the estimated ARDL approach. The estimated ARDL model is a composite of short-run and long-run estimates of the interrelationship among considered series in this study. The clear evidence of our empirical estimates from agricultural output, industrial output, interest rate, inflation and exchange rates are presented in Table 6.

The short-run estimation results show the error correction mechanism which measures the speed or degree of adjustment. It is the rate of adjustment at which the outcome variable changes owing to changes in the regressors. The ARDL test chooses automatically its lag length on all series as we set the model at three to make sure there is enough degree of the freedom owing to an automatic selection of Akaike Information Criterion. The coefficient of the ECT is negative and significant statistically at 5% level. The ECT value (-0.0984) implied that the empirical model adjusts its short-run disequilibrium at 9.84% adjustment speed to return to its long run equilibrium.

Table 6: Estimated ARDL Results of Agricultural Output and Mortality Rates

Table 6: Estimated ARDL Results of Agricultural Output and Mortality Rates				
Dependent Variable: Mortality Rates (MRT)				
Selected Model: ARDL (2, 2, 0, 3, 2, 0)				
Sample: 1981 2019		Included observations: 35		
Short-Run Estimates				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(MRT(-1))	0.949584	0.035016	27.11889	0.0000
D(AGO)	0.005484	0.002075	2.642451	0.0152
D(AGO(-1))	-0.024004	0.002458	-9.767036	0.0000
D(INT)	0.000161	0.000108	1.499465	0.1486
D(INT(-1))	0.000282	9.78E-05	2.880786	0.0089
D(INT(-2))	-0.000272	0.000102	-2.651482	0.0149
D(INF)	0.000105	2.88E-05	3.627512	0.0016
D(INF(-1))	-4.55E-05	2.23E-05	-2.037398	0.0544
ECT(-1)	-0.098431	0.015081	-6.526637	0.0000
Long-run Estimates				
AGO	-0.191980	0.439384	-0.436929	0.6666
IND	0.035590	0.296782	0.119919	0.9057
INT	-0.008808	0.030075	-0.292864	0.7725
INF	-0.019713	0.027116	-0.726978	0.4753
EXR	0.203762	0.318644	0.639465	0.5294
C	6.901067	1.326333	5.203116	0.0000
R-squared	0.7647	F-stat	177.47 (0.000)	
Adj. R-squared	0.6542	D-Watson	2.0386	
Diagnostic Tests				
Serial Correlation	0.2848 [0.7553]	Normality Test:	1.2825 [0.5266]	
Functional Form:	0.5530 [0.5864]	Heteroskedasticity Test:	0.5614 [0.8653]	
Source: Authors' computation (2021).				

Source: Authors' computation (2021).

The short-run estimates of the relationship between agricultural output and mortality rates are presented in Table 6. The parameter of the short-run lag one of change in mortality rates has a positive and significant impact on the current changes in mortality rates at 5%. This means that the current level of mortality rates is influenced positively by the first lag. The short-run parameter estimates of current agricultural output was found to be positive and statistically significant at 5% indicating that it influences changes in mortality rates directly. Meanwhile, the first lag which has a positive coefficient is statistically significant. The short-run coefficients of interest rate at current level and first lag have positive and significant impact on mortality rate. As for the second lag, the coefficient is negative and significant at 5% significance level. Also, the short-run current level of inflation influences mortality rates positively whereas the first lag impacted on mortality rates negatively.

The long-run estimates from Table 6 indicated that agriculture output have negative and insignificant impact on mortality rates in Nigeria. Likewise, low interest rate and inflation rate negatively influence mortality rates in Nigeria within the periods understudied. The result shows that they are in tandem with the theoretical expectations but they are not statistically significant at 5%. On magnitude basis, a 10% changes in agriculture output, interest rate and inflation cause mortality rates to decrease by 1.92%, 0.09% and 0.20% respectively. On the contrary, the table reported that industrial output and exchange rate have direct effects on mortality rates. It is only exchange rate that conforms to a priori expectations. A 10% rise in industrial output and exchange rate increase mortality rates by 0.36% and 2.31% respectively.

The coefficient of determination (Adjusted-R²) is high (65.42%) and it indicates about 65.42% of the total variations in mortality rates explained by the regressors. It simply indicated that the variation of changes in mortality rates was explained by 65.42% variations in agricultural output and other controlling variables. The overall test using the F-statistic (177.47) is significant statistically at 5% level and it shows that the model is well specified. The Durbin Watson statistic (2.0386) shows that there is absence of serial autocorrelation. We test the estimated ARDL model for problems of heteroscedasticity, serial correlation, functional form misspecification, parameter stability and normality which are reported in Table 6. The estimated ARDL model revealed that the model passed the serial correlation, normality test, and heteroskedasticity test. It means

that the error terms are normally distributed with same variances and they are not serially correlated. Also, the Ramsey RESET test was satisfactory for the ARDL model indicating that the model is well distributed.

Robustness Check

The robustness checks of the results are reported in Tables 7, 8, 9 and 10 based on the components of agricultural outputs such as crop production, livestock, forestry and fishing respectively. Among the agriculture components, the results show that the negative impact of crop production on mortality rates is not statistically significant at 5% level in the long-run. However, the indirect impact of fishing on mortality rate is statistically significant at 5%. For livestock and forestry, they positively influence mortality rates but only the latter is significant statistically at 0.05 critical level.

Table 7: Results of Estimated ARDL Model of Crop Production and Mortality Rates

Dependent Variable: Mortality Rates (MRT)				
Selected Model: ARDL(2, 2, 0, 2, 3, 0)				
Sample: 1981 2019			Included observations: 35	
Short-Run Estimates				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(MRT(-1))	0.889191	0.037339	23.81422	0.0000
D(CRP)	0.004502	0.001788	2.517392	0.0200
D(CRP(-1))	-0.018580	0.002019	-9.202872	0.0000
D(INT)	0.000163	0.000110	1.485322	0.1523
D(INT(-1))	0.000581	0.000121	4.792108	0.0001
D(INF)	0.000106	3.02E-05	3.517655	0.0020
D(INF(-1))	-8.18E-05	2.65E-05	-3.088701	0.0056
D(INF(-2))	-6.00E-05	2.44E-05	-2.461956	0.0226
ECT(-1)	-0.233311	0.035581	-6.558017	0.0000
Long-run Estimates				
CRP	-0.014375	0.109531	-0.131244	0.8968
IND	-0.044993	0.100805	-0.446342	0.6599
INT	0.008946	0.008727	1.025097	0.3170
INF	-0.010878	0.006270	-1.734962	0.0974
EXR	0.045528	0.068414	0.665467	0.5130
C	6.324266	0.356968	17.71661	0.0000
R-squared	0.7621	F-stat	165.43 (0.000)	
Adj. R-squared	0.6509	D-Watson	2.1933	
Diagnostic Tests				
Serial Correlation	0.3298 [0.7231]	Normality Test:	0.5992 [0.7411]	
Functional Form:	0.0745 [0.9413]	Heteroskedasticity Test:	1.5105 [0.1909]	
Source: Authors' computation (2021).				

Table 8: Estimated ARDL Results of Livestock and Mortality Rates

Dependent Variable: Mortality Rates (MRT)				
Selected Model: ARDL (4, 4, 4, 4, 4, 4)				
Sample: 1981 2019		Included observations: 35		
Short-Run Estimates				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(MRT(-1))	0.727087	0.079212	9.178955	0.0003
D(MRT(-2))	-0.305713	0.115126	-2.655476	0.0451
D(MRT(-3))	-0.589780	0.099433	-5.931463	0.0019
D(LVP)	-0.012376	0.006737	-1.837179	0.1256
D(LVP(-1))	-0.022994	0.007566	-3.039044	0.0288
D(LVP(-2))	-0.026355	0.004818	-5.470096	0.0028
D(LVP(-3))	0.033310	0.003916	8.505971	0.0004
D(IND)	0.000405	0.002176	0.185916	0.8598
D(IND(-1))	-0.010162	0.002393	-4.245684	0.0081
D(IND(-2))	-0.015745	0.002873	-5.480663	0.0028
D(IND(-3))	-0.013555	0.001962	-6.910212	0.0010
D(INT)	0.000676	0.000160	4.223746	0.0083
D(INT(-1))	-0.001201	0.000228	-5.260713	0.0033
D(INT(-2))	-0.001975	0.000283	-6.970885	0.0009
D(INT(-3))	-0.001296	0.000143	-9.087604	0.0003
D(INF)	0.000226	3.37E-05	6.697432	0.0011
D(INF(-1))	-0.000136	3.06E-05	-4.443627	0.0067
D(INF(-2))	8.83E-05	3.63E-05	2.434958	0.0590
D(INF(-3))	0.000218	2.98E-05	7.312185	0.0007
D(EXR)	0.005228	0.001177	4.442019	0.0068
D(EXR(-1))	0.012385	0.001944	6.372307	0.0014
D(EXR(-2))	0.009897	0.001999	4.950755	0.0043
D(EXR(-3))	0.016408	0.002439	6.727738	0.0011
ECT(-1)	-0.134724	0.014201	-9.486757	0.0002
Long-run Estimates				
LVP	0.055018	0.117357	0.468806	0.6589
IND	-0.146960	0.081206	-1.809711	0.1301
INT	-0.020453	0.008169	-2.503636	0.0542
INF	-0.001851	0.001161	-1.594040	0.1718
EXR	0.108447	0.051570	2.102921	0.0894
C	6.984996	0.226149	30.88674	0.0000
R-squared	0.8928	F-stat	100.76 (0.000)	
Adj. R-squared	0.7778	D-Watson	2.0378	
Diagnostic Tests				
Serial Correlation	2.2455 [0.2090]	Normality Test:	0.6140 [0.7356]	
Functional Form:	1.4833 [0.2122]	Heteroskedasticity Test:	1.6527 [0.3035]	

Source: Authors' computation (2021).

Table 9: Estimated ARDL Results of Forestry and Mortality Rates

Table 6: Estimated ARDL Results on Electricity and Mortality Rates				
Dependent Variable: Mortality Rates (MRT)				
Selected Model: ARDL (4, 4, 3, 2, 4, 4)				
Sample: 1981 2019		Included observations: 35		
Short-Run Estimates				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(MRT(-1))	0.033797	0.068009	0.496946	0.6326
D(MRT(-2))	0.100566	0.070835	1.419715	0.1935
D(MRT(-3))	-0.226907	0.048640	-4.664993	0.0016
D(FRT)	0.038240	0.005085	7.520884	0.0001
D(FRT(-1))	0.050308	0.005969	8.427923	0.0000
D(FRT(-2))	0.024256	0.005335	4.546888	0.0019
D(FRT(-3))	0.024846	0.005316	4.673651	0.0016
D(IND)	0.000732	0.001332	0.549364	0.5978
D(IND(-1))	0.011011	0.001588	6.935746	0.0001
D(IND(-2))	0.004053	0.001303	3.109874	0.0144
D(INT)	0.000832	0.000111	7.505243	0.0001
D(INT(-1))	0.000170	9.13E-05	1.858532	0.1002
D(INF)	-5.51E-05	2.02E-05	-2.728903	0.0259
D(INF(-1))	-0.000126	2.04E-05	-6.209868	0.0003
D(INF(-2))	-0.000217	2.05E-05	-10.56388	0.0000
D(INF(-3))	-0.000117	1.88E-05	-6.223452	0.0003
D(EXR)	-0.002070	0.000658	-3.147427	0.0137
D(EXR(-1))	0.013626	0.001130	12.05918	0.0000
D(EXR(-2))	0.010710	0.000964	11.10612	0.0000
D(EXR(-3))	0.011598	0.001090	10.63925	0.0000
ECT(-1)	-0.110801	0.006274	-17.66072	0.0000
Long-run Estimates				
FRT	0.210166	0.091089	2.307271	0.0499
IND	-0.075627	0.045135	-1.675586	0.1323
INT	0.017410	0.005616	3.100226	0.0147
INF	-0.001101	0.000960	-1.147710	0.2842
EXR	-0.151299	0.048396	-3.126250	0.0141
C	5.579776	0.179327	31.11501	0.0000
R-squared	0.8954	F-stat	279.00 (0.000)	
Adj. R-squared	0.7887	D-Watson	2.0017	
Diagnostic Tests				
Serial Correlation	3.0783 [0.1202]	Normality Test:	1.0187 [0.2006]	
Functional Form:	0.5408 [0.6054]	Heteroskedasticity Test:	0.4659 [0.9325]	
Source: Authors' computation (2021).				

Table 10: Results of Estimated ARDL Model of Fishing and Mortality Rates

Dependent Variable: Mortality Rates (MRT)				
Selected Model: ARDL (4, 4, 3, 3, 4, 4)				
Sample: 1981 2019		Included observations: 35		
Short-Run Estimates				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(MRT(-1))	-0.181443	0.080603	-2.251056	0.0591
D(MRT(-2))	0.055679	0.073312	0.759482	0.4724
D(MRT(-3))	-0.326354	0.054857	-5.949166	0.0006
D(FSH)	0.005420	0.001262	4.296558	0.0036
D(FSH(-1))	-0.009041	0.001456	-6.210646	0.0004
D(FSH(-2))	-0.015792	0.001463	-10.79184	0.0000
D(FSH(-3))	-0.003492	0.001292	-2.702626	0.0305
D(IND)	-0.006094	0.001664	-3.662300	0.0080
D(IND(-1))	0.004038	0.001611	2.507314	0.0406
D(IND(-2))	-0.005681	0.001849	-3.071720	0.0180
D(INT)	0.000240	9.52E-05	2.524477	0.0396
D(INT(-1))	-7.04E-06	8.58E-05	-0.082086	0.9369
D(INT(-2))	-0.000304	9.39E-05	-3.238689	0.0143
D(INF)	0.000160	2.65E-05	6.057682	0.0005
D(INF(-1))	-0.000484	3.76E-05	-12.88142	0.0000
D(INF(-2))	-0.000253	2.57E-05	-9.871259	0.0000
D(INF(-3))	-0.000123	2.12E-05	-5.774030	0.0007
D(EXR)	-0.001027	0.000768	-1.337166	0.2230
D(EXR(-1))	0.021990	0.001344	16.35880	0.0000
D(EXR(-2))	0.018345	0.001287	14.24886	0.0000
D(EXR(-3))	0.016482	0.001393	11.83273	0.0000
ECT(-1)	-0.140115	0.007620	-18.38692	0.0000
Long-run Estimates				
FSH	-0.153417	0.024698	-6.211742	0.0004
IND	0.015159	0.020072	0.755250	0.4747
INT	-0.010020	0.003336	-3.003315	0.0198
INF	-0.004025	0.000977	-4.120916	0.0045
EXR	0.158771	0.022535	7.045386	0.0002
C	6.409595	0.103341	62.02361	0.0000
R-squared	0.8952	F-stat	227.99 (0.000)	
Adj. R-squared	0.7875	D-Watson	1.9948	
Diagnostic Tests				
Serial Correlation	1.5005 [0.3087]	Normality Test:	4.5431 [0.1032]	
Functional Form:	0.2426 [0.8149]	Heteroskedasticity Test:	0.5773 [0.8565]	
Source: Authors' computation (2021).				

Furthermore, the significant short-run coefficients of crop production are positive and negative at current level and first lag respectively. The short-run coefficients of livestock are negative indicating that they indirectly influence mortality rates. However, forestry positively impacted on mortality rate in the short-run. Meanwhile, the current level of fishing production is positive and significant at 5%, whereas, its first, second and third lags are negatives and statistically significant at 5% in the short-run. The coefficient of determination of the models explains a substantial variation of changes in mortality rates. Also, the overall tests of the models using the F-statistic are statistically significant at 5% level. In their respective tables, the estimated ARDL model revealed that the model passed the serial correlation, normality test, heteroskedasticity test and Ramsey RESET test.

Discussions and Conclusion

From the reported results, the cointegration test confirmed that there exists a long run relationship between agriculture output and mortality rates in Nigeria. Specifically, the indirect impact of agriculture outputs on mortality is not significant in the long run. It means that the ability of the agriculture sector to reduce mortality rates in the country is not significant. More so, the current level of short run coefficient of agriculture outputs has positive coefficient whereas the first lag has positive coefficient in the short run. Amongst the agriculture components, the findings show that the negative impact of crop production on mortality rates is not statistically significant at 5% level in the long-run. However, the indirect impact of fishing on mortality rate is statistically significant at 5%. For livestock and forestry, they positively influence mortality rates but only the latter is significant statistically at 0.05 critical level. In the short run, the parameters of crop production are positive and negative at current level and first lag respectively. The short-run coefficients of livestock are negative indicating that they indirectly influence mortality rates. However, forestry positively impacted on mortality rate in the short-run. Meanwhile, the current level of fishing production is positive and significant at 5%, whereas, its first, second and third lags are negatives and statistically significant at 5% in the short-run.

The research paper investigates the effects of agricultural output on human mortality rates in Nigeria between the periods 1981-2019. Employing the autoregressive distributed lag (ARDL) estimator, the study found that a long run relationship exist between agricultural output and human mortality rate in Nigeria. Concerning the estimation results, the indirect impact of agriculture outputs on mortality is not significant in the long run. More so, the current level of short run coefficient of agriculture outputs has positive coefficient whereas the first lag has negative coefficient in the short run. Amongst the agriculture components, the findings show that the negative impact of crop production on mortality rates is not statistically significant in the long-run. However, the indirect impact of fishing on mortality rate is statistically significant. For livestock and forestry, they positively influence mortality rates but only the latter is significant statistically. The study therefore suggests the need for government to adopt pro-poor policies that is capable of improving investments in agricultural activities by both public and private sectors so as to curtail human mortality rate in the country. Also, there is the need to effectively manage interest rate to stimulate high level of agricultural growth which will in turn lead to low mortality rates. In addition, the management board needs to be more proactive and information transfer between policymakers must be quick. Furthermore, macroeconomic implications need to be considered and close monitoring of agriculture agencies by the government to achieve their objectives.

References

- Ajide, K. B. & Alimi, O. Y. (2020). The confounding role of institutions in environment-health outcomes nexus in Africa. *International Economics Journal*, 34(4), 634-663.
- Aldrich, D. P. & Sawada, Y. (2015). The physical and social determinants of mortality in the 3.11 tsunami. *Social Science & Medicine*, 124, 66-75.
- Alimi, O. Y. & Ajide, K. B. (2020). The role of institutions in environment-health relations: Empirical evidence from Sub-Saharan Africa. *Economic Change and Restructuring*. Doi: 10.1007/s10644-020-09299-0
- Alimi, O. Y. & Alese, J. O. (2017). Comparative analysis of investment funding in the Nigerian oil and agricultural sector. *International Journal of Economics and Accounting*, 8(1), 67-82.
- Alimi, O. Y. (2017). Globalization and non-oil export performance in Nigeria: A bound cointegration approach. *EuroEconomica*, 36(2), 44-54.
- Central Bank of Nigeria (2019). CBN Statistical Bulletin, vol. 30, 2019. Available <http://www.statistics.cbn.gov.ng/cbnonlinestats>
- Compton, J., Wiggins, S., & Keats, S. (2010). *Impact of global food crisis on the poor: What is the evidence?* London: Overseas Development Institute.
- Cutler, D., Deaton, A., & Lleras-Muney, A. (2006). The determinants of mortality. *Journal of Economic Perspectives*, 20(3), 97-120.
- Diao, S., Fan, S., Kanyarukiga, S., & Yu, B. (2010). *Agricultural Growth and Investment Options for Poverty Reduction in Rwanda*. IFPRI Research Monograph, Washington DC.
- Ehui, S. K. & Tsigas, M., E. (2009). *The Role of Agriculture in Nigeria's Economic Growth: A General Equilibrium Analysis*. International Association of Agricultural Economists, Conference, August 16-22, 2009, Beijing, China.
- Ewubare, D. B. & Eytape, J. A. (2015). The Effects of Public Expenditure on Agricultural Production Output in Nigeria. *Journal of Research in Humanities and Social Science*, 3(11), 7-23.

- Fang, C., Lyatuu, E. T. & Nie, F. (2015). The role of agriculture in the economic growth and poverty reduction in Tanzania. *Journal of Economics and Sustainable Development*, 6(14), 154–165.
- Food and Agriculture Organization (2019). Data on agriculture output in Nigeria.
- Ijirshar, V. U. (2015). The empirical analysis of agricultural exports and economic growth in Nigeria. *Journal of Development and Agricultural Economics*, 7(3), 113-122.
- Izuchukwu, O. O. (2011). Analysis of the contribution of agricultural sector on the Nigerian economic development. *World Review of Business Research*, 1(1), 191-200.
- Lawn, S. D., Myer, L., Harling, G., Orrell, C., Bekker, L.-G. & Wood, R. (2006). Determinants of mortality and non death losses from an antiretroviral treatment service in South Africa: Implications for program evaluation. *Clinical Infectious Diseases*, 43(6), 770-776.
- Mattew, A. & Mordecai, B. (2016). Impact of Agricultural Output on Economic Development in Nigeria (1986-2014). *Archives of Current Research International*, 4(1), 1-10.
- Mattew, A. & Mordecai, B. (2016). Impact of Agricultural Output on Economic Development in Nigeria (1986-2014). *Archives of Current Research International*, 4(1), 1-10.
- Mesagan, E. P., Ogbuji, I. A., Alimi, O. Y., & Odeleye, A. T. (2019). Growth effects of financial market instruments: The Ghanaian experience. *Forum Scientiae Oeconomia*, 7(4), 67-82.
- Mostafa, G. & van Ginneken, J. K. (2000). Trends in and determinants of mortality in the elderly population of Matlab, Bangladesh. *Social Science & Medicine*, 50(6), 763-771.
- Narayan, P. (2004). Reformulating critical values for the bounds F-statistics approach to cointegration: An application to the tourism demand model for Fiji. Australia: Monash University.
- Ogbuji, I. A., Mesagan, E. P. & Alimi, O. Y. (2020). The dynamic linkage between money market, capital market and economic growth in Ghana: New lessons relearned. *Econometric Research in Finance*, 5(2), 59-78.
- Saungweme, T. & Matandare M. (2014). Agricultural expenditure and economic performance in Zimbabwe (1980-2005). *International Journal of Economics Research*, 5(5), 50-59.
- Sertoglu, K., Ugural, S., & Bekun, F. V. (2017). The contribution of agricultural sector on economic growth of Nigeria. *International Journal of Economics and Financial Issues*, 7(1), 547-552.
- Shahbaz, M., Solarin, S. A., Mahmood, H., & Arouri, M. (2013). Does financial development reduce CO2 emissions in Malaysian economy? A time series analysis. *Economic Modelling*, 35, 145-152.
- Soares, R. R. (2007). On the determinants of mortality reductions in the developing world. *Population and Development Review*, 33(2), 247-287.
- Tiffin, R. & Xavier, I. (2006). Is agriculture the engine of growth? *Agricultural Economics* 35(1), 79–89.
- Yuen Y. S. (2013). Impact of public expenditures on agricultural production investment of Chinese rural households. A B.Sc. Degree Project Submitted to Hong Kong Baptist University.