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## **CAUSALITY BETWEEN POPULATION GROWTH AND ENVIRONMENTAL QUALITY IN NIGERIA**

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### **ABSTRACT**

The adverse effect of population growth if not well managed cannot be overestimated especially its effect on the environment and the livelihood of the people. This study examined empirically the causality between population growth rate and environmental quality in Nigeria spanning from 1981 to 2018. Annual time-series data used were sourced from the central bank of Nigeria and World Development Indicators (WDI). The basic variables are population growth and environmental quality. Population growth is decomposed into two urban population growth, and rural population growth as independent variables, while carbon dioxide emission is used as the proxy for environmental quality which is the dependent variable and fertility rate as a control variable. The study adopted Descriptive Statistics, inferential and Toda Yamamoto (1995) techniques to analyze the data. The result reveals that urban population growth, fertility rate and rural population growth impacted significantly on environmental quality (carbon dioxide emission) in Nigeria. Based on the findings, the study recommended that firstly, the government should as part of its ongoing transformation programme, green its energy policies and diversify into alternative energy sources with less greenhouse gas emission. Rural –urban migration should be curtailed to reduce the pressure on the available facilities in the urban areas.

**Keywords:** Causality, Population Growth and Environmental Quality.

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### **INTRODUCTION**

Population Growth-Environment nexus has become a major mind-boggling issue in recent literature on environmental studies. Several studies by Khalid et al. (2011), Mora (2014) and Emmanuel et al. (2019) showed how population growth affects the environment. Some suggested that rapidly growing population did not only increases pressure on marginal lands, overexploitation of soils, overgrazing, over cutting of wood, soil erosion, silting, flooding but also increases excess use of pesticides, fertilizers, causing land degradation and

water pollution (Khan et al., 009). The world population growth rate has been on the increase over two centuries with the highest population coming from the developing countries. The upsurge in population growth rate has been accounted for by the increase in fertility rate and a decrease in mortality rate given the improvement in science and technology. The increase in population growth in real life is expected to have impacted the environment negatively judging from the postulations of scholars like (Malthus, 1798; Allen & Barness, 1995; Repetto & Holmes, 1983; Rudel, 1989; Ehrlich & Holdren, 1971). This by implication implies that population growth is the root cause of poverty and human sufferings in the world. Given the above disposition, it is not out of place to state that environmental degradation and low agriculture yields are the result of increased population growth in the world.

A critical assessment of extant literature on population growth - environment nexus connote that a major portion of the world population growth comes from the developing countries of Africa, Latin America, East Asia and other scattered island known as the third world countries. Developing countries suffer because of the rapid increase in population growth which amounted to the depletion of natural resources, air and water pollution, deforestation, soil erosion, overgrazing and damage to marine and coastal ecosystem (Trainer, 1990). These prompted scholars like; Cleaver and Schreiber (1994); Ehrlich and Holden (1971); Meadow et al. (1974); Iyoha (2002) and others to have believed that there is a declining trend among food productivity as the population grows geometrically. The decline in environment qualities in developing countries occasioned by the increasing population has resulted in the underdevelopment of the region especially in countries like Ghana, Cameroon, Nigeria, Niger Republic, etc. Among the developing countries, Nigeria happens to have the highest population growth accounting to the seventh most populated country in the world ranking (world bank report,2018). Thus, the motivation to further empirically investigate the effect of population growth on the environment in Nigeria.

Nigeria a developing country with an estimated population of 200,963,599 people representing about 2.61% of the total world population is not immune from the scourging negative impact of population on the environment in the form of land degradation, air pollution, water pollution and dearth of biodiversity in many fronts. This singular impact on the environment has increased the poverty index of Nigeria earning it the world headquarter of poverty. According to Transparency International (2018), lowers economic growth and development, increases dependency on importation. Nigeria is blessed with an abundance of natural resources chief among which is crude oil, to emerge the six exporters of crude oil according to the organization of petroleum exporting countries (OPEC). Current environmental problems in Nigeria include land degradation due to erosion, oil spill, deforestation, desertification, solid waste, carbon monoxide emission from vehicle, machinery and gas flaring (Ibimilua, 2012). These problems as highlighted above pose grave challenges for economic growth and put great pressure on environmental resources in Nigeria. Augustine (2012) observed that environmental pollution has been one of the major problems standing as an impediment to human health in Nigeria. Also, the problem of climatic change is the resultant effects of pollution a product of the quest to meet the needs of the growing population and globalization.

There is plethora literature on the effect of population growth on the environment as well as those that estimated the impact of the environmental qualities on population growth. But, non was able to disaggregate the population growth rate into its rural and urban dimension as to spore comparative assessment of the effect of rural population growth and urban population growth separately or has there been any work that considered the interaction of fertility rate in the population-environment nexus. Thus, a gap in Literature has been created and to fill this gap, this study investigates the effect of population growth on the

environment by disaggregating the population growth into its rural population growth and urban population growth components as well as the consideration of the interacting effect of life expectancy rate.

The rest of this paper is divided into five sections. Immediately after the introduction is the literature review in section two. Section three dwells on research methodology, research design, source of data technique of study, and model specification, Section four centers on data analysis/discussion of findings and policy implications, while section five presents conclusion and recommendations.

## **CONCEPTUAL CLARIFICATIONS**

### **Environment**

Traditionally, the word environment is defined as the total surrounding that includes natural and biological resources. The World Bank (2018) defines the environment as the natural and social conditions surrounding all mankind, including future generations. Therefore, the environment includes the biophysical components and processes of the natural environment such as the land, water, and air (Bayode, 2017). This also includes all layers in the atmosphere, inorganic and organic matter (both living and non-living), socioeconomic components, and processes of the human environment (Emmanuel & Alakinde, 2011 in Ugwuanyi et al., 2018). So, if the environment is polluted it will affect adversely on the quality of life.

Environmental pollution is referred to as the adulteration of the physical and biological components of the earth/atmosphere system to such an extent that normal environmental processes are adversely affected. Environmental pollution is the unfavorable alteration of our surroundings, wholly or largely as a byproduct of man's actions, through direct or indirect effects of the changes in the energy pattern, radiation levels, and chemical and physical constitution and abundance of organisms. Environmental pollution is a global problem and is common to both developed as well as developing countries, which attracts the attention of human beings for its severe long-term consequences.

### **Population Growth**

The term population growth means the annual average increase in the population of people living in a geographical location. The values are estimated using demographic models based on several kinds of demographic parameters: a country's population size, age and sex distribution, levels of internal and international migration, fertility and mortality rates by age and sex groups, and growth rates of urban and rural populations. Population growth in Nigeria has been hovering within 1.4%, 2.1%, 1.7%, 1.7%, 1.3%, 1.2% and 1.1% within the years 1961, 1971, 1980, 1990, 2000, 2010 & 2018 respectively. The cardinal reason behind the upsurge in the population may be due to the absence of functional population policy in Nigeria. The 1988 population policy that allows Nigerians to have not more than 4 children has been obsolete and no longer operational in present Nigeria which could be the reason behind the present increase in the nation's population. Population growth in this context will be disaggregated into its urban and rural components respectively.

## **THEORETICAL LITERATURE**

This study is hinged on two theories namely Thomas Malthus theory of population and demographic transition theory. We may instinctively state that mankind's activities influence

the level of CO<sub>2</sub> emissions in the atmosphere. However, it is more challenging to define what specific factors represent mankind's activities and to what extent each of them contributes to the increase or decrease of the CO<sub>2</sub> emissions.

### **Thomas Malthus theory**

Thomas Malthus theory of population was developed and published in the year 1798 as a result of rapid population growth rate and negative returns in agriculture or food production (food shortage). Thomas Malthus observed geometric growth rate in population vis a vis arithmetic growth in food production, hence predicted a future doom (misery) if not checked properly. The world, however, proved this theory wrong. On the contrary, this present trend situation of the Nigerian economy proves this positive with the rapid population growth rate, food scarcity, large scale poverty migration etc. his prediction of population problems had been justified by the reality of demography in the world. Scholars like Paul Ehrlich believed that population growth is too high and will eventually lead to crisis (Brown, 2011). Many agreed to Thomas Malthus due to the event of the world food price crises of 2007 -2008. Hence the population would be balanced if the food supply with the population level is given adequate attention.

### **Demographic Transition Theory**

Demographic transition is a model that describes changes in population over time. It was propounded by Warren Thompson in the nineteenth century. He observed changes in birth rate and death rate in industrial society. The global demographic transition began in the nineteenth century in the now economically developed parts of the world (the north) with a decline in high birth rate and high death rate in the societies with minimal technology, education (especially of men), and economic development, to low birthrate and low death rate in the societies with advanced technology, education and development. The large reduction in death rate experienced in the early part of the twentieth century was as result of improved in medicine. These transitions are now more or less complete. Transition in the developing world witnessed rapid population growth rate because of the reduction in death, a product of improved medicine/technology which deviated from the experience of the now developed countries.

The world population increases yearly because global birth rate exceeds death rate. The annual birth rate and death rate are primarily determined by levels of fertility and mortality experienced by individuals.

### **Review of Related Empirical Studies**

Ahmed et al. (2005) investigated the interaction between population and environmental degradation on Pakistan. Using time-series data spanning from 1927-2001. Employing vector autoregressive (VAR) on four variables such as population growth, population density growth, mortality rate and fertility rate. To conclude the impact of population growth on the environment, evidence reveals that rapidly growing population accelerates environmental degradation, hence government should give policies on the choice of how to use these resources and for what purposes are the critical issues as well on the resulting impact on the environment to meet those uses and purposes.

Osuntogun and Koku (2007) investigated the impacts of urban road transportation on the ambient air pollutants, such as CO, SO<sub>2</sub>, and NO<sub>2</sub> in three cities in the southwest region in Nigeria: Lagos, Ibadan and Ado- Ekiti. Conclusively the results obtained for each city

exceeded the Federal Ministry of Environment of Nigeria's recommended upper limits of 10ppm, 0.01ppm and 0.04 to 0.06ppm for CO, SO<sub>2</sub>, and NO<sub>2</sub> respectively.

Kafka et al. (2009) examined how human activities are affecting our lives on planet Earth that receives less attention, i.e., the interaction among natural hazards, environmental degradation, and urbanization. Human actions that cause environmental degradation, as well as the ever-increasing population and built environment in hazard-prone regions, are worsening the devastation wrought by nature. Kafka et al. (2009) again pointed out this nexus of natural hazards, environmental degradation, and urbanization and argued that it is a complex problem that does not tend to yield simple, straightforward scientific answers as to where and when it will result in harmful effects.

Ray (2011) investigated Rapid population growth on India with a threatening environment through expansion and intensification of agriculture, uncontrolled growth of urbanization and industrialization, and destruction of natural habitats. With the attempt of examining population change and its impact on land, forest, water and energy resources. It suggests that rapid population growth plays an important role in per capital agriculture land, forest, and water resource. Conclusively, increasing population numbers and growing affluence have resulted in the rapid growth of energy production and consumption in India.

Okhimamhe (2013) assessed the levels of atmospheric carbon dioxide (CO<sub>2</sub>) emission at road junctions in three major cities in the southeast of Niger State in Nigeria, namely: Minna, Bida and Suleja, and identified measures that improve traffic operations while reducing the emission levels that could have implications on global warming, and hence, climate change. On the average, the level of emission of CO<sub>2</sub> recorded at the major road junctions in Suleja, Minna and Bida were 2,856.6ppm, 2,731.1ppm and 2,518.1ppm respectively. The results established that the emission levels in these three cities were approximately eight times more than the internationally accepted safe limits of 350ppm for atmospheric CO<sub>2</sub> but less than the Occupational Safety and Health Administration (OSHA) permissible exposure limits of 5,000ppm which has adverse health effects, and may contribute to climate change, in the long term, if unmitigated.

Okere et al. (2013) the transportation sector's contribution to local and global air pollution, and the strategic and tactical options available for combating the problem in an environment of sustainable development and economic growth. It also examined the origins of, and the damages caused by, air pollution from transport; it assesses the underlying causes, surveys the principal strategic approaches applied to solve the problem, and examines the various mechanisms of intervention available. Causes of air pollution from transportation Several factors can be identified as influencing the amount of emissions attributable to the transport sector and an effective strategy will need to take all these factors into account. They include: Excessive vehicle use Level of activity or vehicle use is an important factor to take into account in the overall analysis of transportation emissions, particularly in those cases where long-run solutions are envisioned to help avoid the development of a problem.

Okonkwo et al. (2014) investigated the effect of automobile emission in Port-Harcourt, Rivers State for two weeks. Two locations noted for heavy traffic congestion in the city were chosen for the study. Monitoring times were chosen to capture the traffic congestion. In total, five mornings and evening measurement were conducted at each location over two weeks beginning from August 11th – 15th 2010 for garrison intersection and August 18th - 22nd 2010 for slaughter intersection. Concentration measurement for Hydrocarbon (HC), sulphur dioxide (SO<sub>2</sub>), Nitrogen dioxide (NO<sub>2</sub>) and carbon monoxide (CO) were carried out in the morning (6.30 – 8.00 am) and evenings (5.00 – 7.00 pm) peak periods of traffic congestion using standard gas monitor (the temperature at the time of measurement were noted). Results show that the levels of these gas emissions were higher than the permissible level from Wednesday to Saturday at the two junctions both morning and

evening. However, the level of these gases on Sunday at the two junctions in the morning and evening were below the detection limit. It implies that these areas are polluted in the morning and evening when offices and commercial activities commence.

Ohlan (2015) investigated the impact of population density, energy consumption, trade openness, and economic growth on CO<sub>2</sub> emissions in India over the 1970-2013 period. Using the ARDL approach, the study revealed that population density, economic growth, and energy consumption have a significant positive impact on CO<sub>2</sub> emissions in both long-and short-run. However, the population has been revealed to be the main contributing factor to CO<sub>2</sub> emissions in India.

Samar (2016) examined the relationship between population and the environment and its impact on sustainable development in Egypt. Using time-series data spanning from the period 1950-2010. Employed multi-equation model with variables such as increased CO<sub>2</sub> emission, mortality and morbidity and GPD per hour worked. It revealed that population growth in Egypt negatively affects the state ability to achieve sustainable development via its negative impact on the environment.

Sulaiman and Abdul-Rahim (2017) examined the three-way linkage relationship between CO<sub>2</sub> emissions, energy consumption, and economic growth in Malaysia over the 1975-2015 period. Employing autoregressive distribution lag (ARDL), the results of the study indicated that economic growth is influenced neither by energy consumption nor by CO<sub>2</sub> emissions. However, CO<sub>2</sub> emissions are revealed to increase with an increase in both energy consumption and economic growth.

Manu and Sulaiman (2017) analyzed the relationship between energy consumption, CO<sub>2</sub> emissions, and economic growth in Malaysia, Spanning from the period of 1965 -2015. Using the simple ordinary least squares (OLS). The findings of the study revealed that CO<sub>2</sub> emissions decrease with an increase in income and increase with an increase in trade openness and that environment Kuznets curve is nonexistent.

## **METHODOS**

### **Research Design**

This research work adopted the quasi-experimental research design in the empirical investigation of the effect of population growth on the environment given that it enables it to use a repeated sample of the same observation over some time.

### **Source of Data**

Data used in this research work was sourced from world bank annual report 2018 (world development indicators) and National Bureau of Statistics. The Population growth which is the independent variable was decomposed into rural and urban population growth, carbon (iv) oxide is the proxy for environmental quality which is the dependent variable in the model while fertility rate serves as a control variable in the model. The essence of aggregating population growth in this context is to enable us to get the expected behaviour of the series under examination. The choice 1981 to 2018 is based on the fact that it cut across both military and civilian regime in the leadership of the country.

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Urban Population Growth Rate	1981 – 2018
Rural Population Growth Rate	1981 – 2018
Carbon dioxide emission	1981 – 2018
Fertility Rate	1981 – 2018

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## **Technique of Study**

The empirical investigation of the effect of population growth on the environment is examined using descriptive and inferential statistic as well as empirical analysis. The descriptive analysis adopted a descriptive statistic while the empirical framework uses Toda Yamamoto (1995) causality test due to the characteristic of the data set. The stationarity test performed with a unit root procedure augmented by Dickey-Fuller reported that some of the variables in the model are integrated of order I(0), I(1), and I(2) respectively. Thus, the justification to apply modified blockchain causality test that will give a robust meaning to the research. Toda Yamamoto (1995) causality is one test that takes care of the situation of this nature. Toda Yamamoto (1995) causality test is a modified none granger causality test based on augmented  $k+d_{max}$  which generates an asymptotic VAR statistic in the form of the chi-square distribution, where VAR (k) is the lag length of the system and  $d_{max}$  is the maximum order of integration in the system. The unique feature of T-Y procedure is that it does not require pre-testing for cointegrating properties of the system and therefore avoids the potential bias being associated with unit root test and cointegration test since it could be applied irrespective of whether the series is I(0), I(1) or I(2) and whether the series are cointegrated or not cointegrated of arbitrary order (Menyah & Wolde-Rufael, 2010; Rambaldi & Doran, 1996).

T-Y approach which is based on augmented VAR modelling has a wald test statistic. This modified wald test has asymptotic chi-square ( $\chi^2$ ) distribution regardless of the order of integration of the series or their cointegrating properties and it fits a standard vector autoregression model on levels of the variables. This provides information about the long causality of the series which is ignored in other methods that use first differencing. As stated earlier, T-Y approach uses a modified Wald test (MWALD) for restrictions on the parameter of VAR (k, i.e. the lag length of the system). In this process, T-Y approach artificially augments the lag order (k) by the maximum order of integration,  $d_{max}$ , i.e (k+  $d_{max}$ ). Then, (k+  $d_{max}$ ) order of VAR is estimated.

## **DEFINITION OF VARIABLES**

### **The Urban Population Growth**

The urban population growth is the annual increase in the total number of persons living in the cities or area. It is also the mass migrations of people from rural villages and other countries in search of white-collar jobs or greener pasture. Urbanization affects climate change and is the most relevant feature for an increase in energy consumption and carbon dioxide emission through the burning of plants vehicle emission, household and industrialization. Urban cities are energy-intensive with a strong trend in economic activities. Increase in urban population growth rate has a positive impact on carbon dioxide emissions and this, in turn, leads to poor environmental quality in Nigeria. The apriori expectation that an increase in population growth in the urban cities will increase environment degradation proxy of environmental qualities. Hence,  $UBPR > 0$

### **The Rural Population Growth**

The rural population growth is the annual increase in the total number of persons living in the village over time. Rural population growth means the tendency of the population of rural people to double overtime. The people living in rural areas are dependent on agriculture as a livelihood, one would expect that excessive population growth rate has a deleterious impact on the environment. Excessive

production of CO<sub>2</sub> in rural villages will cause pollution which will affect the quality of the environment especially farmers and fishermen which will, in turn, increase the poverty level. The apriori expectation is that an increase in population growth in the rural villages will increase environment degradation proxy of environmental qualities. Therefore, RUPG>0.

### Fertility Rate

This refers to the number of live births per 1,000 women of reproductive age or the average number of children born to women during their reproductive year. The higher the fertility rate the higher will be the population and the rate of environmental degradation. Thus, the apriori is positive FER > 0.

### Carbon Dioxide Emission

Carbon dioxide emission is the emission stemming from the burning of fossil fuels and the manufacturing of cement. They include carbon dioxide produced during consumption of solid, liquid and gas fuels as well as gas flaring. It is an odorless gas and is responsible for global warming. Carbon dioxide emission has always left a lot of damage to human lives recently. Carbon dioxide emissions from vehicles transport energy, household gases, industries have posed a challenge to environmental quality through the increase in urbanization and rural population growth in Nigeria. Consumption of household level, firms and individual emission is chiefly influenced by the increase in population growth in Nigeria which outcome causes environmental degradation in Nigeria.

### Model Specification

This research work adopted the modified version of Suleiman (2014) model in his empirical investigation of the relationship between energy consumption, CO<sub>2</sub> emission and economic growth in Nigeria. In estimating the model, a non-granger causality and Toda Yamamoto (1995) was employed.

However, in our case, we employed Toda Yamamoto (1995) test. T-Y non-granger causality is a modified VAR procedure built on k=4, D<sub>max</sub>=1. Thus, the following system of equations is estimated:

$$\begin{bmatrix} CO2_t \\ UBPG_t \\ RUPG_t \\ FER_t \end{bmatrix} = A_0 + A_1 \begin{bmatrix} CO2_{t-1} \\ UBPG_{t-1} \\ RUPG_{t-1} \\ FER_{t-1} \end{bmatrix} + A_2 \begin{bmatrix} CO2_{t-2} \\ UBPG_{t-2} \\ RUPG_{t-2} \\ FER_{t-2} \end{bmatrix} + A_3 \begin{bmatrix} CO2_{t-3} \\ UBPG_{t-3} \\ RUPG_{t-3} \\ FER_{t-3} \end{bmatrix} \\ + A_4 \begin{bmatrix} CO2_{t-4} \\ UBPG_{t-4} \\ RUPG_{t-4} \\ FER_{t-4} \end{bmatrix} + A_5 \begin{bmatrix} CO2_{t-5} \\ UBPG_{t-5} \\ RUPG_{t-5} \\ FER_{t-5} \end{bmatrix} + A_6 \begin{bmatrix} CO2_{t-6} \\ UBPG_{t-6} \\ RUPG_{t-6} \\ FER_{t-6} \end{bmatrix} + \begin{bmatrix} \varepsilon CO2_t \\ \varepsilon UBPG_t \\ \varepsilon RUPG_t \\ \varepsilon FER_t \end{bmatrix}$$



Where  $A_1, \dots, A_3$  are  $4 \times 4$  matrices of coefficients with  $A_0$  being  $3 \times 1$  identity matrix and  $\xi_s$  are the disturbance terms which are assumed to have zero mean and constant variance. To test the hypothesis that RUPG, UBPG and LER does not granger cause Carbon Dioxide emission ( $CO_2$ ) in Nigeria, we use the following hypothesis:  $\alpha^1 = \alpha^2 = \alpha^3 = \alpha^4 = 0$  against the alternative that the null is not true  $\alpha^1 \neq \alpha^2 \neq \alpha^3 \neq \alpha^4 \neq 0$

Where,

$CO_2$ = Carbon dioxide emission

UBPG= Urban Population Growth Rate

RUPG= Rural Population Growth Rate

FER= Fertility Rate

## DATA ANALYSIS

**Table 1. Descriptive statistic result**

	$CO_2$	UBPR	RUPG	FER
Mean	0.529557	4.628411	55492916	43.26655
Median	0.461402	4.559453	55339598	44.75500
Maximum	1.009958	6.815307	75736394	46.12700
Minimum	0.075471	3.465513	38182622	36.97600
Std. Dev.	0.294853	0.876197	11473250	3.084465
Skewness	-0.031787	0.315678	0.122555	-0.678310
Kurtosis	1.614615	2.168353	1.753103	1.955089
Jarque-Bera	3.045276	1.726225	2.556816	4.642736
Probability	0.218136	0.421847	0.278480	0.098139
Sum	20.12318	175.8796	2.11E+09	1644.129
Sum Sq. Dev.	3.216723	28.40565	4.87E+15	352.0152
Observations	38	38	38	38

The mean value which is the average of distribution for  $CO_2$ , UBPR, RUPG, & FER is 0.529557, 4.62841, 5542916, 43.26655. While the median which is the measures of central tendency are; 0.461402, 4.555453, 55339598 and 44.75500. The maximum and minimum value for the distributions are; 1.009958, 6.815307, 75736394, 46.12700 and 0.075471, 3.465513, 38182622, 36.97600 respectively. The skewness indicates that  $CO_2$  and FER have long-left tails while UBPR and RUPG have long-right tails. The Kurtosis which measures the degree of peakedness of the series indicates all the series are flat (plytokurtic) relative to normal except UBPR which appeared peaked (leptokurtic). Finally, the Jarque-Bera statistic and its probability value show that the series in question are normally distributed given that the probability values attached to the jarque-bera statistic are far more than the threshold 5%. The normality of the residual is premised on the insignificant nature of the probability values.

**Table 2. UNIT ROOT(ADF)**

Variable	Level		1 <sup>st</sup> difference		2 <sup>nd</sup> Difference		Order
	T-stat	Crit 5%	T. stat	Crit 5%	T. stat	Crit 5%	
$CO_2$	-1.69204	-2.943427	-6.485352	-2.945842	-	-	I(1)
UBPR	-3.155282	-2.943427	-	-	-	-	I(0)
RUPG	0.792929	-2.945842	-1.382249	-2.945842	-4.561970	-2.948404	I(2)
FER	-1.163790	-2.945842	-1.460709	-2.945842	-5.681088	-2.948404	I(0)

Table 2. illustrates the stationarity condition of the series with a unit root procedure augmented by Dicky fuller. The result as shown above indicates that the coefficient of UBPR was mean reverting while others become stationary after first and second differencing. Given the complication inherent in the ADF result, it became necessary to perform a confirmatory

test with KPSS as to ascertain the maximum order of integration of the series which qualifies us to Toda Yamamoto (1995) procedure. In the KPSS result, it was inferred that CO2 emission and UBPR were mean reverting while others became stationary after first differencing.

**Table 3. Unit Root (KPSS) Result**

Variable	Level		1 <sup>st</sup> Difference		2 <sup>nd</sup> Difference		Order
	T-stat	Critical value	T. stat	Critical value	-		
CO <sub>2</sub>	0.140372	0.463000	-	-	-	-	I(0)
RUPG	0.744732	0.463000	0.205752	0.463000	-	-	I(1)
UBPR	0.318458	0.463000	-	-	-	-	I(0)
FER	0.631965	0.463000	0.420455	0.463000	0.254780	0.463000	I(2)

A critical look at the characteristic of the variables indicates that three of the series are mean-reverting (stationary at level) while others became stationary after first and second differences in line with the positions Box and Jenkins (1978) who opines that none stationary series will be made stationary after first differencing. Thus, the need to apply a modified non-granger causality test developed by Toda and Yamamoto (1995). The essence of which is that the test allows for the estimation of the causality running from the independent variables to the dependent variable. Toda Yamamoto (1995) remained a none granger causality test based on augmented VAR statistic  $k + d_{max}$  which generate asymptotic VAR statistic in the form of chi-square distribution was performed on lag length (3) chosen by Akaike information criterion (AIC). The justification of this test is premised on the confirmatory unit root test performed with KPSS. KPSS is the mirror opposite of ADF.

### Toda Yamamoto

#### Dependent Variable: CO<sub>2</sub> Result

Excluded	Chi-sq	Df	Prob.
UBPR	23.52014	3	0.0000
RUPG	10.14586	3	0.0174
FER	33.15140	3	0.0000
All		9	---

#### Dependent variable: UBPR result

Excluded	Chi-sq	Df	Prob.
CO <sub>2</sub>	12.53536	3	0.0058
RUPG	9.735069	3	0.0210
FER	30.82924	3	0.0000
All		9	---

#### Dependent variable: RUPG result

Excluded	Chi-sq	Df	Prob.
CO <sub>2</sub>	12.13682	3	0.0069
UBPR	2.385814	3	0.4963

FER	48.20967	3	0.0000
All		9	---
Dependent variable: FER result			
Excluded	Chi-sq	Df	Prob.
CO <sub>2</sub>	6.414304	3	0.0931
UBPR	0.033411	3	0.9984
RUPG	1.828052	3	0.6088
All		9	---

Table 4. illustrates the Toda-Yamamoto (1995) non-granger causality test which is a one-way (univariate test) causality on the impact of population growth on environmental degradation in Nigeria. It can be inferred from the CO<sub>2</sub> equation that:

- Urban Population Growth (UBGR) granger cause CO<sub>2</sub> emission given the fact that the probability value is statistically significant at 5% level of significance. CO<sub>2</sub> emission also granger cause UBPR. An increase in UBGR will emit 23 units increase on CO<sub>2</sub> emission in Nigeria, *ceteris paribus*. The growth in Urban cities is caused by mass migrations of people from rural villages and other countries in search of white-collar jobs or the quest to meet the basic need of life to be alive. The position of this research supported the work of Inmaculada, Aurelia and Rafael (2006) who examined the impact of population on CO<sub>2</sub> emission: evidence from European countries. It is also consistence with Sarbapriya and Ishita as discussed in the impact of population growth on environmental degradation in India (2011), and Ahmed et al. (2005) also investigated the interaction between population and environmental degradation on Pakistan. Harold, Diego and Jurgen (2019) examined the effect of changing population or density on urban carbon dioxide emission.
- Rural Population Growth (RUPG) granger cause CO<sub>2</sub> given the fact that the probability value of the coefficient is statistically significant at 5% level of significance. A unit increase in RUPG will amount to a 10% increase in CO<sub>2</sub> emission in Nigeria, *ceteris paribus*. This implies that an increase in RUPG will increase the volume of CO<sub>2</sub> emission in Nigeria. Rural population growth which means the tendency of the population of the rural people to double overtime causing CO<sub>2</sub> is in line with the expectation of the study. The outcome of this estimation is not far from the point raised by Zaman et al. (2011) as investigated, the impact of population on environmental degradation in South Asia: application of seemingly unrelated regression equation model”
- Fertility Rate (FER) a control variable in the model also granger cause CO<sub>2</sub> emission given the significant posture of the probability value. A unit increase in FER will emit 33unit increase on CO<sub>2</sub> emission, *ceteris paribus*. This implies that an increase in fertility rate in Nigeria increases carbon dioxide emission in both Urban cities and Rural villages but more carbon dioxide will be generated in the urban city due to higher population in the metropolitan cities. The outcome of this estimation is in line with Joseph et al. (2018) examined climate change and life expectancy in a developing country: Evidence from greenhouse gas (CO<sub>2</sub>) emission in Nigeria.

## CONCLUSION

The point of convergence in this empirical exposition is that population growth increases the rate of environment degradation in Nigeria. But the highest influence is from urban population growth, which implies urban population growth cause more damage to the environment the rural population growth. The position of the research work implies that

Malthusian theory applies to Nigeria environment where population factors drastically reduce the quality of the environment.

## **Recommendations**

In the view of the fact that the Nigeria state is facing problems related to environmental degradation resulting from overpopulation and massive pressure on the environment and a party to Kyoto protocol to United Nations Framework Convention on Climate Change (UNFCCC), it became imperative to critically review the main source of growth in population and the degree of damages melted on the Environment.

- This empirical evidence suggests that any attempt to reduce population factors and life expectancy rate will lower CO<sub>2</sub> emissions which is desirable in Nigeria.
- The policy recommendation that could be deduced from the empirical evidence is that Nigeria should as part of its ongoing transformation programmed adopts green energy and also diversify into other alternative energy sources with less greenhouse gas emission.
- Rural-Urban Migration should be curtailed to reduce the pressure on the available facilities in the metropolises, by providing social infrastructure in the rural areas
- Literacy rate should be increased to reduce population growth in Rural Villages and Urban Cities This will assist in reducing CO<sub>2</sub> emissions and at the same sustaining long-run economic growth.

## **REFERENCES**

- Ahmad, M.H., Azhar, U., Wati, S. A., & Inam, Z. (2005). Interaction between population and environmental degradation. *The Pakistan Development Review*, 44(4), 1135-1150.
- Alakinde, M. K. (2011). *Nature of environmental science*. Monograph of Department of Urban and Regional Planning, Federal University Press.
- Augustine, C. (2012). Impact of air pollution on the environment in Port Harcourt, Nigeria. *Journal of Environmental Science and Water Resources*, 1(3), 46-51.
- Bayode, O. J. A., Adewunmi, E. A., & Odunwole, S. (2011). Environmental implications of oil exploration and exploitation in the coastal region of Ondo State, Nigeria: A regional planning appraised, *Journal of Geography and Regional Planning*, 4(3), 100-121.
- Cleaver & Schreiber (1994). *Reversing the spiral: The population, agriculture and environmental nexus on Sub-Sahara Africa*. The World Bank.
- Dickey, D. A., & Fuller, W. A. (1981). Likelihood ratio statistics for autoregressive time series with a unit root. *Econometrica*, 49(23), 1057-1072.
- Ehrlich, P. R., & Holdren, J.P., (1971). The impact of population growth, *Science*, 171, 1212-1217.
- Emmanuel, M., Saidou, O., & Francis, M. B. (2019). Implications of population growth on environmental degradation in Cameroon. *Econometrica*, 49(4), 1057-1072.
- Haroldo, V. R., Diego, R., & Jürgen, K. P. (2019). Effects of changing population or density on urban carbon dioxide emissions. <http://www.doi.10.1038/s41467-019-11184-y>.

- Howard, E., Doran, A., & Rambaldi, N. (1997). Applying linear time-varying constraints to econometric models: With an application to demand systems. *Journal of Econometrics*, 79(1), 83-95. [https://doi.org/10.1016/S0304-4076\(97\)00008-0](https://doi.org/10.1016/S0304-4076(97)00008-0).
- Ibimilua, A. F. (2012). Appraisal of the causes and consequences of human induced deforestation in Ekiti State, Nigeria. *Journal of Sustainable Development in Africa*, 14(3) 37-52.
- Inmaculada, M., Aurelia, B., & Rafael, M. (2006). *Impact of population on CO<sub>2</sub> emissions. Evidence from European Countries* NOTA DI LAVORO.
- Iyoha, M. A. (2008). *Explaining African economic growth performance: The case of Nigeria. Country case studies*. University Press.
- Iyoha, M. A. (2000) The impact of external debt reduction on economic growth in Nigeria. *Nigeria Journal of Economic and Social Studies*, 42, 1-79.
- Jenkins, W. K. (1978). *Policy analysis: A political and organizational perspective*. Martin Robertson.
- Joseph, I. A., Fredrick, O. A., Romanus, O. U., Ambrose, N. O. & Tochukwu, O., (2018). climate change and life expectancy in a developing country: Evidence from Greenhouse Gas (CO<sub>2</sub>) Emission in Nigeria. *International Journal of Economics and Financial Issues, Econjournals*, 8(4), 113-119.
- Kafka, A. L., Frapper, A. E., & Synder, N. P. (2009). Natural hazards, environmental degradation, and the urbanization of planet Earth., *Proceedings of the International Conference on Ethics and Sustainability of the Earth*, Boston College. [https://wfs.bc.edu/kafka/misc/Anthropocene/EthicsEnv\\_Kafka\\_etal\\_110609.pdf](https://wfs.bc.edu/kafka/misc/Anthropocene/EthicsEnv_Kafka_etal_110609.pdf).
- Khalid, Z., Khan, H., Muhammad, M. K., Zohra, S., & Nawaz, M. (2011). *Impact of population on environmental degradation in South Asia: Application of seemingly unrelated regression equation model*. Environmental Economics, LLC Consulting Publishing.
- Khan, H., Inamullah, E., & Shams, K. (2009). Population, environment and poverty in Pakistan: linkages and empirical evidence, *Environment, Development and Sustainability*, 11(3), 375-392.
- Kojo, M., & Wolde-Rufael, Y. (2010). CO<sub>2</sub> emissions, nuclear energy, renewable energy and economic growth in the US. *Energy Policy*, 38(6), 2911-2915.
- Lester, B. (2011). Great food crisis of 2011 foreign policy, <http://foreignpolicy.com/2011/01/10/the-great-food-crisis-of-2011>.
- Malthus, T. R. (1798). *An essay on the principle of population as it affects the future improvement of society*. Johnson.
- Manu, S. B., & Sulaiman, C. (2017). Environmental Kuznets Curve and the relationship between energy consumption, economic growth and CO<sub>2</sub> emissions in Malaysia. *Journal of Economics and Sustainable Development*, 8(16), 142-148.
- Maro, C. (2014). Revisiting the environmental and socioeconomics effects of population growth: A fundamental but fading issues in modern scientific, public and political circles. *Environmental Economics*, 2(1), 678-695.
- Meadows, D.H., Meadows, D.L., Randers, J., & Behrens, W. W. (1972). *Limits to growth*. Universe Books.
- Ohlan, R. (2015). Impact of population density, energy consumption, economic growth and trade openness on CO<sub>2</sub> emissions in India. *Natural Hazards*, 79, 1409-1428.
- Okere, G. N, Nwachukwu, K. C., & Ezebuoro, V.O. (2013). Alternative automobile pollution control policies: The perspective of motorists in Owerri municipal of Imo State. *Journal of Education Soc. Research*, 3(4), 9-19.
- Okhimamhe, A. A., & Okelola, O. F. (2013). Assessment of carbon dioxide emission at road junctions in the southeast of Niger state, Nigeria. *Alam Cipta*, 1(2), 59-70.

- Osuntogun, B. A., & Koku, C. A. (2007). Environmental impacts of urban road transportation in the Southwestern States of Nigeria. *J. Applied Sci.*, 7 (16), 23-58.
- Patterson, D. J., & Henein, N. A. (1992). *Emission from combustion engines and their control*. Ann Arbor Science Publishers.
- Robert, R., & Thomas, H. (1983). Role of population in resource depletion in developing countries, *Nigerian Economic and Financial Review*, 5(2), 609-632.
- Sarbapriya, R., & Shyampur, S. M. (2011). Impact of population growth on environmental degradation: Case of India. *The Pakistan Development Review*, 44(4), 1135-1150.
- Sulaiman, C., & Abdul-Rahim, A. S. (2017). The relationship between CO2 emission, energy consumption and economic growth in Malaysia: A three-way linkage approach. *Environmental Science and Pollution Research*, 2(4), 25204-25220.
- Sulaiman, C., Salisu, I. W., & Wong, M. H. (2014). Energy consumption, CO2 emissions and GDP in Nigeria. *Geo Journal*, 79(3), 30-45.
- Sylvia, O., Kenneth, O., & Mary, F. O. (2014). Assessment of automobile induced pollution in an urban Area (A Case Study of Port-Harcourt City, Rivers State, Nigeria). *Chemical and Process Engineering Research*, 25(8), 2225-2237.
- The World Bank Annual Report (2018). World Bank Group. <http://documents.worldbank.org/curated/en/630671538158537244/The-World-Bank-Annual-Report-2018>.
- Toda, H. Y., & Yamamoto, T. (1995). Statistical inference in vector autoregressions with possibly integrated processes. *Journal of Econometrics*, 66(28), 225-250.
- Tom, R., & Roper, J. (1989). Environmental impacts of urban road transportation in the Southwestern States of Nigeria. *Journal of Applied Science*, 8(3), 76-89.
- Trainer, F. E. (1990). Environmental significance of development theory. *Ecological Economics*, 5(2), 277-286.