African Journal of Environment and Natural Science Research
ISSN: 2689-9434
Volume 5, Issue 1, 2022 (pp. 12-24)
www.abjournals.org

URBANIZATION AND ENVIRONMENTAL UNSUSTAINABILITY: AN ECOLOGICAL FOOTPRINT ANALYSIS FOR NIGERIA

Aderinto Esther R.

Department of Economics, Lead City University, Ibadan, Oyo State, Nigeria.

E-mail: esthercareer@yahoo.com   Mobile phone: +2348021473839

Cite this article:

Aderinto Esther R. (2022), Urbanization and Environmental Unsustainability: An Ecological Footprint Analysis for Nigeria. African Journal of Environment and Natural Science Research 5(1), 12-24. DOI: 10.52589/AJENSR-WDVDCDUZ.

Manuscript History

Received: 19 Nov 2021

Accepted: 12 Dec 2021

Published: 24 March 2022

ABSTRACT: *The earth's limited natural resources and assimilation capacity, coupled with increased production and consumption activities of a rapidly growing population, has made the global environment unsustainable. This study therefore analyses the empirical relationship between urbanization and environmental unsustainability in Nigeria by employing the ecological deficit obtained from the ecological footprint as a measure of environmental unsustainability. The study contributes to empirical literature on the subject matter by employing the STIRPAT model as against the Environmental Kuznets Curve (EKC) model employed by most studies for Nigeria. Secondly, the study differs from others that used carbon dioxide emissions (CO_2) as a measure of sustainability (unsustainability) of the environment by employing the difference between biocapacity per capita and ecological footprint per capita, otherwise regarded as ecological surplus (deficit), as a measure of environmental sustainability (unsustainability). Time series data spanning from 1981 to 2019 was used and the STIRPAT framework was adopted. Autoregressive Distributed Lag Technique of estimation was employed for the long- and short-run estimates, while the results were validated with the Dynamic Ordinary Least Square Technique (DOLS) as well as the Fully Modified Ordinary Least Square Technique (FMOLS). Short- and long-run results revealed that urbanization significantly has negative effects on environmental unsustainability. However, the working population has a positive effect on environmental unsustainability in the long run. In the short run, per capita income and the working population have positive effects on environmental unsustainability. The study therefore recommends responsible consumption and production activities that will improve environmental quality.*

KEYWORDS: Ecological Deficit, Population, Urbanization, Environmental Unsustainability

Article DOI: 10.52589/AJENSR-WDVDCDUZ
DOI URL: https://doi.org/10.52589/AJENSR-WDVDCDUZ

INTRODUCTION

Global warming, extreme weather conditions and continuous environmental degradation have aroused interest on issues of environmental sustainability (Shahbaz et al., 2016). The Sustainable Development Goals (SDGs) were designed to ensure a sustainable future for all, of which the environment contributes in no small way. The SDGs are a collection of seventeen goals geared towards poverty reduction, climate resilience, environmental degradation, peace and justice (United Nations, 2020), with about six of these goals being focused on the environment.

In achieving sustainable development, expansion in population plays a very crucial role but could have a deteriorating effect on the environment especially when it exceeds a nation’s productive capacity. Population growth influences the production and consumption activities of countries across the world and in view of this, exerts pressure on the existing earth resources (land, water and air, amongst others), thus contributing a great deal to climate change and posing a threat to environmental sustainability. Similarly, the composition of a country’s population determines the extent to which resources are utilized and consumed. This is so because a working population contributes more to the production and consumption activities of a country.

Global population is increasing consistently and it has been predicted that by 2030, about 60% of global population will be concentrated in urban centres. It has also been projected that a larger percentage of this increase in urban population (about 90 to 95%) will emerge from low- and middle-income countries in Asia and Africa, of which India, China and Nigeria are predicted to take the lead. The reason for this is not far-fetched as people tend to migrate to cities for an improved standard of living. The resulting effect of this will be an increase in resource consumption followed by a high emission rate that will pose a threat to the environment.

As defined by Global Footprint Network (2017), environmental sustainability refers to human interaction with the environment in a responsible way that reduces degradation or depletion of natural resources. It seeks to ensure that the environmental needs of today are met without leaving lesser units of environmental resources for the future generation. Human’s consumption of environmental resources beyond the earth’s regenerative capacity could be very detrimental. Given an increasing population, the supply-demand gap of these resources could be widened. In this regard, the ecological footprint (EFP) measures the supply of natural resources as well as human demand on the environment, and is therefore an appropriate measure of sustainability. However, in evaluating the EFP as a measure of environmental sustainability, biocapacity (BC) is an important indicator. Borucke et al. (2012) posits that biocapacity is a measurement of people’s ecological budget or nature’s regenerative capacity that is calculated by biologically productive land and sea areas as given in EF calculations.

The EFP measures the required ecological assets for production and absorption of generated waste from the use of technology and resource management. The EFP analysis indicates whether a country has an ecological deficit or surplus. When it exceeds a nation’s biocapacity, such a country is regarded to have an ecological deficit. This is because such a country is consuming more environmental resources than it is producing. Similarly, an ecological surplus occurs when the EFP of a country is lower than its biocapacity. The implication of an ecological deficit is that environmental resources are being depleted. According to Bagliani et al. (2008), ecological deficit indicates environmental unsustainability while ecological surplus is a prerequisite for environmental sustainability.

Since the 1970s, global consumption of natural resources has increased by 50 percent. However, this does not match up with the available resources as this has been recorded to have decreased by over 30 percent since then. A global average ecological footprint of 2.75 global hectares per person was recorded in 2016 with a corresponding global average biocapacity of 1.63 global hectares per person (Global Footprint, 2018). It can be inferred from Global Footprint (2018), that the world recorded an ecological deficit of 1.1 global hectares per person in 2016. However, to ensure environmental sustainability, ecological footprint should be smaller than biocapacity.

Over the years, Nigeria has recorded an ecological deficit. In 2017, the country's EFP was 1.0 gha with a biocapacity of 0.6 gha, thus recording a deficit of 0.4 gha (Global Footprint Network, 2018). With a teeming population, this implies an increase in the production and consumption activities of the country which may have deteriorating effects on the environment. Given the threat of climate change and its potential effect on economic activities, it has been projected by Chindo and Abdulrahim (2018) that about 6% to 30% decline in the Gross Domestic Product of Nigeria by 2050 may be owing to climate change if proper mitigation measures are not put in place.

This study therefore examines the effect of urbanization on environmental unsustainability in Nigeria. The study contributes to empirical literature on the subject matter in two ways. It employs the STIRPAT model as against the Environmental Kuznets Curve (EKC) model employed by most studies for Nigeria. Secondly, the study differs from others that used carbon dioxide emissions (CO_2) as a measure of environmental sustainability (unsustainability) as it employs the difference between biocapacity per capita and EFP per capita otherwise regarded as ecological surplus (deficit) as a measure of sustainability (unsustainability) of the environment.

THEORETICAL FRAMEWORK AND METHODOLOGY

Data employed for this study spans from 1981–2019. Data employed include ecological deficit as a measure of environmental unsustainability, which is obtained by subtracting biocapacity per capita from EFP per capita, urban population growth, active working population, per capita income, energy consumption used as a proxy for technology, financial development sourced from World Development Indicator and ecological footprint sourced from Global Footprint Network.

Two main models have been employed in literature to analyse the population-environment nexus vis-à-vis the IPAT (Impact, Population, Affluence, Technology) model and the Environmental Kuznets curve (EKC) model. The IPAT model founded by Ehrlich and Holdren (1971) posits that environmental quality (I) is determined by population (P), affluence (A) measured by GDP per capita and technology (T).

$$I = P.\ A.\ T\text{---} \qquad (1)$$

The theory submits that as population increases, environmental quality decreases due to increasing demand for land and other resources (Ehrlich & Holdren, 1971). Similarly, an increase in affluence also increases environmental degradation. However, technology could have positive or negative effects as it could either improve or worsen the environment depending on how it is employed (Commoner, 1972). This model has however been criticized for generating a proportional impact of environmental change by changing one factor and simultaneously holding others constant (Fan et al., 2006).

To overcome the limitation of the IPAT model, a stochastic form of the model was developed—the Stochastic Impacts by Regression on Population, Affluence, and Technology (STIRPAT) model—which can be estimated using regression techniques (Dietz & Rosa, 1994). The STIRPAT model allows for the analysis of the non-proportionate impact of a variable on the environment. This model still retains the ecological foundation of the IPAT model as it hinges on the Structural Human Ecology theory. It is however more flexible than the IPAT model as it gives room for other theoretically relevant variables to be included in the model (Dietz & Rosa, 1994). Similarly, the model does not confine itself to any particular measure of environmental impact and as such allows for the use of environmental indicators like EFP (Dietz et al., 2007; Rosa et al., 2004; York et al., 2003a).

This study therefore adapts the STIRPAT model as developed by Dietz and Rosa (1994) and as adapted by Janson and Johnson (2017). Thus, the model for this study is specified in the form of a linear-log model given that the difference between biocapacity per capita and EFP per capita (ecological deficit) used as a measure of environmental unsustainability is a negative series. The model for the study is given as:

$$EST_t = \beta_0 + \beta_1 lnUP_t + \beta_2 lnGDP_t + \beta_3 lnE_t + \beta_4 lnWP_t + \beta_5 lnFIN_t + \mu_t - - - - - - - - - - - - - (2)$$

where EST_t is environmental unsustainability, $lnUP_t$ is the natural logarithm of urban population growth rate, $lnGDP_t$ is the natural logarithm of GDP per capita used as proxy for affluence, lnE_t is the natural logarithm of energy consumption used as proxy for technology, $lnWP_t$ is the natural logarithm of active working population, $lnFIN_t$ is the natural logarithm of financial development, and μt is the error term.

The study adopts the Autoregressive Distributed Lag (ARDL) technique and its cointegration approach, i.e., bounds test is used to establish the presence (absence) of long run relationship between the variables. This approach has some advantages over others in the sense that it is applicable for series that exhibit a mixed order of integration, i.e., I(0) and I(1) variables. Similarly, the ARDL technique estimates simultaneously the long-run and short-run parameters of the model. The ARDL model to be estimated is represented below:

$$\begin{aligned} EST_t = {} & \beta_0 + \sum_{i=1}^{n} \beta_1 \Delta lnUP_{t-1} + \sum_{i=1}^{n} \beta_2 \Delta lnGDP_{t-1} + \sum_{i=1}^{n} \beta_3 \Delta lnE_{t-1} \\ & + \sum_{i=1}^{n} \beta_4 \Delta lnWP_{t-1} + \sum_{i=1}^{n} \beta_5 \Delta lnFIN_{t-1} + \propto_1 lnUP_{t-1} \\ & + \propto_1 lnUP_{t-1} + \propto_2 lnGDP_{t-1} + \propto_3 lnE_{t-1} + \propto_4 lnWP_{t-1} + \propto_5 lnFIN_{t-1} + \mu t \\ & - (3) \end{aligned}$$

where β₁ to β₅ are the short run coefficients and α₁ to α₅ are the long-run coefficients of the variables. The Bound test for cointegration will be used to determine whether there is long-run relationship between the variables of interest. The cointegration will be tested at 5% level of significance. If cointegration is established, the long-run and short-run models of ARDL specification in Equation (3) are estimated as:

$$\begin{aligned} EST_t = {} & \beta_0 + \sum_{i=1}^{n} \beta_1 lnUP_{t-1} + \sum_{i=1}^{n} \beta_2 lnGDP_{t-1} + \sum_{i=1}^{n} \beta_3 lnE_{t-1} \\ & + \sum_{i=1}^{n} \beta_4 lnWP + \sum_{i=1}^{n} \beta_5 lnFIN_{t-1} + \mu_2 t - - - - - - - - - - - - - - - - \\ & - - - (4) \end{aligned}$$

$$\begin{aligned} EST_t = {} & \beta_0 + \sum_{i=1}^{n} \beta_1 \Delta lnUP_{t-1} + \sum_{i=1}^{n} \beta_2 \Delta lnGDP_{t-1} + \sum_{i=1}^{n} \beta_3 \Delta lnE_{t-1} \\ & + \sum_{i=1}^{n} \beta_4 \Delta lnWP_{t-1} + \sum_{i=1}^{n} \beta_5 \Delta lnFIN_{t-1} + \emptyset ECM_{t-1} + \mu_t - - - - - - - - \\ & - - - - - - - - - - - - - (5) \end{aligned}$$

where ecm is the error correction representation in equation (5) and Φ is the speed of adjustment.

Lastly, as a robustness check for the ARDL long-run results, the study adopts the Dynamic Ordinary Least Square (DOLS) and Fully Modified Ordinary Least square (FMOLS) techniques. These techniques can also be used for variables with a mixed order of integration and as such is adopted to validate the ARDL long run estimates.

RESULTS AND DISCUSSION

Unit Root Test

The Augmented-Dickey Fuller (ADF) and Phillip Perron (PP) tests are employed in a bid to ascertain the unit-root properties of the data.

Table 1: Unit Root Test Result

Variable	**ADF Test Statistic at level (I_0) Trend only**	**PP Test Statistic at level (I0) Trend only**	**ADF Test Statistic at first difference (I_1) Trend only**	**PP Test Statistic at first difference (I1) Trend only**
ENVIRONMENTAL UNSUSTAINABILITY	-1.927	-1.341	-3.458**	-3.458**
URBAN POPULATION GROWTH	-9.891*	-8.850*	--------	----------
GDP/CAPITA	-1.107	-0.889	-3.366**	-3.297***
ENERGY USE	-2.788	-2.675	-5.704*	-6.743*
ACTIVE WORKING POPULATION	1.823	-1.349	-4.329*	-2.776
FINANCIAL DEVELOPMENT	-1.100	-1.043	-5.609*	-6.064*
CRITICAL VALUES				
1%	-4.226	-4.219	-4.244	-4.226
5%	-3.536	-3.533	-3.544	-3.533
10%	-3.200	-3.198	-3.205	-3.198

Source: Author's Computation (2021)

Note: *, ** and *** indicate significance at 1%, 5% and 10% levels respectively.

Results shown in table 1 reports unit root test for all our variables. ADF results show that variables exhibit a mix order of integration. This justifies our choice of ARDL methodology as variables exhibit a mix of integration order 1(0) and 1(1).

Bounds Test for Cointegration

For the Bounds test, the F-statistic value is compared against the two critical value bounds (upper and lower bounds) developed by Pesaran *et al*. (2001). If the calculated F-statistics value is greater than the upper bound at 5 percent, then cointegration is established.

Table 2: Bounds Test Result

F-Statistic	**7.843***		
Critical Values	1%	5%	10%
Lower Bound	3.29	2.56	2.22
Upper Bound	4.37	3.49	3.09

Source: Author's Computation (2021)

Note: * indicates significance and rejection of the null hypothesis of no cointegration at 1% significance level.

Table 2 reported above shows the Bounds Test for linear cointegration. This approach is used for testing whether or not there is cointegration among the variables employed. Since the calculated F-Statistic (7.843) is greater than the upper bound at 1%, 5% and 10%, we therefore establish a long-run relationship.

ARDL Results

The short- and long-run estimates for all variables are presented using the ARDL framework.

Table 3: ARDL Result

Dependent Variable: EST				
Variable	Coefficient	Standard Error	T-Statistics	Probability
LONG-RUN ESTIMATES				
LNGDP	-0.306	0.065	-4.737	0.001*
LNWP	1.979	0.528	3.749	0.005*
LNUP	-0.386	0.096	-4.012	0.003*
LNE	-0.832	0.337	-2.467	0.036**
LNFIN	-0.136	0.066	-2.055	0.070*
C	-29.100	7.433	-3.914	0.003*
SHORT-RUN ESTIMATES				
DLNGDP	0.137	0.065	2.112	0.064***
DLNWP	6.053	3.123	1.938	0.085***
DLNUP	-0.184	0.079	-2.340	0.044**
DLNE	-0.217	0.082	-2.626	0.027**
DLNFIN	0.192	0.048	4.038	0.002*
ECM	-1.684	0.176	-9.565	0.000*
R -Squared.		*0.982*		
Adjusted R-Square.		*0.934*		
DW Statistics.		*2.316*		
Normality test		*0.658*		
Breusch-Pagan-Godfrey (Heteroskedasticity).		*0.664*		
Breusch-Godfrey (Serial Correlation)		*0.153*		

Source: Author's Computation (2021)

Note: *, ** and *** indicate probability values at 1%, 5% and 10% respectively.

Results shown in table 3 reveal that in the long run, per capita income influences ecological deficit negatively and significantly. This means that a percentage increase in per capita income will reduce ecological deficit by 0.003 units. Similarly, in the long run, active working population has a positive and significant effect on ecological deficit at 1 percent. A percentage increase in active working population will therefore increase ecological deficit by 0.019 units. This conforms with a priori expectation as it is assumed that an increase in working population will increase consumption and demand on the environment.

Urban population growth has a negative relationship with ecological deficit at 1 percent. A percentage increase in urban population growth rate will reduce ecological deficit by 0.0038 units. Energy use has a negatively significant relationship with ecological deficit at 5 percent as a percentage increase in energy consumption will reduce ecological deficit by 0.008 units. In the same vein, financial development has a negative and significant relationship with ecological deficit at 5 percent as a percentage increase in financial development will reduce ecological deficit by 0.001 units.

Short-run analysis shows that per capita income has a positive relationship with ecological deficit at 10 percent. A percentage increase in GDP per capita will therefore increase ecological deficit by 0.001 units. This conforms with long-run results and a priori expectation. Similarly, active working population positively determines ecological deficit at 10 percent with a percentage increase in active working population increasing ecological deficit by 0.06 units. This conforms with a priori expectation and corroborates long-run findings. Urban population growth rate has a significantly negative relationship with ecological deficit at 5 percent in the short run. A percentage increase in urban population growth rate in the short run will reduce ecological deficit by 0.001 units. Energy consumption has a negative and significant relationship with ecological deficit at 5 percent with a percentage increase in energy consumption, reducing ecological deficit by 0.002 units. Financial development positively determines ecological deficit at 1 percent significance level with a percentage increase in financial development, increasing ecological deficit by 0.001 units.

The speed of adjustment from short-run to long-run equilibrium given any shock in the model is about 168 percent given by the error correction term. To ensure the reliability of the results, some post-estimation diagnostic tests were done. Normality, heteroskedasticity and serial correlation test results show that the null hypotheses for all these tests could be rejected. This shows that the results are free from all these econometric problems. Similarly, cumulative sum (CUSUM) and cumulative sum of squares (CUSUMSQ) tests for stability of the model are reported.

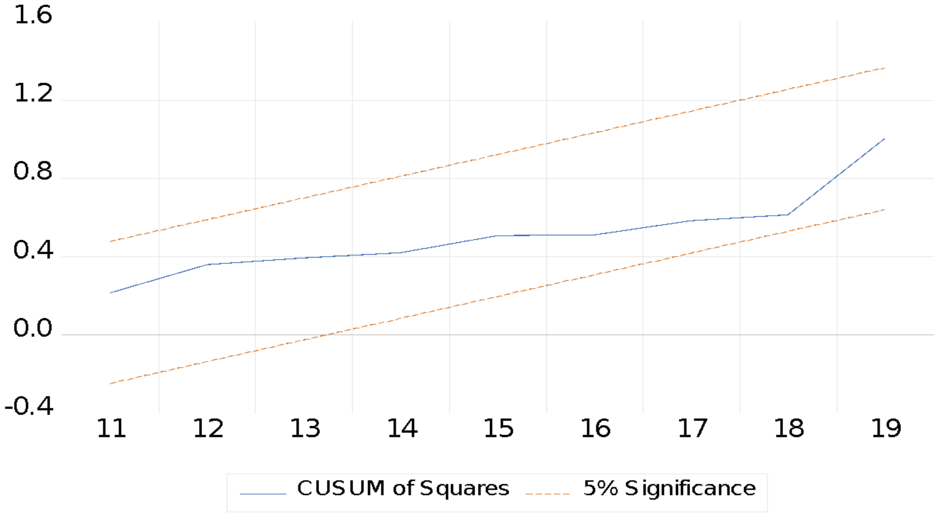

Figure 1: Cusum of Squares test.

Source: Author's Computation (2021)

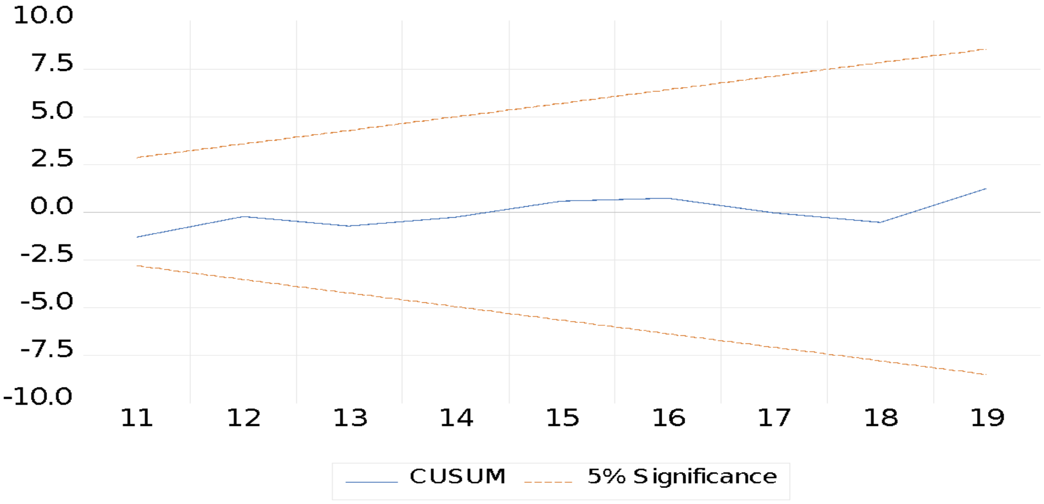

Figure 2: Cusum test

Source: Author's Computation (2021)

Results illustrated in Figures 1 and 2 show that the model is stable as the residuals are within the critical bounds at 5% significance.

Article DOI: 10.52589/AJENSR-WDVDCDUZ
DOI URL: https://doi.org/10.52589/AJENSR-WDVDCDUZ

Robustness Check

To validate the long-run ARDL result, DOLS and FMOLS results are presented below.

Table 4: FMOLS Results

Dependent Variable: LNEST				
Variable	Coefficient	Standard Error	T-Statistics	Probability
LNGDP	-0.235	0.020	-11.660	0.000*
LNWP	1.429	0.159	8.976	0.000*
LNUP	-0.456	0.064	-7.083	0.000*
LNE	-0.387	0.085	-4.509	0.000*
LNFIN	-0.103	0.030	-3.425	0.001*
C	-21.458	2.574	-8.336	0.000*

Source: Author's Computation (2021)

Note: *, ** and *** indicate probability values at 1%, 5% and 10% respectively.

The FMOLS result presented in table 4 conforms with the ARDL long-run estimates. Per capita income, working population, urban population growth, energy consumption and financial development have negative relationship with ecological deficit and are all statistically significant at 1 percent. Active working population on the other hand has a positive relationship with ecological deficit at 1 percent.

Table 5: DOLS Results

Dependent Variable: LNEST				
Variable	Coefficient	Standard Error	T-Statistics	Probability
LNGDP	-0.166	0.028	-5.878	0.000*
LNWP	0.795	0.233	3.410	0.004*
LNUP	-0.335	0.070	-4.769	0.000*
LNE	-0.133	0.167	-0.719	0.437^{ns}
LNFIN	-0.013	0.038	-0.335	0.742^{ns}
C	-12.383	3.389	-3.653	0.002*

Source: Author's Computation (2021)

Note: *, ** and *** indicate probability values at 1%, 5% and 10% respectively; ns = not significant.

From this DOLS analysis in table 5, energy consumption and financial development do not significantly determine ecological deficit but have a negative relationship with ecological deficit as indicated by the long-run ARDL results. Per capita income and urban population growth are seen to have a negatively significant relationship with ecological deficit at 1 percent. Only active working population has a significantly positive effect on ecological deficit.

Article DOI: 10.52589/AJENSR-WDVDCDUZ
DOI URL: https://doi.org/10.52589/AJENSR-WDVDCDUZ

CONCLUSION AND POLICY RECOMMENDATION

The study analysed the effect of urban population growth on environmental unsustainability in Nigeria from 1981–2019 by employing the STIRPAT model within an ARDL estimation framework. Ecological deficit was used as a proxy for environmental unsustainability given that the nation's EFP overshoots its biocapacity since the 1970s. Long-run results were also validated with the DOLS and FMOLS estimation techniques. Long-run results revealed that of all the variables employed, only active working age population has a positive effect on ecological deficit, thereby increasing the unsustainability of the Nigerian environment. Other variables like per capita income, urban population, energy consumption and financial development were seen to exert negative effects on ecological deficits against a priori expectations.

However, short-run ARDL estimates reveal that per capita income, active working age population and financial development have positive effects on ecological deficit. This conforms with a priori expectation. The working age population is the share of total population in every economy with the largest consumption level. Their consumption pattern will therefore exert a great pressure on the environment since current consumption level is not environmentally sustainable. Similarly, an increase in per capita income increases consumption level though marginally as not all the increase in income is expected to be spent on consumption, according to the Keynesian theory. Financial development implies an increasing level of production in the country which has its deteriorating effect on the environment.

The study therefore recommends that responsible consumption and production activities that are environmentally friendly should be encouraged in line with sustainable development goals. This should extend to food and other agricultural products, buildings, transportation and energy. In the same vein, since energy consumption has been seen not to be a positive contributor to ecological deficit, it then means that technology is becoming more environmentally friendly and as such, the government should continue in its pursuit of favorable energy policies that will further improve environmental quality in terms of renewable energy and energy efficiency measures.

REFERENCES

Aiyetan, I., and P. Olomola. 2017. Environmental degradation, energy consumption, population growth and economic growth: Does Environmental Kuznets curve matter for Nigeria? *Economic and Policy Review* 16(2): 1-14.

Al-Mulali, U., C. Weng-Wai, L. Sheau-Ting, A.H. Mohammed. 2015. Investigating the environmental Kuznets curve (EKC) hypothesis by utilizing the ecological footprint as an indicator of environmental degradation. *Ecol. Indic*. 48: 315–323.

Azam, Muhammad; Khan, Abdul Qayyum (2016). Urbanization and environmental degradation: Evidence from four SAARC Countries-Bangladesh, India, Pakistan, and Sri Lanka. *Environmental Progress & Sustainable Energy, 35(3), 823–832.*

Bagliani, M., G. Bravo and S. Dalmazzone. 2008. A Consumption-Based Approach to Environmental Kuznets Curves Using the Ecological Footprint Indicator. *Ecological Economics,* 65(3): 650-661.

Article DOI: 10.52589/AJENSR-WDVDCDUZ
DOI URL: https://doi.org/10.52589/AJENSR-WDVDCDUZ

Borucke, M., D. Moore, G. Cranston and A. Galli. 2012. Accounting for demand and supply of the Biosphere's regenerative capacity: The National Footprint Accounts' underlying methodology and framework. Ecological Indicators 24:518–533.

Charfeddine, L. 2017. The impact of energy consumption and economic development on Ecological Footprint and CO 2 emissions: Evidence from a Markov Switching Equilibrium Correction Model. *Energy Econ.* 65: 355–374.

Commoner, B. 1972. On "The Closing Circle". *Bulletin on the Atomic Scientists*. https://eric.ed.gov/ (Visited 30th May, 2021).

Dietz, T. and A. Eugene. 1997. Effects of Population and Affluence on CO_2 Emissions. *Proceedings of the National Academy of Sciences*, 94(11): 175 - 179.

Dietz, T. and A. Eugene. 1994. Rethinking the Environmental Impacts of Population, Affluence, and Technology. *Human Ecology Review* 1: 2277 - 300.

Dietz, T., A. Eugene and R. York. 2007. Driving the Human Ecological Footprint. *Frontiers of Human Ecology*, 5(11): 13 - 18.

Effiong,E**.** 2016. Urbanization and Environmental Quality in Africa. https://mmpra.uub.uuni - muenchen.dde//773224//. (Visited 12th March, 2021).

Ehrlich, P.R., and J.P. Holdren. 1971. Impact of population growth. *Science, (171):*1212 - 1217.

Enjema, F.M, C.S. Molem, C.F. Dobdinga, A.R. Afuge and M.B. Ngoe. 2020. Urbanization and Environmental Sustainability in Cameroon: An ARDL Technique. *European Journal of Economic and Financial Research*, 4(3):14-39.

Erturk, E. 2011. Ecological Surplus and Its Economic Implications: A Three Country Study. *The International Journal of Environmental, Cultural, Economic, and Social Sustainability Annual Review* 7 (3): 397-408.

Fan, Y., L. Liu, G. Wu and Y. Wei. 2006. Analyzing impact factors of CO_2 emissions using the STIRPAT model. *Environmental Impact Assessment Review*, 26(4): 377-395.

Gasimli, O., I. Haq, S. Kumara, N. Gamage and F. Shihadeh. 2019. Energy, Trade, Urb anization and Environmental Degradation Nexus in Sri Lanka: Bounds Testing Approach, *Energies 2019*: 1 – 15.

Global Footprint Network 2017. Ecological Footprint: Overview http://: *footprintnetwork.org*. (Visited 15th May, 2021).

Grossman, G. and A. Krueger. 1994. Economic growth and the environment. *Quarterly Journal of Economics 110: 353-378.*

Jansson, F. and P. Johnsson. 2017. Human pressure on the environment: A study on population, affluence and technology on ecological footprint. A Bachelor Thesis in Economics, Jonkoping University International Business School, Sweden. 35 pp.

Ozturk, I., F. Bilgili. 2015. Economic growth and biomass consumption nexus: Dynamic panel analysis for Sub-Sahara African countries, *Appl. Energy 137*: 110–116.

Pesaran, M.H, Y. Shin and R.J. Smith. 2001. Bounds testing approaches to the analysis of level relationships. *Journal of Econ* 16 : 289–326

Richardson, K. and P. Nnadi. 2018. Urban population growth and environmental sustainability in Nigeria. *Journal of Empirical Studies*, 5 (1) :12-19.

Rosa, E. and D. Thomas. 1998. Climate Change and Society: Speculation, Construction, and Scientific Investigation. *International Sociology* 13(44): 421 - 455.

Rosa, E., Y. Richard and D. Thomas. 2004. Tracking the Anthropogenic Drivers of Ecological Impacts. *Ambio* 33(88): 509 - 512.

Saka, A. 2014. Urban population growth and the environment in China: An investigation. *Advances in Management and Applied Economics* 4(1): 137-149.

Salim, R., S. Rafiq, S. Shafiei and Y. Yao. 2019. Does urbanization increase pollutant emission and energy intensity? Evidence from some Asian developing economies. *Applied Economics.* 51 (36): 4008-4024.

Shahbaz M., R. Sbia, H. Hamdi and I. Ozturk. 2014. Economic growth, electricity consumption, urbanization and environmental degradation relationship in United Arab Emirates. *Ecol Indic* 45: 622–631.

Shaheen, A., J. Sheng, S. Arshad, S. Salam and M. Hafeez. 2020. The Dynamic Linkage between Income, Energy Consumption, Urbanization and Carbon Emissions in Pakistan. *Polish Journal of Environmental Studies*. *29* (1): 267 – 276.

Sharma S. 2011. Determinants of carbon dioxide emissions: empirical evidence from 69 countries. *Energy* 88(1): 376–382

Shi, A. 2003. The impact of population pressure on global carbon dioxide emissions, 1975-1996: Evidence from pooled cross-country data. *Ecological Economics* 44: 29-42.

Sulaiman, C. and A.S. Abdul-Rahim. 2018. Population Growth and CO_2 Emission in Nigeria: A Recursive ARDL Approach. *SAGE Open,* 8(2): 2158244018765916.

Ulucak. R. and F. Bilgili. 2018. A reinvestigation of EKC model by ecological footprint measurement for high, middle and low income countries**,** *Journal of Cleaner Production*, 188 :144-157.

United Nations. 2014. Population and world urbanization prospects. http://www.un.org/en/development/desa/news/ population/world. (Visited 22nd May, 2021).

Yahaya, S.N., M. Hussain and M.B. Bashir. 2020. Population growth and environmental degradation in Nigeria, *Academic Journal of Economic Studies*, 6(1): 31-35.

York, R., E.A. Rosa and T. Dietz. 2003. STIRPAT, IPAT and IMPACT: Analytic tools for unpacking the driving forces of environmental impacts. *Ecol Econ* 46(3): 351–365.