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Article

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Population Growth and Environmental Degradation in Nigeria

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Abstract

Growth in the rate of a nation's population is linked with increased environmental degradation. This study analyzed the role of population growth, energy use, GDP, financial progress and trade on environmental degradation in Nigeria by utilizing ARDL technique from 1980–2014. The model bound test result shows a long run association among the variables. The short run estimation indicates that population density; energy resources and financial progress raise the level of environmental degradation. However, output growth reduces environmental pollution in Nigeria. The estimated long run analysis reveals that population growth and financial progress accelerate environmental dilapidation, while trade promote environmental quality. The study suggests that policymakers in Nigeria should design policies that will incorporate population regulation measures, urban decongestion, sensitization and proper awareness to the citizens for environmental quality.

Keywords

Environmental degradation, population growth, GDP, ARDL, Nigeria

JEL Codes: Q52, Q54

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1. Introduction

Environmental degradation in recent years has become a global challenge (IPCC, 2018). For the past decades Carbon emissions (CO_2) worldwide has been growing to the extent of deteriorating the ecosystem, habitant, economic performance and development in both advanced and emerging countries (Danlami *et al.*, 2018). Global CO_2 emissions increases rapidly in recent time and are on course to reach a new record, extending far the challenge that world faces to restrict the effects of climate change (Tiwari, 2011). Similarly, carbon emissions are the main agents of greenhouse gases that accelerate global temperature and caused ocean and atmospheric heat, extreme weather and rising sea levels (IPCC, 2018). In addition, carbon dioxide emissions from both industrialized and emerging countries grow at 1.3 % annually, and it is projected to be double by the year 2030, if control measures are not put in place (IPCC, 2014).

Many studies have argued that, various factors such as population growth, energy consumption, urbanization, and urgent need for both industrialized and developing countries to pursue higher economic growth and development, are the main cause of environmental pollution (Acaravci and Ozturk, 2010; Sehrawat *et al.*, 2015). Therefore, it is stressed that, policy measures to mitigate CO_2 emissions are necessary towards achieving sustainable economic growth and development. In 2015, United Nations and other international agencies for human development have emphasized that the global community to take all necessary actions in decoupling CO_2 emissions for environmental quality.

According to the world resource institute (WRI), African per capita CO_2 emissions were 0.8 metric tons per person in the year 2008 and increased 0.86 metric tons in 2013. Thus, it is argued that African countries have experienced excessive heat as the result of increased temperature at 0.7^0 C that the continent becomes vulnerable to the effects of climate change. These effects may include increase in drought and floods that will accelerates low food production, diseases outbreak such as malaria and change in the natural ecosystem and loss of biodiversity (IPCC, 2007).

The total CO_2 emissions in Nigeria were 492.44 million metric tons for 2014 representing about 1.01 % of the global greenhouse gas emissions. These emissions consist 38.2% from the land use change and forestry, 32.6 % from energy use, 14. 0 % waste, 13.0 % from agriculture and 2.1 % industrial process sector. According to WRI, Nigerian CO_2 emissions grow by 25 % from 1990 to 2014 with 1% annual increase. For instance, CO_2 emissions increased from 39,196.563 kt in 1990 to 76,057.245kt in 2000, it further raise to 96,280.752 kt in 2014 (WDI, 2017). This trend illustrates that CO_2 emissions in Nigeria have a positive trend.

In this regard, growing population in Nigeria believe to be an agent of increasing the level of CO_2 emissions. Presently, Nigeria is the most highly populate nation among the Sub Saharan African countries with population of 200, 938, 935 and

2.6 % annual growth rate. In 2019, Nigeria is placed at the 7th most populated country in the world and the estimated population density of 221 per km^2 with 51.9 % of the population living in urban areas(United Nations, 2019). The urban population also increases by 26.4 % and the country's share of the world population raise by 0.8 % (United Nations, 2019; WDI, 2017). This, it implies that approximately, every year population in Nigeria grow by 1% and indicating more number of the population are concentrated in urban areas. Therefore, this situation may likely increase the concentration of CO_2 emissions in the atmosphere due more human and economic activities. Hence, it is important to understand the effects population growth on environmental pollution in Nigeria for suitable and effective policies that help in reducing poverty, increase in human and economic development and consequently to attain sustainable development.

2. Literature review

Relationship in the literature on the issue regarding population density, energy use, GDP, financial development and CO_2 has been established. Taking the instance of the study by Hassan and Salim (2015) that explore the link among population ageing, GDP and CO_2 in 25 OECD nations from 1980–2009. They reveal that population reduce the level of CO_2. *Begum et al.* (2015) examine the influence of population growth, energy resource and GDP on CO_2 in Malaysia using DOLS technique from 1970–1980. The outcome indicates population density does not influence CO_2. Meanwhile, Ohlan (2015) applies ARDL technique to analyze the effect of population growth, economic progress and energy on CO_2 in India from 1970–2013. The study's outcome reveals that population density accelerates CO_2. Lacheheb, Abdul-Rahim, and Sirag (2015) stressed that population and output growth accelerates the level of CO_2 in Algeria. Likewise, Audi and Ali (2016) analyze the connection among population growth, energy use, financial progress and GDP on environmental dilapidation in Lebanon from 1974–2014. The outcome shows that population growth increases the level of CO_2. Haseeb, Hassan, and Azam (2016) explore the effect of urbanization, GDP and energy use on CO_2 for BRICS nations using STRIPAT and FMOLS techniques from 1990–2014. The outcome shows that concentration of population in urban area increase the amount of CO_2 discharge. Similarly, Dong *et al*. (2018) documents that population growth strongly accelerates the explosion of CO_2 in 128 nations from 1990–2014. However, study by Sulaiman and Abdul-Rahim (2018) argued that population growth has no effect on the explosion of CO_2 in Nigeria.

In another development, Heidari et al. (2015) studied the influence of energy use on CO_2 for 5 Asian nations from 1980 to 2008. The study finds that energy resources increase CO_2. Jebli *et al.* (2017) reveal energy use in 25 OECD countries accelerates the level of CO_2. This outcome is consistent with result reported by Wang *et al.* (2018). However, Nguyen and Kakinaka (2019) document that renewable energy reduce CO_2 in 107 nations. Meanwhile, Study by Sehrawat *et al.* (2015) stressed that in India, financial development increases the level CO_2 discharges. Javid and Sharif (2016) investigate the influence of financial performance, output growth, energy and trade on CO_2 in Pakistan. The outcome reveals that financial progress, output growth, and energy resources promote CO_2. Seetanah *et al.* (2019) argue that financial development has no effect on environmental dilapidation in 12 small island economies. From different dimension, Mutascu *et al.* (2014) analyze the link among GDP, energy resources and CO_2 in Romania. The study reveals that GDP and energy use are strong determinants for CO_2. Abdouli and Hammami (2017) studied the influence of output growth and environmental dilapidation in MENA countries using GMM approach from 1990 to 2010. The outcome shows output growth promotes CO_2. Acheampong, (2018) reveals that economic performance decrease CO_2 in 116 emerging nations. Nevertheless, *Al-Mulali et al.* (2015) studied the influence of trade openness on CO_2 in Europe. The outcome indicate that trade enhances environmental condition. Similarly, Dogan and Turkekul (2016) reported that trade improves environmental quality in the USA. In contrast, Lv and Xu (2019) concluded that trade openness increases CO_2 in 55 nations.

Theoretically, population density is linked with the increasing level of CO_2. However, from the above reviewed literature very few studies examined the connection between population growth and environmental quality in developing nations, particularly in Nigerian context (Sulaiman and Abdul-Rahim, 2018). Therefore, the current study examines the influence of population density on environmental degradation in Nigeria.

3. Methodology of research

3.1. Data

Data was obtained on annual bases for CO_2 per capita (metric tons), population growth (annual growth), energy use (kg of oil equivalent) financial development (domestic credit % of GDP), GDP per capita (current USD) and trade openness (sum imports and exports % of GDP) from 1980–2014. The data was soured from world development indicator (WDI). All the variables are changed to their elasticity unit. Table 1 illustrates the descriptive analysis of the variables. It is shown that CO_2 have larger value among the variables for the mean and GDP in the case of standard deviation.

Table 1. Descriptive analysis

Variables	Min	Max	Mean	SD
LCO2	10.46	11.57	11.09	0.37
LPOP	0.181	0.189	0.185	0.26
LEC	6.50	6.68	6.57	0.04
LGDP	1.56	1.32	8.24	8.67
LFD	2.16	3.64	2.65	0.32
LTO	0.09	0.53	0.33	0.13

3.2. Specification of the model

3.2.1. Test for Stationarity

The study applies ADF and PP test for stationarity and order of intergradation of the variables in the model. Thus, the following equation illustrates the ADF test:

$$\Delta K_t = \alpha + \theta_{yt-1} + \lambda L + \sum_{j-1}^{l} \sigma_j \Delta K_{t-j-1} + \varepsilon_t \quad (1)$$

In equation (1) K shows the series of the period t, α signifies the coefficient, l illustrates the lags and ε_t denotes the error term. Therefore, to ascertain the absence of unit root in the series the value of the ADF must be greater than the critical value. In addition, the PP test is prescribed in the equation below:

$$\sigma^2 = T^{-1}\sum_1^T \bar{e}_r^2 + 2T^{-1}\sum_{t-1}^{l} w(t,l) \sum_{r=t+1}^{l} \bar{e}_t \bar{e}_{t-1} \quad (2)$$

Where, w(r, l) = 1[t/ (1+l)] and l represents the lags

3.2.2. Model of the study

The connection between environmental degradation and the independent variables is studied using of a modified model of Audi and Ali (2016).

LEVD = f (LPOP, LEC, LGDP, LFD, LTO) (3)

From equation 3 LEVD, LEC, LGDP, LFD and LTO show the log for environmental degradation, energy consumption, economic growth, financial development, and trade openness. The study utilizes Autoregressive Distributed Lag (ARDL) estimation. The technique produces unbiased and efficient estimation. Hence, Equation 4 illustrates the model of the study.

$$\begin{aligned}\Delta LEVD_t = \lambda_0 &+ \sum_{j=0}^{n} \lambda_1 \Delta LEVD_{t-j} + \sum_{j=1}^{n} \lambda_2 \Delta LPOP_{t-j} + \sum_{j=0}^{n} \lambda_3 \Delta LEC_{t-j} + \sum_{j=0}^{n} \lambda_4 \Delta LGDP_{t-j} \\ &+ \sum_{j=0}^{n} \lambda_5 \Delta LFD_{t-j} + \sum_{j=0}^{n} \lambda_6 \Delta LTO_{t-j} + \varphi_1 LEVD_{t-1} + \varphi_2 LPOP_{t-1} + \varphi_3 LEC_{t-1} \\ &+ \varphi_4 LGDP_{t-1} + \varphi_5 LFD_{t-1} + \varphi_6 LTO_{t-1} + \varepsilon_t \end{aligned} \quad (4)$$

In equation 4, Δ shows the first difference operator, t denotes time and ε symbolized the error term. Therefore, long-run association among the variables is detected when value of F-statistics is greater than upper critical value (UCB) (Pesaran *et al.* 2001). In addtion, the speed of adjustment in the model for the variables is validated when value of the error correction term is reaffirm nagetaive and significant.

4. Results

The stationary of the variables for the studys model are determind using ADF and PP tests. Hence all the variable are stationary at first defference as shown in table 2.

Table 2. Outcome of the Unit root tests

Variable	ADF LEVEL		PP LEVEL		ADF First Diff		PP First Diff	
LEVD	-1.157370	(0.6811)	-1.186378	(0.6689)	-5.648897*	(0.0000)	-5.648869*	(0.0000)
LPOP	-0.854103	(0.7870)	1.000211	(0.9957)	-4.460321*	(0.0018)	-2.077581	(0.2414)
LEC	-1.285820	(0.6247)	-1.132332	(0.6915)	-5.179471*	(0.0002)	-7.546742*	(0.0000)
LGDP	0.379942	(0.9791)	0.234078	(0.9709)	-5.259011*	(0.0001)	-5.274971*	(0.0001)
LFD	-2.593421	(0.1041)	-2.430566	(0.1413)	-5.107497*	(0.0002)	-8.754044*	(0.0000)
LTO	-2.004886	(0.2834)	-2.251271	(0.1930)	-7.204570*	(0.0000)	-7.295208*	(0.0000)

Note: * signifies statistically significance at one percent level.

The bound test result is shown in table 3 illustrates. It is indicates that F-statistc value is greater than the UBC value, implying that the veriables in the model are cointegrated.

Table 3. Bound test

F-statistics	1% I(0)	I(1)	5% I(0)	I(1)
4.75	3.41	4.68	2.62	3.79

Table 4 illustrates the result of the model estimation. It is shown from the short-run estimation that population growth, energy use, financial progress and trade influence environmental degradation positively. Similarly, the variables adjust at about 78 percent to long run and its coefficient is found negative and significant. Moreover, in the long run the estimation shows that population growth accelerates the level of environmental degradation in Nigeria. It implies that a 1 percent increase in growth of the population cause 3.5 percent increase in environmental dilapidation. The positive association between population growth and environmental degradation in Nigeria is not surprising as it has been justified that for more than several decades' population growth is increasing at the increasing rate with about 200 million people in the country as at 2019. Moreover, the implication of the result is that 3.5 percent rise in environmental pollution could raise more number of people into extreme poverty and diseases outbreak as well as the high cost of leaving in the nation. This result is consistent with finding reported by (Audi and Ali 2016). Similarly, a 1 percent increase in financial development leads environmental degradation to rise by 0.24 percent. Meanwhile, the outcome of the estimation reveals that a 1 percent rise in trade result to 0.05 decrease environmental degradation.

Table 4. Outcome of the short and long run estimation

Variables	Coefficients	SD Errors	t-Statistics	Prob
Short run estimates				
∆LPOP	1.615469	1.837983	-2.01207	0.0654
∆LEC	9.145724**	2.189541	4.177005	0.0011
∆LGDP	-0.000405***	0.000182	-2.22628	0.0443
∆LFD	0.196368	0.098766	1.988221	0.0683
∆LTO	0.014995**	0.005803	2.583798	0.2854
ECT(-1)	-0.786354	0.242074	-3.248406	0.0063
Long run estimates				
LPOP	3.540112**	1.094495	3.234472	0.0065
LEC	1.554033	2.848571	0.545548	0.5946
LGDP	0.000028	0.000178	0.157222	0.8775
LFD	0.249720	0.139510	1.789972	0.0968
LTO	-0.053282	0.014293	-3.727968	0.0025
C	-6.473089	0.140809	-4.010614	0.0015

Notes: *, ** and *** signifies statistically significant at 1, 5 and 10 percent levels.

Post estimation checks are presented in table 5. The outcome shows that the model has no and serial correlation, heteroscedasticity as well as the residuals of the estimated model is normally distributed.

Table 5. Model Diagnostic checks

Test	F-statistics	Probability	Result
Breusch-Pagan Test.	1.431304	0.2518	No Heteroskedasticity
Breusch-Godfrey Test	1.000905	0.3987	No Serial Correlation
Jarque-Bera	1.587311	0.4518	Normally Distributed

5. Conclusions

This study analyzed the role of population growth, energy use, GDP, financial progress and trade on environmental degradation in Nigeria by utilizing ARDL technique from 1980–2014. The model bound test result shows a long run association among the variables. In the short run estimation population density, energy resources and financial development increase environmental degradation. However, output growth reduces environmental pollution in Nigeria. The estimated long run analysis reveals that population growth and financial development accelerate environmental dilapidation, while trade promote environmental quality. Therefore, the study suggest policymakers in Nigeria should design policies toward promoting environmental quality in the nation through policies that will incorporate population regulation measures, urban decongestion, sensitization and proper awareness for environmental quality. Unavailability of data on some variables became the study's limitation. Thus, the future studies should capture other variables like energy production, urbanization for expansion of the framework and policy analysis.

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