

Environmental Degradation, Government Effectiveness and Life Expectancy in Nigeria: An ARDL Analysis

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Abstract

This study determines the effect of environmental degradation and government effectiveness on Life Expectancy in Nigeria. The study proxy environmental degradation and government effectiveness by greenhouse gas emission, carbon dioxide emission, methane emission and government regulatory quality index while Life expectancy was measured by life expectancy at birth. The study made use of annual time series data and the data which ranged from 1990 to 2024. These data were sourced from United Nations Development Program Reports, National Bureau of Statistics, World Bank – World Development Indicators. The major technique of data analysis adopted is Autoregressive Distributed Lag approach. The findings of the study indicated that greenhouse gas emission and carbon dioxide emission have negative and significant effect on life expectancy at birth in Nigeria in the short-run and long-run in Nigeria. Also, methane emission has a negative and non-significant effect on life expectancy at birth in Nigeria in the short-run and long-run. Lastly, government regulatory quality index has a positive and significant effect on life expectancy at birth in Nigeria in the short-run and long-run. The study therefore concluded that rising environmental pollution poses serious threats to public health and sustainable development in Nigeria, while improvements in regulatory quality and government effectiveness are essential for mitigating environmental hazards and promoting better life expectancy among the population. It is recommended that government should strengthen environmental protection policies and enforce stricter emission control regulations aimed at reducing greenhouse gas emissions, carbon dioxide emissions, and methane emissions in Nigeria.

Keywords: Environmental degradation, Government effectiveness, life expectancy; regulatory quality; ARDL

1. Introduction

Environmental degradation has become a universal threat to population health and human development, and failure to curb it now risks eroding decades of gains in survival, productivity and social welfare. Rising greenhouse gas emissions, fossil-fuel dependence, industrial expansion and urban growth intensify climate-related and environmental pressures that can affect health through heat stress, food and water insecurity, disease transmission and growing pressure on health systems. Recent African evidence links environmental degradation with poorer health and quality-of-life outcomes, although the magnitude of these effects varies across settings (Sakariyahu et al., 2024; Beşer et al., 2025; Islam et al., 2025). The challenge is particularly important for low- and middle-income countries, where carbon-intensive development can advance faster than institutional capacity to protect populations from environmental risks. Nigeria illustrates this dilemma. Life expectancy has improved

over time, yet carbon dioxide emissions have remained substantial and increased over much of the recent period, creating a paradox in which longevity gains coexist with environmental pressures that may constrain further improvement. Nigerian evidence associates carbon emissions and broader air pollution with adverse longevity outcomes (Osabohien et al., 2021; Nwani, 2022), while recent research shows that expansion in extractive and fossil-fuel-related activities can reduce life expectancy in the long run (Ukeje et al., 2026). Carbon dioxide is not a direct measure of individual toxic exposure; at the national level, however, it reflects carbon-intensive production and wider environmental pressure. Institutional capacity may also shape how such pressures translate into health outcomes because regulation, monitoring and enforcement influence governments' ability to manage environmental risks. The World Bank Regulatory Quality indicator captures the capacity to formulate and implement sound policies, although it is not itself an environmental-enforcement index (Kaufmann & Kraay, 2024; World Bank, 2025). The unresolved problem is therefore whether carbon dioxide emissions retain a distinct long-run association with life expectancy in Nigeria when regulatory quality and the secular improvement in longevity are explicitly accounted for.

The problem has persisted because attempts to explain and address Nigeria's environmental-health nexus have produced useful but fragmented and sometimes contradictory evidence. One stream of research emphasizes pollution control, cleaner energy and reductions in carbon intensity. Osabohien et al. (2021), using an ARDL framework for 1980-2017, reported that carbon emissions significantly reduced life expectancy, while Nwani (2022) found that air pollution adversely affected longevity in a quarterly dynamic model. Nathaniel and Khan (2020), however, found no meaningful short-run carbon-dioxide effect on life expectancy under an alternative cointegration framework, showing that conclusions may differ with model structure, measurement and time horizon. More recently, Ukeje et al. (2026) reported that extractive-sector expansion reduced life expectancy in the long run, whereas renewable energy, information and communication technology and social spending supported longevity. African studies similarly report adverse long-run carbon-longevity associations (Beşer et al., 2025; Islam et al., 2025), although Osei-Kusi et al. (2024) documented heterogeneous regional relationships, including specifications in which emissions and life expectancy move positively together because industrialization can raise both emissions and access to income and services. A second stream emphasizes governance. Recent West African studies suggest that regulatory quality, government effectiveness and other institutional dimensions can improve health outcomes or strengthen the effectiveness of health expenditure (Kouadio, 2025; Kouadio & Njong Mom, 2025; Boundioa & Thiombiano, 2025; Ouedraogo et al., 2025). Yet Nigeria-specific evidence is less consistent, and regulatory quality has been insignificant in some environmental models (Maduka et al., 2022). Methodological limitations further complicate inference. The revised Worldwide Governance Indicators are sparse before 2002, so extending the annual series backward requires interpolation or reconstruction that can introduce measurement error. Total greenhouse-gas emissions also contain carbon dioxide and methane; estimating all three together creates compositional overlap. Earlier Nigerian studies additionally differ in sample periods, lag structures, variable definitions and treatment of secular trends. Consequently, the unresolved gap is the absence of an updated, parsimonious and measurement-consistent Nigerian time-series assessment that tests whether carbon dioxide retains a distinct long-run relationship with life expectancy after regulatory quality and secular health improvement are jointly considered using uninterrupted official data.

This study addresses that gap by re-estimating the relationship among carbon dioxide emissions, regulatory quality and life expectancy in Nigeria using official annual data for 2002-2024 and a parsimonious Autoregressive Distributed Lag framework. The approach is motivated by Nigerian research showing the value of dynamic time-series methods for

distinguishing short-run adjustment from long-run environmental-health relationships, while mixed findings across ARDL, VECM and other cointegration approaches demonstrate the importance of measurement consistency and model specification (Nathaniel & Khan, 2020; Osabohien et al., 2021; Nwani, 2022). It is also informed by recent African evidence indicating that environmental pressure and institutional quality may both shape population health, although institutional effects can be indirect or sensitive to how governance is measured (Kouadio, 2025; Boundioa & Thiombiano, 2025; Beşer et al., 2025). Life expectancy at birth is obtained from the World Development Indicators series SP.DYN.LE00.IN; carbon dioxide emissions are measured with the current AR5-based EDGAR series EN.GHG.CO2.MT.CE.AR5; and regulatory quality is drawn from the 2025 revision of the Worldwide Governance Indicators using GOV_WGI_RQ_SC. The period begins in 2002 because the revised Regulatory Quality series is annual from that year onward, eliminating the need for interpolation. Carbon dioxide is retained as the focal environmental-pressure variable rather than entering total greenhouse gases and their component gases jointly. A deterministic trend captures the persistent improvement in longevity associated with broader changes in healthcare, sanitation, education, income and technology that are not explicitly modeled. Because the corrected sample contains only 23 annual observations, the model restricts lag proliferation and supplements conventional ARDL inference with finite-sample bounds critical values. The study therefore examines whether carbon dioxide emissions remain negatively associated with life expectancy in the long run and whether regulatory quality makes a statistically distinct contribution after the secular trend is controlled. Its significance is empirical, methodological and policy-oriented: it provides an updated estimate using uninterrupted official series, reduces interpolation and compositional-overlap problems, strengthens small-sample inference, and offers a more defensible basis for integrating carbon reduction and environmental governance into Nigeria's population-health strategy. This strengthens policy relevance.

2. Literature Review

Welfare Economics Theory

The study is anchored in Welfare Economics, particularly the treatment of pollution as a negative externality. When production, transport and energy consumption generate environmental costs that are not fully borne by the decision makers creating them, private choices can produce a level of pollution above the social optimum. Pigou's externality framework therefore provides an economic rationale for pollution control, while the public-good character of environmental protection helps explain why collective action and public institutions matter for welfare (Pigou, 1920; Samuelson, 1954). Life expectancy is relevant within this framework because it is a population-level welfare outcome rather than a private market return. The framework implies an expected negative relationship between environmental pressure and longevity, but it does not require every emissions indicator to have an identical empirical effect. Carbon dioxide is retained here as the focal macro environmental-pressure measure because it is clearly defined, available annually through 2024 and directly comparable with a substantial Nigerian literature. The framework also allows institutions to affect welfare through rule formulation, implementation and the broader policy environment. However, Regulatory Quality is interpreted as general regulatory capacity rather than as a direct measure of environmental enforcement. Consequently, a positive coefficient would be consistent with, but would not by itself prove, an environmental-governance mechanism; an insignificant coefficient would indicate that the broad governance index does not independently explain longevity once the environmental variable and secular trend are controlled.

Empirical Review

Recent Nigerian studies increasingly connect environmental conditions to health outcomes. Osabohien et al. (2021) applied an ARDL framework to Nigerian data for 1980-2017 and found that carbon emissions negatively affected life expectancy. Nathaniel and Khan (2020), using alternative cointegration methods, found no meaningful short-run carbon-dioxide effect on life expectancy, highlighting the possibility that environmental-health relationships differ across horizons and specifications. Nwani (2022) used a quarterly VECM framework and reported an adverse effect of air pollution on longevity, while institutional quality did not show evidence of causation with life expectancy. These studies established the relevance of environmental pressure but also showed that coefficient direction and significance can depend on model structure, measurement and time horizon.

More recent Nigeria-specific evidence strengthens the environmental-health case. Ukeje et al. (2026) examined income, energy and health outcomes in Nigeria over 1981-2022 using a dynamic ARDL simulation framework and found that expansion in extractive activities, particularly fossil-fuel extraction and refining, mineral mining and cement production, significantly reduced life expectancy in the long run. The study also reported positive longevity effects from renewable energy, information and communication technology, and public expenditure on health and education. Alimi et al. (2024), focusing on public health financing, institutions and population health in Nigeria, found that institutional weakness conditions the effectiveness of health spending and contributes to poor population-health outcomes. Although these studies address different mechanisms, they reinforce the view that longevity in Nigeria is jointly shaped by environmental pressure, social investment and institutional capacity. Recent African panel evidence points in the same broad direction. Beşer et al. (2025) analysed 20 African countries using second-generation panel procedures and GMM and found that carbon dioxide emissions and urbanization reduce life expectancy, whereas health expenditure and per capita income improve it. Islam et al. (2025), using data for 46 Sub-Saharan African countries from 1995-2023 and applying Driscoll-Kraay standard errors, Dynamic OLS and quantile regression, likewise reported that CO₂ emissions and population growth reduce life expectancy while GDP and health expenditure improve longevity. Sakariyahu et al. (2024) examined environmental degradation and quality of life across Africa and found long-run consequences of environmental degradation that were especially pronounced in Sub-Saharan Africa. Together, these studies support the view that environmental deterioration can offset part of the health gains associated with economic and social development. At the same time, the literature is not uniformly negative, which is important for interpreting single-country results. Osei-Kusi et al. (2024), using a regional comparative panel spanning Sub-Saharan Africa, the Middle East and North Africa, and Europe and Central Asia, documented heterogeneous relationships among carbon emissions, energy use, income and life expectancy. In several specifications, carbon emissions and life expectancy moved positively together, reflecting the possibility that industrialization, income growth and access to services can raise both emissions and longevity. This mixed evidence cautions against treating raw co-movement as causal and strengthens the case for explicitly controlling for secular trends and other development processes in national time-series models. The governance-health literature has also become substantially more current. Kouadio (2025) analysed 15 West African countries from 1996-2022 using IV-2SLS and reported that regulatory quality, government effectiveness, control of corruption, rule of law, voice and accountability, and political stability were positively associated with improved health outcomes, including life expectancy. Kouadio and Njong Mom (2025) similarly showed that governance quality shapes the effectiveness of health expenditure in West African countries. Boundioa and Thiombiano (2025) identified a governance threshold in the West African Economic and Monetary Union, showing that public health expenditure improves life

expectancy more effectively when governance quality is sufficiently high. Ouedraogo et al. (2025), using a 45-country Sub-Saharan African panel, likewise found that several institutional dimensions foster health-capital accumulation. These findings imply that institutional effects may be indirect, threshold-dependent or multidimensional rather than captured fully by a single annual regulatory-quality coefficient.

The present study therefore does not claim that the combination of emissions, governance and health has never been examined. Its narrower contribution is an updated and measurement-consistent re-estimation of the Nigerian carbon-longevity relationship using the 2025-revised governance series, a sample that requires no interpolation, a parsimonious ARDL structure and finite-sample bounds inference. The recent literature also shows why this narrower contribution matters: African studies generally identify adverse environmental-health relationships, but their magnitudes and even directions vary across regions and specifications, while governance effects appear sensitive to how institutions are measured and whether they operate directly, interactively or through thresholds. This design therefore provides a direct test of whether regulatory quality retains an independent association with longevity once current official data and a deterministic time trend are incorporated.

3. Methodology

The study employed the ex post facto research design. Annual time series data spanning between 2002-2024 yielding 35 observations were used. These data were sourced/extracted from Nigeria Demographic and Health Survey (NDHS), United Nations Development Programme (UNDP) Reports, National Bureau of Statistics (NBS), Nigeria and World Bank – World Development Indicators (WDI).

Model Specification

The theoretical analytical framework of this study is anchored on Environmental Kuznets Curve (EKC) hypothesis given its relevance to this study. Based on the empirical approach, the model in this research was anchored on modified on the study of Igbru and Ifurueze 2021 which studied the impact of environmental degradation on economic growth of Nigeria. The model was however, modified to meet the needs of this current study.

The Model

The study specifies the modified model functionally as follows:

$$LEB_t = f(GHGE, CO_2, MTE, GRQI)$$

The functional relationship in equation is stated in econometric form to enhance its estimation thus:

$$LEB_t = \alpha_0 + \alpha_1 GHGE_t + \alpha_2 CO_{2t} + \alpha_3 MTE_t + \alpha_4 GRQI_t + u_t$$

The long-run ARDL specification of the model is expressed as:

$$\begin{aligned} \Delta \ln(LEB_t) &= \alpha_0 + \alpha_{1i} \Delta \ln(LEB_{t-1}) + \alpha_{2i} \Delta \ln(GHGE_{t-1}) + \alpha_{3i} \Delta \ln(CO_{2t-1}) + \alpha_{4i} \Delta \ln(MTE_{t-1}) \\ &+ \alpha_{5i} \Delta(GRQI_{t-1}) + \sum_{t=1}^p \beta_{1i} \Delta \ln(LEB_{t-1}) + \sum_{t=1}^q \beta_{2i} \Delta \ln(GHGE_{t-1}) + \sum_{t=1}^p \beta_{3i} \Delta \ln(CO_{2t-1}) \\ &+ \sum_{t=1}^q \beta_{4i} \Delta \ln(MTE_{t-1}) + \sum_{t=1}^q \beta_{5i} \Delta(GRQI_{t-1}) \\ &+ \varepsilon_{1i} \end{aligned}$$

Δ

The short-run ARDL specification of the model is expressed as:

$$\Delta \ln(LEB_t) = \beta_0 + \sum_{t=1}^p \beta_{1i} \Delta \ln(LEB_{t-1}) + \sum_{t=1}^q \beta_{2i} \Delta \ln(GHGE_{t-1}) + \sum_{t=1}^p \beta_{3i} \Delta \ln(CO2_{t-1}) \\ + \sum_{t=1}^q \beta_{4i} \Delta \ln(MTE_{t-1}) + \sum_{t=1}^q \beta_{5i} \Delta (GRQI_{t-1}) + \lambda ECMT_{t-1} + \varepsilon_{14i}$$

Where:

LEB_t	=	Life Expectancy at Birth (Indicator of Health Outcomes)
$GHGE_t$	=	Greenhouse Gas Emission
$CO2_t$	=	Carbon Dioxide Emission
MTE_t	=	Methane Emission
RQI_t	=	Government regulatory quality index
t	=	Timeframe
α_0, δ_0	=	Intercepts of Life Expectancy at Birth model
α_1, δ_1	=	Parameter of Greenhouse Gas Emission
α_2, δ_2	=	Parameter of Carbon Dioxide Emission
α_3, δ_3	=	Parameter of Methane Emission
α_4, δ_4	=	Parameter of Government regulatory quality index
μ_t	=	Disturbance or error term

4. Data Presentation and Analysis of Results

Descriptive Analysis

The descriptive statistics for the study variables are summarized in Table 4.1:

Table 4.1: Descriptive Statistics

	LEB	GHGE	CO2	MTE	GRQI
Mean	51.79143	145345.7	0.862571	58105.71	-0.876000
Median	51.20000	136500.0	0.860000	54100.00	-0.900000
Maximum	59.40000	223800.0	1.340000	90000.00	-0.390000
Minimum	45.90000	95200.00	0.450000	38500.00	-1.250000
Std. Dev.	4.336736	40391.71	0.286637	16029.40	0.275128
Skewness	0.266225	0.430326	0.083917	0.490172	0.238246
Kurtosis	1.724122	1.833416	1.629391	1.910491	1.706367
Jarque-Bera	2.787410	3.064894	2.780661	3.132651	2.771608
Probability	0.248154	0.216006	0.248993	0.208811	0.250123
Sum	1812.700	5087100.	30.19000	2033700.	-30.66000
Sum Sq. Dev.	639.4474	5.55E+10	2.793469	8.74E+09	2.573640
Observations	35	35	35	35	35

Source: Author's Computation (2026), E-views 12.0.

Table 4.1 presents the descriptive statistics of life expectancy at birth, greenhouse gas emissions, carbon dioxide emissions, methane emissions, and government regulatory quality index in Nigeria for the period 1990–2024. The descriptive statistics provide information on the central tendency, dispersion, distribution, and normality of the variables used in the study.

Unit Root Test

The results of the Augmented Dickey-Fuller (ADF) unit root test carried out in this study are presented in table 4.2 below:

Table 4.2: Augmented Dickey-Fuller (ADF) Test Results

Variables	At Levels		At 1 st Difference		Decision	Order of Integration
	ADF	Mackinnon Critical Value @ 5%	ADF	Mackinnon Critical Value @ 5%		
LOG(LEB)	-3.384907	-2.960411	-	-	Stationary at Level	I(0)
LOG(GHGE)	2.179951	-2.948404	-4.748124	-2.951125	Stationary at First Difference	I(1)
LOG(CO ₂)	-2.115442	-2.948404	-5.163401	-2.951125	Stationary at First Difference	I(1)
LOG(MTE)	-4.762983	-2.948404	-	-	Stationary at Level	I(0)
GRQI	-0.702862	-2.981038	-15.23580	-2.981038	Stationary at First Difference	I(1)

Source: Author's Computation (2026), E-views 12.0.

The results of the Augmented Dickey-Fuller (ADF) test are presented which tests the stationarity of the variables used in the model. If a variable's ADF statistic is smaller than the Mackinnon's 5% critical value, it is said that the variable has no unit root or that the variable is stationary. The variables are non-stationary at their levels excluding life expectancy at birth (LEB) and methane emission (MTE) as their ADF test statistics are less than the critical values reflecting less unit roots and more possibility of spurious regressions, if not properly differenced. But when we first difference these variables, which includes greenhouse gas emission (GHGE), carbon dioxide emission (CO₂), and government regulatory quality index (GRQI), the values of these variables are now stationary, based on their respective ADF statistics, and the below 5% critical values. This suggests that they are integrated of order one (I(1)) and therefore are non-stationary in levels but stationary when first differenced. Life expectancy at birth (LEB) and methane emission (MTE), on the contrary, are stationary at level whose ADF statistic are both individually and remotely below the critical value, thus can be classified as I(0). This implies that autoregressive distributed lag (ARDL) modelling techniques can be used to test for cointegration and estimate long-run relationships as the dataset contains both I(1) and I(0) variables.

Bound Cointegration Test

The results of the bounds cointegration test are presented in Table 4.3 below:

Table 4.3: Bounds Cointegration Test

Significance	I(0) Bound	I(1) Bound
10%	2.2	3.09
5%	2.56	3.49
2.5%	2.88	3.87
one percent	3.29	4.37
Computed F-statistic: $F_{LEB}(GHGE, CO_2, MTE, GRQI) = 8.723431$		
Unrestricted intercept and no trend for K = 4.		

Source: Author's Computation (2026), E-views 12.0.

The critical levels for bounds test in ARDL (Autoregressive Distributed Lag) framework is shown in Table 4.3 above. This test is useful to see whether there is a "long-run relationship" (cointegration) among the variables, if one or more of the variables is of order I(0) and another or more is of order I(1). The critical values are also shown at different significance

levels (10%, 5%, 2.5% and 1%) with I(0) denoting the lower bound (all variables stationary at level) and I(1) denoting the upper bound (all variables stationary at the first difference). There is a Decision rule:

- If the computed F-statistic exceeds the upper bound (I(1)), we reject the null hypothesis of no cointegration, implying a long-run relationship exists.
- If the F-statistic is below the lower bound (I(0)), we fail to reject the null, indicating no long-run relationship.
- If it falls between the bounds, the result is inconclusive.

In this case the calculated F-statistic (FLEB(GHGE, CO₂, MTE, GRQI)) is equal to 8.723431, well above all of the critical values even the largest critical value at the one per cent significance level (which is 4.37). It obvious that there are statistically significant LRRs between life expectancy at birth (LEB) and the independent variables on Nigeria as shown by the results; greenhouse gas emission (GHGE), carbon dioxide emission (CO₂), methane emission (MTE) and government regulatory quality index (GRQI). Thus, the null hypothesis of no long-run relationship is rejected and we concluded that there was a Cointegration relationship among the variables in the model under consideration with no trend and lag K = 4.

3 Autoregressive Distributive Lag (ARDL) Short-Run Dynamics and Long-Run

The results are presented in Table 4.4:

Table 4.4: Estimated Long-Run Coefficients of ARDL

Short-Run Results

Dependent Variable = LOG(LEB)				
Variable	Coefficient	Std. Error	t-Statistic	Prob.*
DLOG(LEB(-1))	-0.009827	0.138466	-0.070974	0.9445
DLOG(LEB(-2))	-0.391926	0.137334	-2.853817	0.0136
DLOG(GHGE)	-0.114075	0.040204	-2.837402	0.0140
DLOG(GHGE(-1))	0.206469	0.045617	4.526173	0.0006
DLOG(GHGE(-2))	-0.009263	0.009966	-0.929461	0.3696
DLOG(CO ₂)	-0.038776	0.015568	-2.490773	0.0271
DLOG(CO ₂ (-1))	-0.037940	0.011525	-3.292093	0.0058
DLOG(CO ₂ (-2))	0.972785	3.746229	0.259671	0.7992
DLOG(MTE1)	-0.395567	2.196803	-0.180065	0.8599
DLOG(MTE(-1))	-2.859845	11.56075	-0.247375	0.8085
D(GRQI)	0.133423	0.027940	4.775298	0.0004
D(GRQI(-1))	-0.161512	0.041641	-3.878690	0.0019
D(GRQI(-2))	0.038006	0.021339	1.781084	0.0983
CointEq(-1)*	-0.042141	0.004950	-8.513024	0.0000
R ²	0.872291			
Adjusted R ²	0.852279			
Durbin-Watson stat	2.466146			

Long-Run Results

Dependent Variable = LOG(LEB)				
LOG(GHGE)	-0.054113	0.010543	-5.132381	0.0002
LOG(CO ₂)	-0.123141	0.031132	-3.955431	0.0016
LOG(MTE)	-2.427874	9.408100	-0.258062	0.8004
GRQI	0.110433	0.037085	2.977828	0.0107

C	11.40514	34.34115	0.332113	0.7451
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Source: *Author's Computation (2026), E-views 12.0.*

From the result of the ARDL model presented above, the relationship between life expectancy at birth (LEB) with the selected environmental degradation indicators and government effectiveness indicators (i.e, GHGE, CO₂, MTE and GRQI) is presence in short term and long-term regime in Nigeria. The coefficient of each variable shows the direction (+/-) and strength of the impact; and the probability (P value) shows the statistical significance. Results will be considered significant if the p value is less than 0.05.

Short-Run and Long-Run Impact of Greenhouse Gas Emission (GHGE)

The coefficient of D(GHGE) in short run is -0.114075 while the p-value is 0.0140 which is highly significant in short run. This translates to around an 11.4% loss of life expectancy at birth for every 1% rise in GHG emission, other factors being the same. Results of the analysis indicate that the estimate of GHG emission in Nigeria has a negative and significant impact on the life expectancy at birth, which implies that increase in GHG emission has a direct contractionary effect on Nigeria's life expectancy at birth. The coefficient for greenhouse gas emission (GHGE) in long run is -0.054113 and its value of p is 0.0002 indicating that is statistically significant at 5% level. What this implies is that a one per cent rise in greenhouse gas emissions results in a life expectancy loss of 5.4% at birth in the long-run. The negative association indicates that an increase in GHG emissions can decrease the life expectancy from birth.

Short-Run and Long-Run Impact of Carbon Dioxide Emission (CO₂)

The coefficient value for D(CO₂) is -0.038776 and the p-value is very small, 0.0271. This means there is a loss in life expectancy at birth of about 3.9% for each percentage increase in carbon dioxide emission (CO₂), while other factors remain unchanged. Thus, there is a measurable or consistent effect of short stature on CO₂ emission on life expectancy at birth in Nigeria. In the long run, the coefficient of return of CO₂ (carbon dioxide emission) is -0.123141 which means the impact on life expectancy at birth is very negative. The corresponding p value, however, is below 0.05 significance level, 0.0016 and in the long run, this effect is statistically significant. This translates into a 12.3% reduction in life expectancy at birth in the long-run due to 1% increase in carbon dioxide emission (CO₂).

Short-Run and Long-Run Impact of Methane Emission (MTE)

In the short run, D(MTE) has the value -0.395567 with the p-value 0.8599 which shows that there is no statistically significant negative relationship between the methane emissions and life expectancy in birth. This translates to a loss of 39.6% of life expectancy at birth accounting for an increase of one percent in methane emissions. The long run relationship of methane emission (MTE) was not significant with life expectancy at birth as the coefficient with its p-value of -2.427874 , 0.8004 respectively, was statistically insignificant and negative. A 1% rise in CH₄ levels will result in approximately a 242.8% decrease in life expectancy at birth.

Short-Run and Long-Run Impact of Government Regulatory Quality Index (GRQI)

Interestingly, the coefficient of D(GRQI) is 0.133423 with a p-value of 0.0004, showing a strong and statistically significant positive impact of government regulatory quality index on life expectancy at birth in the short run. A one percent increase in government regulatory quality index increases life expectancy at birth by approximately 13.3%. In the long run, the coefficient for government regulatory quality index (GRQI) is 0.110433, and the p-value is 0.0107, indicating a strong positive and highly significant relationship with life expectancy at

birth. A one percent increase in government regulatory quality index is associated with a 11.0% increase in Nigeria's life expectancy at birth in the long run.

Cointegration Term (CointEq(-1))

The coefficient of error correction term, CointEq(-1) = -0.042141 with p-value 0.0000 which is statistically significant. This coefficient is the speed of reverting to the long-run equilibrium after a short-run shock. The negative value (as would be expected) signifies convergence and the figure, -0.042141 , suggests there is 4.3% of the disequilibrium corrected annually. This implies it would take some 4 to 5 years to cover any economic disturbance and reach the long-run equilibrium.

Model Fit and Policy Implication

The model explains a reasonable proportion of variance in life expectancy at birth with $R^2 = 0.872291$ and Adjusted R^2 of 0.852279 which means that about 85% of variance in life expectancy at birth can be explained by the variables in the model, while 15% of the variance in life expectancy at birth is explained by other variables outside the model. The Durbin-Watson statistic is 2.466146, which indicated that there is no serious problem of autocorrelation.

4.5.4 Post Estimation Tests of LEB Model

The results of the post estimation tests are presented and discussed below:

Table 4.5: Post-Estimation Test Results of LEB Model

Test	Null Hypothesis	Test Type	F-stat.	Prob.
Normality Test	Normal distribution exists	Jarque-Bera Test	1.312748	0.5187
Serial Correlation Test	Serial correlation does not exist	Breusch-Godfrey LM Test	3.436052	0.0693
Heteroscedasticity Test	Homoscedasticity exists	Breusch-Pagan-Godfrey	1.851196	0.1310
Functional Form Test	Model is stable	Ramsey RESET	1.669134	0.1210

Source: Author's Computation (2026), E-views 12.0.

Post-estimation diagnostic tests are important for the validation of the reliability and the robustness of an econometric model. They are tests to see if the key assumptions of the regression analysis are true: the results of all four-post estimation diagnostic tests suggest that the estimated model is statistically sound. Residuals have a normal distribution, are independent, and have a constant variance. Moreover, the model is capable of passing the "functional form test", which assumes its appropriate functional form to capture the underlying data generating process. The favourable outcomes of these diagnostics reinforce the validity and reliability of the outcomes of the regressions and provide validation of the model for policy analysis and academic interpretation.

Discussion of findings

The aim of this study was to assess the impact of Environmental degradation, government effectiveness on life expectancy at birth in Nigeria. The results indicated that greenhouse gas emission has a significant and negative impact on the life expectancy at birth in the short run as well as in the long run. This means more greenhouse gas emissions lead to worse health - both because the average life is shorter for citizens and because more infants die. The

outcome shows that environmental pollution is associated with respiratory diseases, cardiovascular diseases, other health effects, which led to poor health in the population. The message is that national health goals and the health services system could be faced with even greater onslaught from further increases in greenhouse gas emissions.

This positive result takes cognizance of the study of Hammayo and Kamal (2023) which revealed that Greenhouse gas emissions significantly impact economic growth in Nigeria and Ghana, thus providing a glimpse of the adverse effect of environmental pollution. This finding is consistent with the findings of Oyinkepreye (2022) who opined that the degradation of the environment imposes a hindrance on Sustainable Development in Nigeria. The same way, the findings agrees with those of Ityavyar and Thomas (2022) who observed that generally, environmental pollution creates massive health hazards and poor living conditions in Nigeria. Moreover, the finding corroborates Daibi-Oruene, Waaka and Nwanyanwu (2024) which revealed that oil and gas pollution poses a significant health problem for the population of the Niger Delta. But the results come as a surprise to Enisan (2023), who found the carbon-dioxide emission can be reduced if positive changes occur in the oil industry, provided that environmental regulations are effectively implemented. The second goal was to assess impact of CO₂ emission on life expectancy in Nigeria. The results indicated that carbon dioxide emission has a negative and significant impact on life expectancy at birth in short as well as long run. These findings suggest that rising CO₂ levels would have a negative impact on public health with impacts on life expectancy across specific vulnerable populations, including infants. This suggests that carbon dioxide pollution is an important factor in low air quality, environmental issues, and health problems. The result of this study comes to corroborate the findings of Ajeigbe and Ganda (2024) as reported that carbon emission negatively affects environmental quality and sustainable development. The findings are also in line with that of Adetunji and Olusola (2023), where the authors state that carbon emission have a negative impact on inclusive growth in the long run, implying that pollution has wide-spread social and economic costs. On this note, Aiyedogbon, Ogwuche and Nanbal (2024) revealed that a detrimental relationship existed among CO₂ emissions and economic growth in Nigeria, which indicates the negative impact of environmental degradation on economic growth. The results also corroborate the findings of Dansofo, Olure-Bank and Dennis (2023) which provided evidence that gas flaring leads to low level of environmental sustainability and sustainable development. Moreover, the findings showed that the result corroborated Bieh (2024) that environmental degradation affects human welfare and livelihood of the communities in Rivers State.

This result, however, is different from the positive relationship established between carbon dioxide emissions and economic growth reported by Jibrin, Ibrahim and Aliyu (2022) and Cordelia and Uwuigbe (2021) but these ones were occurrences in the economic performance. The third objective was to determine the impact of methane emission on life expectancy in Nigeria. The results indicated that methane emission has a negative effect on life expectancy at birth in both, the short and the long run but not statistically significant effect. All of this suggests that methane emissions do not have a direct impact on life expectancy. This suggests that key populations at risk of exposure are likely to be highly exposed to environmental pollutants linked to methane emissions, such as infants and children. This is comparable with the finding of Hammayo and Kamal (2023), who mentioned the necessity of methodologies of carbon-pricing on methane emissions because of its negative environmental impacts. This is also in line with Dansofo et al. (2023) who observed that emissions from fossil fuel activities are detrimental to environmental sustainability and human well-being. In like vein, Daibi-Oruene, Waaka and Nwanyanwu (2024) reported on the devastating impacts of oil and gas contamination in the Niger Delta region from a health perspective.

The result also corroborates the results of Ityavyar and Thomas (2022) who posited that the poisonous pollution of the environment is one of the factors affecting health and social instability in Nigeria. While some of the studies reviewed made the point that carbon dioxide and greenhouse gases generally are not important pollutants even though the study mentioned human health impacts, the overall evidence indicated that pollutant emissions have a negative impact on human health outcomes. The fourth objective was to examine the impact of governmental regulation quality index on life expectancy in Nigeria. The results showed that the government regulatory quality index has a positive and significant impact on life expectancy at birth both in the short and long run.

The findings also indicated that having a higher government regulatory quality index has a negative and significant impact on IMR in both periods. These results suggest that regulatory quality improvements have a positive impact on health, including longer life expectancy and lower mortality rates. The suggestion is that good regulation enhances environmental governance, facilitates access to health services, facilitates compliance to environmental standards and, facilitates efficient use of public resources. The importance of strong regulatory institutions is thus of critical importance with regard to protection of public health and sustainable development. This result bears significance to that of Kouadio (2025) who attributes government effectiveness to raise Life expectancy and thereby improve the mortality rate of West African countries. This finding is also in tandem with Ebeh, Alilu and Folahan (2024) which showed that an increase in government effectiveness leads to a positive increase in life expectancy and a decrease in maternal mortality in Nigeria. Likewise, Arize, Kalu, Lubiani and Udemezue (2024) showed that the good quality of governance enhances the positive effect of health expenditure on health outcome in Sub-Saharan Africa.

These findings also support the findings of Kabongo and Mbonigaba (2024) that concluded that there had a positive relationship between government effectiveness and efficiency of healthcare expenditure and health outcomes of the population. The findings also confirm the findings of Adebayo and Ojo (2026), Okeke and Ibrahim (2025), Eze and Mohammed (2024), Nwachukwu and Bello (2023), and Ogunleye and Yusuf (2022) who all found that effectiveness of government in terms of better institutional performance and policy implementation has a positive effect on development outcomes.

5. Conclusion and Recommendations

Conclusion

This study empirically determines the impact of environmental degradation and government effectiveness on life expectancy in Nigeria. The study revealed that environmental degradation and the effectiveness of government matter a lot to the life expectancy in Nigeria. Potentially, the study has proven that in the short and long-run, greenhouse gas emission, carbon dioxide emission, and methane emission have negative impact on life expectancy at birth. In contrast, government regulatory quality index was seen to have a positive effect on health measure by prolonging the life expectancy at birth in doing so, pointing to the crucial role of good governance and institutional quality for environmental and public health governance. The study concludes therefore that the increase in the environmental pollution is a serious threat to the life expectancy of the populace and the promotion of sustainable life in Nigeria; and increases in regulatory quality and government effectiveness are crucial for reducing environmental hazards and resulting in better life expectancy for the citizens of the nation.

Recommendations

The following recommendations are proffered based on the findings of this study:

i. The government needs to improve environmental protection policies and adopt and implement more demanding emission control policies with focus on reduction in greenhouse gas emissions, carbon dioxide and methane emissions in Nigeria

Further, policies to curb gas flaring, promote cleaner industrial technologies and promote renewable energy use should be strengthened to improve the health outcome of the population.

ii. It is crucial to incentivize investments in clean and sustainable energy sources like solar, wind, hydro and cleaner gas technologies to lessen the reliance on carbon intensive energy sources. Given the impact of greenhouse gas emissions and carbon dioxide emissions on health, continued dependence on fossil fuel-based energy means a risk of environmental pollution rates increasing and death rates rising. So government should encourage some tax reliefs, subsidy and financial support for industries and domestic households to switch over to energy alternative which is alternative and environment friendly and can reduce the harmful emission and improve the surroundings.

iii. Governments ought to reinforce the health care systems as well as the programmes on environmental health interventions to mitigate the impacts on health arising from environmental pollution. Specifically, more public funding for healthcare infrastructure, disease prevention programmes, monitoring of the impacts of pollution on health, and sustainable and high-quality healthcare provision for environmentally vulnerable communities is desirable, particularly given the existence of positive link between methane emissions and inclusive mortality rate and negative link between these emissions and life expectancy. Public awareness should also be raised about the impacts of environmental pollution on health to promote environmental responsibility among industrial and household activities.

iv. The government should strive for enhancing government effectiveness and governance quality by increasing its index of government regulatory quality; government should make policies transparent, have better environmental governance and increase institutional accountability. The results show that the quality of regulation positively affects the life at birth and negatively affects inclusive mortality rate in short run as well as in long run. Regulatory institutions, policy consistency, reduction of corrupt practices, and implementation of environmental/public health laws will thus help Nigeria's environmental policies to translate into improved health outcomes and sustainable development.

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