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Environmental Pollution and Life Expectancy among Intrepreneurs

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Abstract

Purpose

This study examines environmental pollution and life expectancy among intrapreneurs in Nigeria from 1981 to 2023. The study envisages the outcomes on post Covid-19 from 2020-2023 using review analysis on the sustainability, survival and success of intrapreneurs in the business enterprise.

Methodology/Approach

Hence, empirical data from 1981-2019 in antecedents to the past using annual time series data obtained from secondary sources and analyzed using the Toda-Yamamoto estimation technique of analysis. The study used Life Expectancy to capture post covid-19 outcomes among intrapreneurs with response variable as Carbon dioxide, Nitrous Oxide, Health Outcomes and Particulate Matter were used as the main explanatory variables, whereas Government Expenditure on Health is used as the check or control variable.

Findings

The findings reveal that Carbon dioxide, Nitrous oxide and Particulate Matter reveal no causality with Life Expectancy during the period of study. Implying that Carbon dioxide emission, Nitrous oxide emission and Particulate Matter do not contribute or result to life expectancy reduction in Nigeria during the period of study (1981-2023). However, further finding reveals that increase in life Expectancy result a causal effect on carbon dioxide emission, implying that increase in life expectancy leads to a continuous pollution of the environment especially the Carbon dioxide emission in the period of study.

Research Implications/Practical implications

Moreover, the current life expectancy for Nigeria in 2023 is 55.75 years, a 0.57% increase from 2022. The life expectancy for Nigeria in 2022 was 55.44 years, a 0.57% increase from 2021. The study recommended that clean and renewable energy sources such as solar energy, wind energy *and Hydro energy to replace the fossil fuel energy in the country. Also, products that utilize solar energy, wind energy, Hydro energy and other renewable product should be made tax free in order to encourage mass production. This is in a bid to cut down the rate of emission in the country on the after-math of Covid-19. The study further recommends green entrepreneurship should be promoted for the sustainability, survival and success of intrapreneurs in line with the people, planet and profit both in the short-term and long-term.*

***Keywords**: Environmental Pollution, Green Entrepreneurship, Intrapreneur, Life Expectancy, Health Implications, Post Covid-19*

1. OVERVIEW

Nobody wants to die, everybody pray for long life to enjoy the sweeten comb of the honey even at old age. The livelihood of intrapreneurs should be a great concern, because they are the livewire of micro and macro enterprise (Ovharhe, 2021; 2022; 2023). They pursued the dreams, vision and mission of firms to be accomplished. Intrapreneurs are the eyes, ears, hands, feet and brain of the entrepreneurs that is while intrapreneurs' energizes the flame of the enterprise to be burning with passion and spirit of enthusiasm. Intrapreneurs are the mid-field players of the enterprise because they are the game changers. Interpreneurs are the heart beat of any enterprise because they propel and control momentum of the blood stream-flow of both micro and macro firms. If the livelihood of intrepreneur is shortening, the organizational life cycle will tend to shrink which will affect the merchandizing activities of the enterprise both operationally and strategically. Replacement of intrapreneurs with high level of proficiency on character, competence and capacity is very difficult to fine. Intrapreneur with tremendous social capital, intellectual capital, and organizational citizenship behavior is not easy to search for in the labour market. Intrapreneur with reputable character, competence and capability factors are priceless because of the scarcity as highly demanded human resource commodity with limited supply, also the likelihood of intrapreneurs with utmost integrity and diligence. This means the life expectancy should be preserved at all means. High value place on the longevity of intrapreneurs should be of great deal of concern to globe, nations, states, organization and families because they affect all aspect of human life (Ovharhe & Abada, 2023a, 2023b).

Intrapreneurs are supportive individuals that assist to boost an entrepreneur to achieve its targeted goals in the short-term and long-term. Thus, any employee hired by an entrepreneur to accomplished the enterprise purpose, vision and mission specifically could be said to be an intrapreneur. Intrapreneurs are the wealth instrumentation and economic resource to any enterprise. Intrapreneurs which are economic resource entity are valuable, priceless and scared globally. If intrapreneurs breathe, the enterprise breathes; if intrepreneur sleep, the enterprise sleeps; if intrapreneurs cry, the enterprise cries; if intrapreneurs smile, the enterprise smiles. Intrapreneurs are the threshold that magnet the wealth and treasure of the enterprise (Chibuike & Ovharhe, 2022; Chibuike, Ovharhe & Abada, 2022). Intrapreneurs are coated with innovation skills, creativity, talent and business opportunities potentials to unlock secret code that drives business to sustainability, survival and success.

Nevertheless, without intrapreneurs, no entrepreneur can sustain and survive in the business competitive parity in the long-term. In the short-term, the entrepreneur can push and pull for a period of time. But, there are recklessness and turbulence in the business environment intrapreneurs step up to face the storms and mitigate the climax for sustainability of the business. The vital fact is that behind every successful entrepreneur in business, there is the presence of intrapreneur that boosts the enterprise sustainability, survival and success on supply chain management system (Effa *et al*., 2023a, 2023b). Intrapreneurs anchor the success of business intelligence, artificial intelligence and human intelligence that leads to enterprise growth and development. This means intrapreneurs are booster of machine learning, data virtualization, big data analytics, data science among others that enable human and enterprise to achieve the sustainable development goals and climate change management.
Ovharhe and Odepli (2024) strongly believe that despise the bottlenecks and pitfalls on environmental degradation and pollution issues the application of market intelligence, sale intelligence and production intelligence, strategic intelligence, tactical intelligence and operational intelligence will enable the enterprise to sustain in the long-term (Ovharhe & Woko, 2024).
Ovharhe and Okolo (2022) averred that the negligence of the green environment such as environmental pollution control and mitigation has affected livelihood of intrapreneurs and the enterprise positive resultant outcome on the return on asset, return on equity, return on capital employed on the business growth and expansion. In the nut shell, this negligence shortens the life span of business and intrapreneur in the short-term and long-term respectively (Ovahrhe *et al*, 2021; 2022, 2023).
The current life expectancy for Nigeria in 2023 is 55.75 years, a 0.57% increase from 2022. The life expectancy for Nigeria in 2022 was 55.44 years, a 0.57% increase from 2021. Whereas, Monaco, Iceland and Japan are among the top three countries with the lowest infant mortality rates with around 2 infant deaths per 1,000 infants within their first year of life. Generally, the countries with the lowest infant mortality also have some of the highest average life expectancy (Egbichi, Abuh, Okafor, Godwin & Adedoyin, 2018).

The correlate between pollution and health poses a lot of complexities. For pollutants to have an effect on health, susceptible individuals must receive doses of the pollutant, or its decomposition products, sufficient to trigger detectable symptoms (Mlambo, Ngonisa, Ntshangase, Ndlovu & Mvuyana, 2023). For this to occur, these individuals must have been expose to the pollutant, often over relatively long periods of time or on repeated occasions. Such exposures require that the susceptible individuals and pollutants share the same environments at the same time. Health consequences of environmental pollution are thus far from being inevitable (Effiong & Bassey, 2020). Even for pollutants that are inherently toxic, they depend on the coincidence of both the emission and dispersion processes that determine where and when the pollutant occurs in the environment, and the human behaviors that determine where and when they occupy those same locations (Edeme, Emecheta & Omeje, 2017).

Bezverkhyi and Poddubna, (2023) postulated that in the 21st century humanity faced challenges related to its sustainability and survival of enterprise merchandizing activities . The resultant

negation effect might be link to pandemic, wars, global climate change and pollution in the enterprise environment. The whole process can simply be regarded as a causal chain, from source to effect as this indicates most pollutants are of human origin. They are derived from human activities such as industry, energy production and use, transport, domestic activities, waste disposal, agriculture and recreation. In some cases, however, natural sources of pollution may also be significant. These include Radon (a radio-active chemical element with atomic number 86, one of the noble gases) a release through the decay of radioactive materials in the Earth's crust. Also, arsenic released into ground-waters from natural rock sources, heavy metals accumulating in soils and sediments derived from ore-bearing rocks, particulates and sulphur dioxide released by wildfires or volcanic activity are all examples. Release from these various sources occurs in a wide range of ways, and to a range of different environmental media, including the atmosphere, surface waters, ground waters and soil. Estimates of emission by source and environmental medium are inevitably only approximate, for they can rarely be measured directly (Beyene & Balázs, 2021).
Conversely, one of the pollutants from the industries is $PM_{2.5.}$ According to Etchie et al, (2018).Nigeria as at 2015, long-term exposure to ambient $PM_{2.5}$ pollution reduces life expectancy by approximately 3.5 years on the average, with a range of 2.4–4.1 years in the LGAs.

Ordinioha and Brisibe (2013) buttress this fact by noting that people in the Niger Delta are directly dependent on the natural environment for food and livelihood and face heightened risks of exposure to contaminants through contact with and consumption of food and water. This investigation presented a review of hydrocarbon concentration on the marine and terrestrial environment of the Niger Delta and potential exposure of human populations to these contaminants. The study also analyzed health implications of oil spills in the region. Their results showed increased cases of child malnutrition, cancer, kidney diseases, diarrhea and anemia, all of which are attributable to direct exposure to high levels of environmental pollution.
Based on the tail of discussion, the study examined environmental pollution and life expectancy among intrapreneurs in Nigeria from 1981 to 2023. The study envisage the outcomes on Post Covid-19 among the sustainability, survival and success of intrapreneurs in the business enterprise from 2020 to 2023, while investigates the effect of pre-covid 19 from 1981 to 2019 using time series analysis.

Aim and Objectives of the Study
The aim of this study is to empirically investigate the impact of environmental pollution on health outcomes in Nigeria. The specific objectives are to:

i. examine the effects of environmental pollution emissions {(Carbon Dioxide (CO_2), Particulate Matter ($PM_{2.5}$), Nitrous Oxide (N_2O) emission), Government expedition on Health (GEX)} on life expectancy in Nigeria

Hypotheses
The hypothesis that is tested in this study is stated below:
Ho_1: Environmental pollution emissions {(Carbon Dioxide (CO_2), Particulate Matter ($PM_{2.5}$),

Nitrous Oxide (N_2O) emission), Government expedition on Health (GEX)} does not significantly impact on life expectancy in Nigeria.

2. LITERATURE REVIEW

Conceptual Clarifications

This section of the study gives an in depth clarification of the basic concepts in the study.

Environmental Pollution

Environmental pollution is one of the most serious problems facing humanity and other life forms on our planet today. Holdgate (1979) defined environmental pollution as the introduction by man, into the environment, of substances or energy liable to cause interference with legitimate uses of environment. Environmental pollution is defined as “the contamination of the physical and biological components of the earth/atmosphere system to such an extent that normal environmental processes are adversely affected. Pollutants can be naturally occurring substances or energies, but they are considered contaminants when in excess of natural levels. Any use of natural resource at a rate higher than nature’s capacity to restore itself can result in pollution of air, water and land (WHO, 2023).

Pollution Haven Theory

The Pollution Haven Hypothesis (PHH) was first postulated by Copeland and Taylor in 1994 as in Gill, Viswanathan and Karim (2018). The pollution haven theory or hypothesis posits that when large industrialized nations seek to set up factories or offices abroad, they will often look for the cheapest option in terms of resources and labor that offers the land and material access they require. However, this often comes at the cost of environmentally unsound practices. Developing nations with cheap resources and labor tend to have less stringent environmental regulations, and conversely, nations with stricter environmental regulations become more expensive for companies as a result of the costs associated with meeting these standards. Thus, companies that choose to physically invest in foreign countries tend to relocate to the countries with the lowest environmental standards or weakest enforcement. Thus, the assumptions of the theories emphasize that; Pollution costs have an impact on the margins, where they exert some effect on investment decisions and trade flows. Pollution control costs are important enough to measurably influence trade and investment. Countries set their environmental standards below socially-efficient levels in order to attract investment or to promote their exports.

3. METHODOLOGY

The study adopts the quasi-experimental research design for the study. This design is chosen because it is an empirical study of the association between environmental pollution and health outcomes in Nigeria. The study employs descriptive statistics and Toda-Yamamoto estimation technique as the main analytical tool.

This study Environmental Pollution and Health Outcomes in Nigeria captures the following variables namely; Life Expectancy (LEX), Maternal Mortality Rate (MMR), Infant Mortality Rate (IMR), Nitrous Oxide (N2O), Carbon Dioxide (CO_2) Particulate Matter ($PM_{2.5}$) and Government Expenditure on Health (GXH). These variables are elaborated below.

Dependent variables

Life Expectancy (LEX) is the dependent variable which is explained below.

(i) Life Expectancy (LEX)

Life expectancy is the estimated average years a person is projected or likely to live before death. It is a statistical measure of the average time an organism is expected to live based on the year of its birth, its current age and other demographic factors (Nkalu & Edeme, 2019). The most commonly used measure is Life Expectancy at Birth (LEB) which can be defined in two ways. Cohort Life Expectancy at Birth (LEB) is the mean length of life of an actual birth cohort (all individual born in a given year) and can be computed only for cohort born many decades ago so that all their members have died (Mariani, Pérez-Barahona & Raffin, 2009). A cohort life table shows the probability of a person from a given cohort dying at each age over the course of their lifetime. In this context, a cohort refers to a group of people with the same year of birth.

The cohort life table is based on age-specific probabilities of death, which are calculated using observed deaths (mortality) data from the cohort. A cohort life table uses a combination of observed mortality rates for past years and projections about mortality rates for the cohort in future years. For example, cohort life expectancy at age 65 years in 2016 would be worked out using the mortality rate for age 65 years in 2016, for age 66 years in 2017, for age 67 years in 2018 and so on. This uses observed mortality rates up to 2018 and projected mortality rates from the most recently published projections for 2019 onwards. The cohort life table takes into account observed and projected improvements in mortality for the cohort throughout its lifetime. Cohort figures are therefore regarded as a more appropriate measure of how long a person of a given age would be expected to live on average than the alternative measure, known as period life expectancy, which is calculated using mortality rates for a fixed period in time (Osabohien, Aderemi, Akindele & Jolayemi, 2021).

Life Expectancy at Birth (LEB) is the mean length of life of a hypothetical cohort assumed to be exposed, from birth through death to the mortality rate observed at a given years (Bayati, Akbarian & Kavosi, 2013). It is a different way of looking at life expectancies is the use of period life expectancies, rather than the cohort life expectancies that we have looked at so far. Period life expectancies use mortality rates from a single year (or group of years) and assume that those rates apply throughout the remainder of a person's life. This means that any future changes to mortality rates would not be taken into account. Period life expectancies are a useful measure of mortality rates experienced over a given period (Romanus, Timothy, Dolapo & Lydia, 2020).. They can provide a baseline against which to benchmark cohort life expectancies.

For past years, they provide an objective way of comparing trends in mortality over time, between areas of a country and with other countries. Official life tables in the UK and in other countries that relate to past years are generally period life tables for these reasons (Sede & Ohemeng, 2015). Cohort life expectancies, even for past years, usually require projected mortality rates for their calculation and so, in such cases, involve an element of subjectivity. Many other types of life expectancy that allow you to make comparisons for different population sub-groups, or to look at how long people might expect to live in good health (healthy life expectancy), are calculated on a period basis.

for boosting life expectancy, Beato (2024) from Babson College, the renowned entrepreneurship institute with champiopreneurship trait laid emphasis on resilience and allyship of champiopreneur, leadership applying business intelligence, creativity and innovation to achieve enterprise excellence. Breato (2024) and Ovharhe (2024) inclined that these factorial elements are expected to augment vital proceedings in empowering, proliferating and advancing infant-childhood, women, youth entrepreneurs in beyond now and SDG towards champiopreneurship.

Independents Variables

In this study, Carbon dioxide emission (Co_2), Nitrous oxide (No_2), Particulate Matter ($PM_{2.5}$) and Government Expenditure on Health (GXH) filled in as the informative factors in the model.

(i) Carbon Dioxide (CO_2)

Carbon dioxide molecules consist of one (1) carbon atom and covalently double bonded two (2) oxygen atoms, it is a colourless gas with a density about 53 higher burning of carbon containing power and other plant matter. The measure of Co_2 at the atmosphere his expended since individuals started consuming a lot of coal and oil in the nineteenth century.

It is expected that an expression in carbon dioxide in Co_2 emanation will diminish life expectancy (LEX).

Therefore, δ LEX, / $\delta\, Co_2 < 0$

(ii). **Nitrous Oxide (N_2O)** Nitrous Oxide, commonly known as laughing gas or nitrous, is a chemical compound having an oxide of nitrogen with the formula in No_2at room temperature. It is colourless non-inflammable gas, with a slight metallic scent and taste. At elevated temperatures nitrous oxide is a powerful oxidizer similar to molecular oxygen.

It is expected that an expansion in No_2 outflow will diminish Life expectancy (LEX). Therefore δLEX/ $\delta No_2 < 0.$

Particulate Matter (($PM_{2.5}$)

The term fine particles or Particulate Matter (($PM_{2.5}$), refers to tiny particles or droplets in the air that are two and one half microns or less in width. Like inches, meters and miles, a micron is a unit o measurement for distance. The worth's of the larger particles in ($PM_{2.5}$) size range would

be thirty times smaller than human hair. The smaller particles are so small that several thousand of them could fit on the period at the end of this sentence. The United State Environmental Protection Agency (EPA) established National Ambient Air Quality standards for ($P_{m2.5}$) in 1997 and revised them in 2006 and 2012. National Ambient Air Standards are established to be protective public health (Zhang *et al.*, 2019).
It is expected that an expansion in $PM_{2.5}$ outflow will diminish Maternal Mortality Rate (MMR). Therefore $\delta MMR / \delta PM_{2.5} < 0$.

(iii). **Government Expenditure on Health**

General government (excluding social security) expenditure on health refers to expenditures incurred by central, state/regional and local government authorities, excluding social security schemes. Included are non-market, non-profit institutions that are controlled and mainly financed by government units (OECD Health Data 2001). General government (excluding social security) expenditure on health refers to expenditures incurred by central, state/regional and local government authorities, excluding social security schemes. Included are non-market, non-profit institutions that are controlled and mainly financed by government units.

Model Specification

The Model Specification of this study is in line with the work of Odusanya (2014) with a slight modification. Odusanya (2014) examined the effect of environmental quality on health care spending in Nigeria within 1960-2011. The study adopts Auto Regressive Distributive Lag (ARDL) bound testing approach to investigate the effects of environmental quality (proxied by CO_2 emission) on health care spending in the long and short run period. Odusanya's base line model states that; LE = f(CO2 , FFC, TEPC, EH).

Where: LE is life expectancy, CO_2 is an emission of carbon dioxide (in kiloton) from consumption of solid, liquid, and gas fuel or burning of bushes, construction industry, manufacturing activities etc. On its turn, FFC is energy consumption from fossil fuels, measured as a percentage of total energy consumption. TEPC represents the total electric power consumption, calculated as the total net consumption of the generating units and measured as in kilowatt-hours (kWh) per capita. EH is used to capture government health expenditure and is measured as the proportion of total government expenditure spent on healthcare.

The point of emphasis was the nexus between real per capita health expenditure and per capita Co_2 emissions in Nigeria. But this study deviates from this scholars by designing three models, while the former is a single model. In this investigation the present study disaggregated health outcome into life expectancy.

Model
Life Expectancy (LEX) is a function of carbon dioxide (CO_2), nitrous oxide (N_2O) Particulate Matter ($PM_{2.5}$) and Government Expenditure on Health (GXH)
Thus the functional form of the models are as follows:

Model one (Life expectancy model)

$LEX= f(CO_2, N_2O, PM_{2.5}, GXH)$ ………………………………... equ (a)

Where;
LEX=Life expectancy rate
CO_2= Carbon dioxide
N_2O = Nitrous oxide
$PM_{2.5}$= Particulate Matter
GXH=Government Expenditure on Health
Econometrically, equation (3.1) is specified as

Model one

$LEX= \beta_0+ \beta_1 Co_2+ \beta_2 N_2O + \beta_3PM_{2.5}+ \beta_4GXH+\mu$………….………. equ (b)

Where;

LEX, CO_2, N_2O, $PM_{2.5}$ and GXH are as earlier defined.

β_0=intercept

β_1- β_4, α1-α4 and π1-π4 are coefficient of the independent variable

μ1, μ2 and μ3 are stochastic term /error term and CO_2, N_2O, $PM_{2.5}$, GXH, LEX remained as defined above. It is expected that these variables will reduce life expectancy, Thus, a priori expectation are β_1-β_3 AND $\beta_4 < 0$

The study adopts descriptive statistics and unit root test to estimate the link between environmental pollution and health outcomes in Nigeria. The study applied Toda-Yamamoto estimation technique due to the result of the unit root test.

4. RESULTS AND DISCUSSION

The E-view analysis was focused on 1981-2019, whereas, the review analysis capture from 2020-2023.

Presentation of Data

The trend of Nigerian's Life Expectancy (LEX), Carbon dioxide emission (CO_2), Nitrous oxide (N_2O) Particulate Matter ($PM_{2.5}$) and Government Expenditure on Health (GXH) are presented in table

Data on the variables-LEX, CO_2, N_2O, PM2.5 and GXH (1981-2019).

Periods	LEX	CO2	N2O	PM2.5	GXH
1981	45.637	0.87430925	12780.45	-	0.0844575
1982	45.867	0.84727766	13501.08	-	0.0959464

1983	46.023	0.75464209	13395.68	-	0.0827864
1984	46.106	0.85483601	13538.73	-	0.1015487
1985	46.127	0.83641324	13298.3	-	0.1320247
1986	46.101	0.85703744	13570.2	-	0.1341245
1987	46.048	0.67398509	13732.02	-	0.0413145
1988	45.99	0.78264527	13736.39	-	0.4228
1989	45.939	0.45740662	14471.62	-	0.5753
1990	45.9	0.41167477	15542.51	81.46689	0.5007
1991	45.875	0.43282688	14410.89	81.46689	0.6182
1992	45.857	0.46539645	15448.26	81.46689	0.1501607
1993	45.845	0.43950119	15623.45	81.46689	3.8716009
1994	45.843	0.33429857	15488.74	81.46689	2.0939837
1995	45.854	0.31201403	15799.47	77.88861	3.3207
1996	45.88	0.33479508	15706.91	77.88861	3.0237074
1997	45.923	0.36379871	15980.87	77.88861	3.8910988
1998	45.994	0.326916	16325.98	77.88861	4.7422667
1999	46.103	0.3341685	16131.27	77.88861	16.638773
2000	46.267	0.64704259	16230.62	74.50545	15.218082
2001	46.51	0.69395568	17581.17	74.50545	24.522272
2002	46.835	0.73553254	16007.71	74.50545	40.621417
2003	47.242	0.76055829	15776.91	74.50545	33.267982
2004	47.72	0.7315821	16738.24	74.50545	34.198484
2005	48.252	0.76419041	16555.54	59.98227	55.662997
2006	48.812	0.68921072	26531.11	59.98227	62.253622
2007	49.373	0.64827779	37938.31	59.98227	81.909366
2008	49.913	0.63876777	31494.46	59.98227	98.219319
2009	50.422	0.49298093	33,571	59.98227	90.2
2010	50.896	0.72017502	35475.2	51.52977	99.1
2011	51.346	0.80885464	35829.9	53.37225	231.8
2012	51.786	0.71165279	36184.7	50.09322	197.9
2013	52.228	0.72383244	35829.93	46.39325	179.98693
2014	52.672	0.73768261	35948.18	41.60273	195.97678
2015	53.112	0.64000315	35987.6	115.124	257.7
2016	53.541	0.64728484	35921.9	122.4784	200.82399
2017	53.95	0.6749902	35953.56	93.07	245.18802
2018	54.332	0.65409273	35954.35	72.8555891	296.44279
2019	54.687	0.65878926	35943.27	72.0078815	388.36714

Note: LEX = Life Expectancy
CO_2 = Carbon dioxide Emission
N_2O = Nitrous oxide
$PM_{2.5}$ = Particulate matter
GXH = Government Expenditure on Health

Source: World Development Indicators (2019) and CBN statistical bulletin (2019).
NB: The E-view analysis was focused on 1981-2019, whereas, the review analysis capture from 2020-2023.

Empirical Analysis for Life Expectancy Rate (LEX), Model.

i. Unit Root Test for Life Expectancy (LEX) model one

Table below presents result of stationarity test of variable used in life expectancy model using Augmented Dickey Fuller (ADF) and Kwiatkowski-Phillips-Schmidt-Stim (KPSS) test.

Augmented Dicker Fuller (ADF) Unit Root Test Result on Life Expectancy (LEX) models one.

Variables	ADF at level	ADF at 1st	ADF at 2nd differences	Status	Remark
LEX	-1.118962	-1.142225	-4.051249	1(2)	Stationary
CO_2	-2.173144	-6.810304		1 (1)	Stationary
N_2O	-0.533224	-5.661445		1(1)	Stationary
$PM_{2.5}$	-3.239679	-		1(0)	Stationary
GXH	-2.994850	2.034424	-3.924636	1(1)	Stationary
CRITICAL VALUES					
1%	-3.632900	-3.632900	-3.632900		
5%	-2.948404	-2.948404	-2.948404		
10%	-2.612874	-2.612874	-2.612874		

Source: Author's Computation

Kwiatkowski-Phillips-Schmidt-Stim (KPSS)Unit Root Test result for Life Expectancy (LEX) model

Variables	KPSS at level	KPSS at 1st	KPSS at 2nd differences	Status	Remark
LEX	0.655776	0.541281	0.188970	1(2)	Stationary
CO_2	0.129624			1(0)	Stationary
N_2O	0.644024	0.104490		1(1)	Stationary
$PM_{2.5}$	0.161337			1(0)	Stationary

GXH	0.650704	0.687235	0.312066	1(2)	Stationary
CRITICAL VALUES					
1%	0.739000	0.739000	0.739600		
5%	0.463000	0.463000	0.463000		
10%	0.347000	0.347000	0.347000		

Source: Author's computation

The outcome of the unit root test ADF table of for Life Expectancy (LEX) model reveals that LEX was stationary at second difference I(2), CO_2, N_2O and GXH were stationary at first difference I(1), while $PM_{2.5}$ were stationary at level 1(O).

Hence, the study conclude that the variables used in the life expectancy model (LEX) were integrated of different order integration, that is, I(2), I(1) and 1(O).

The result of the KPSS presented in table 4.4 Reveals that LEX and GXH were stationary at second difference I(2), CO_2 and $PM_{2.5}$ were stationary at level I(O), while N_2O is stationary at first difference I(1). Hence the study proceed to conduct the Toda Yamamoto Casualty test for Life Expectancy Rate (LEX).

Toda-Yamamoto Estimation result for Life Expectancy (LEX) Model

Dependent variable: LEX

Excluded	Chi-sq	Df	Prob.
CO2	5.069375	2	0.0793
N2O	2.760373	2	0.2515
PM25	0.018749	2	0.9907
GXH	3.839008	2	0.1467
All	32.54339	8	0.0001

Dependent variable: CO2

Excluded	Chi-sq	Df	Prob.
LEX	11.00384	2	0.0041
N2O	0.458490	2	0.7951
PM25	0.332499	2	0.8468
GXH	0.307728	2	0.8574
All	13.15548	8	0.1066

Dependent variable: N2O

Excluded	Chi-sq	Df	Prob.
LEX	7.753813	2	0.0207
CO2	1.452733	2	0.4837
PM25	6.581320	2	0.0372
GXH	1.103866	2	0.5758
All	10.72882	8	0.2175

Dependent variable: PM25

Excluded	Chi-sq	Df	Prob.
LEX	46.02048	2	0.0000
CO2	3.357062	2	0.1866
N2O	20.42167	2	0.0000
GXH	15.46331	2	0.0004
All	260.7803	8	0.0000

Dependent variable: GXH

Excluded	Chi-sq	Df	Prob.
LEX	1.570200	2	0.4561
CO2	3.841791	2	0.1465
N2O	2.505699	2	0.2857
PM25	10.47078	2	0.0053
All	64.24331	8	0.0000

Source: Authors computation

From table the result of the Toda-Yamamoto causality test shows that CO_2, N_2O, $PM_{2.5}$ and GXH show no causality with LEX; N_2O, $PM_{2.5}$ and GXH show no causality with CO_2; CO_2 and GXH show no causality with N_2O; CO_2 Show no causality with $PM_{2.5}$; LEX, CO_2, and N_2O show no causality with GXH, Also, the study find that there is a unidirectional causality which run strictly from LEX to CO_2, LEX to N_2O, $PM_{2.5}$ to N_2O, LEX to $PM_{2.5}$, N_2O to $PM_{2.5}$, GXH to $PM_{2.5}$ and $PM_{2.5}$ to GXH.

Discussion of Result for Life Expectancy (LEX) model one(1)

(i) Relationship between Carbon dioxide (CO_2), Nitrous Oxide (N_2O), Particulate Matter ($PM_{2.5}$) and Government Expenditure on Health (GXH) on Life Expectancy (LEX) in Nigeria.

From the results of the Toda-Yamamoto Causality test the study reveals that there is no causal relationship between Carbon dioxide (CO_2) and Life Expectancy (LEX) with direction from Carbon dioxide (CO_2) to Life Expectancy (LEX) in Nigeria within the period of study. This is shown by the chi-square value of 5.069375 and probability value of 0.0793 which is greater than 0.05 percent. This implies that carbon dioxide (CO_2) emission does not contribute or result to a reduction in life Expectancy (LEX) in Nigeria during the period of study.

(ii) Nitrous Oxide (N_2O) and Life Expectancy (LEX) in Nigeria.

The result of the Toda-Yamamoto causality test reveals that there is no causal relationship between Nitrous oxide (N_2O) and life Expectancy (LEX) with direction from Nitrous Oxide (N_2O) to Life Expectancy (LEX) in Nigeria within the period of study. This is shown by the chi-square value of 2.760373 and probability value of 0.2515 which is greater than 0.05 percent. This implies that Nitrous oxide does not contribute or result to a reduction in Life Expectancy (LEX) in Nigeria during the period of study.

(iii) Particulate Matter ($PM_{2.5}$) and Life Expectancy (LEX) in Nigeria

The result of the Toda-Yamamoto causality test reveals that there is no causal relationship between Particulate Matter ($PM_{2.5}$) and life Expectancy (LEX) with direction from Particulate Matter ($PM_{2.5}$) to Life Expectancy (LEX) in Nigeria within the period of study. This is shown by the chi-square value of 0.018749 and probability value of 0.9907 which is greater than 0.05 percent. This implies that Particulate Matter ($PM_{2.5}$) does not contribute or result to a reduction in Life Expectancy (LEX) in Nigeria during the period of study.

(iv) Government Expenditure on Health (GXH) and life Expectancy in Nigeria

The result of the Toda-Yamamoto causality test reveals that there is no causal relationship between Government Expenditure on Health (GXH) and life Expectancy (LEX) with direction from Government Expenditure on Health (GXH) to Life Expectancy (LEX) in Nigeria within the period of study. This is shown by the chi-square value of 3.839008 and probability value of 0.1467 which is greater than 0.05 percent. This implies that Government Expenditure on Health (GXH) does not contribute or result to a reduction in Life Expectancy (LEX) in Nigeria during the period of study.

(v) Life Expectancy (LEX) and carbon dioxide (CO2) in Nigeria.

The result of the Toda-Yamamoto causality test reveal that causality exit between Life Expectancy (LEX) and Carbon dioxide (CO_2) emission in Nigeria during the period of study or there exist a unidirectional casualty which run strictly from (LEX) to CO_2 with chi-square value of 11.00385 and probability value of 0.0041. This implies that increase in Life Expectancy (LEX) result to an increase in the emission of Carbon dioxide (CO_2) in Nigeria during the period of study.

(vi)**Nitrous Oxide (N_2O) and Carbon Dioxide (CO_2) in Nigeria.**

The result of the Toda-Yamamoto causality test reveals that there is no causal relationship between Nitrous Oxide and Carbon dioxide (CO_2) in Nigeria during the period of study. This is shown by the chi-square value of 0.458490 and probability value of 0.7951. However since the probability value is greater than 0.05% this implies that Carbon dioxide (CO_2) emission does not contribute to Nitrous Oxide (N_2O) emission in Nigeria during the period of study.

(vii) **Particulate Matter ($PM_{2.5}$) and Carbon dioxide (CO_2) Emission in Nigeria**

The result of the Toda-Yamamoto causality test reveals that there is no causal relationship between Particulate Matter ($PM_{2.5}$) and Carbon dioxide (CO_2) in Nigeria during the period of study. This is shown by the chi-square value of 0.332499 and probability value of 0.8468. Consequently, since the probability value of 0.8468 is greater than 0.05%. This implies that Particulate Matter ($Pm_{2.5}$) does not contribute or result to Carbon dioxide(CO_2) emission in Nigeria during the period of study.

(viii) **Government Expenditure on Health and Carbon dioxide (CO_2) in Nigeria.**

The result of the Toda-Yamamoto causality test reveals that there is no causal relationship between Government Expenditure on Health (GXH) and Carbon dioxide emission in Nigeria during the period of study. This is shown by the chi-square value of 0.307728 and probability value of 0.8574. However, since the probability value is greater than 0.05% percent, the implication is that Government Expenditure on Health (GXH) does not contribute to Carbon dioxide (CO_2) emission in Nigeria during the period of study.

(ix) **Life Expectancy (LEX) and Nitrous oxide (N_2O) in Nigeria**.

The result of the Toda-Yamamoto causality test reveal that causality exit between Life Expectancy (LEX) and Nitrous oxide (N_2O) emission in Nigeria during the period of study or there exist a unidirectional casualty which run strictly from (LEX) to N_2O with chi-square value of 7.753813 and probability value of 0.0207.This implies that increase in Life Expectancy (LEX) result to an increase in the emission of Nitrous oxide (N_2O) in Nigeria during the period of study

Empirical Analysis for Life Expectancy Rate (LEX), model one.

ii. Unit Root Test for Life Expectancy (LEX) model one

Table below presents result of stationarity test of variable used in life expectancy model using Augmented Dickey Fuller (ADF) and Kwiatkowski-Phillips-Schmidt-Stim (KPSS) test.

Augmented Dicker Fuller (ADF) Unit Root Test Result on Life Expectancy (LEX) models one.

Variables	ADF at level	ADF at 1st	ADF at 2nd differences	Status	Remark
LEX	-1.118962	-1.142225	-4.051249	1(2)	Stationary
CO_2	-2.173144	-6.810304		1 (1)	Stationary
N_2O	-0.533224	-5.661445		1(1)	Stationary
$PM_{2.5}$	-3.239679	-		1(0)	Stationary
GXH	-2.994850	2.034424	-3.924636	1(1)	Stationary
CRITICAL VALUES					
1%	-3.632900	-3.632900	-3.632900		
5%	-2.948404	-2.948404	-2.948404		

10%	-2.612874	-2.612874	-2.612874

Source: Author's Computation

Kwiatkowski-Phillips-Schmidt-Stim (KPSS)Unit Root Test result for Life Expectancy (LEX) model one

Variables	KPSS at level	KPSS at 1st	KPSS at differences	2nd Status	Remark
LEX	0.655776	0.541281	0.188970	1(2)	Stationary
CO_2	0.129624			1(0)	Stationary
N_2O	0.644024	0.104490		1(1)	Stationary
$PM_{2.5}$	0.161337			1(0)	Stationary
GXH	0.650704	0.687235	0.312066	1(2)	Stationary
CRITICAL VALUES					
1%	0.739000	0.739000	0.739600		
5%	0.463000	0.463000	0.463000		
10%	0.347000	0.347000	0.347000		

Source: Author's computation

The outcome of the unit root test ADF table of for Life Expectancy (LEX) model 4.3 reveals that LEX was stationary at second difference I(2), CO_2, N_2O and GXH were stationary at first difference I(1), while $PM_{2.5}$ were stationary at level 1(O).

Hence, the study conclude that the variables used in the life expectancy model (LEX) were integrated of different order integration, that is, I(2), I(1) and 1(O).

The result of the KPSS presented in table 4.4 Reveals that LEX and GXH were stationary at second difference I(2), CO_2 and $PM_{2.5}$ were stationary at level I(O), while N_2O is stationary at first difference I(1). Hence the study proceed to conduct the Toda Yamamoto Casualty test for Life Expectancy Rate (LEX).

Toda-Yamamoto Estimation result for Life Expectancy (LEX) model one

Dependent variable: LEX

Excluded	Chi-sq	Df	Prob.
CO2	5.069375	2	0.0793

N2O	2.760373	2	0.2515
PM25	0.018749	2	0.9907
GXH	3.839008	2	0.1467
All	32.54339	8	0.0001

Dependent variable: CO2

Excluded	Chi-sq	Df	Prob.
LEX	11.00384	2	0.0041
N2O	0.458490	2	0.7951
PM25	0.332499	2	0.8468
GXH	0.307728	2	0.8574
All	13.15548	8	0.1066

Dependent variable: N2O

Excluded	Chi-sq	Df	Prob.
LEX	7.753813	2	0.0207
CO2	1.452733	2	0.4837
PM25	6.581320	2	0.0372
GXH	1.103866	2	0.5758
All	10.72882	8	0.2175

Dependent variable: PM25

Excluded	Chi-sq	Df	Prob.
LEX	46.02048	2	0.0000
CO2	3.357062	2	0.1866
N2O	20.42167	2	0.0000
GXH	15.46331	2	0.0004
All	260.7803	8	0.0000

Dependent variable: GXH

Excluded	Chi-sq	Df	Prob.
LEX	1.570200	2	0.4561
CO2	3.841791	2	0.1465
N2O	2.505699	2	0.2857

PM25	10.47078	2	0.0053
All	64.24331	8	0.0000

Source: Authors computation

From table the result of the Toda-Yamamoto causality test shows that CO_2, N_2O, $PM_{2.5}$ and GXH show no causality with LEX; N_2O, $PM_{2.5}$ and GXH show no causality with CO_2; CO_2 and GXH show no causality with N_2O; CO_2 Show no causality with $PM_{2.5}$; LEX, CO_2, and N_2O show no causality with GXH, Also, the study find that there is a unidirectional causality which run strictly from LEX to CO_2, LEX to N_2O, $PM_{2.5}$ to N_2O, LEX to $PM_{2.5}$, N_2O to $PM_{2.5}$, GXH to $PM_{2.5}$ and $PM_{2.5}$ to GXH.

-Discussion of Result for Life Expectancy (LEX) Model

(i) Relationship between Carbon dioxide (CO_2), Nitrous Oxide (N_2O), Particulate Matter ($PM_{2.5}$) and Government Expenditure on Health (GXH) on Life Expectancy (LEX) in Nigeria.

From the results of the Toda-Yamamoto Causality test the study reveals that there is no causal relationship between Carbon dioxide (CO_2) and Life Expectancy (LEX) with direction from Carbon dioxide (CO_2) to Life Expectancy (LEX) in Nigeria within the period of study. This is shown by the chi-square value of 5.069375 and probability value of 0.0793 which is greater than 0.05 percent. This implies that carbon dioxide (CO_2) emission does not contribute or result to a reduction in life Expectancy (LEX) in Nigeria during the period of study.

(ii) Nitrous Oxide (N_2O) and Life Expectancy (LEX) in Nigeria.

The result of the Toda-Yamamoto causality test reveals that there is no causal relationship between Nitrous oxide (N_2O) and life Expectancy (LEX) with direction from Nitrous Oxide (N_2O) to Life Expectancy (LEX) in Nigeria within the period of study. This is shown by the chi-square value of 2.760373 and probability value of 0.2515 which is greater than 0.05 percent. This implies that Nitrous oxide does not contribute or result to a reduction in Life Expectancy (LEX) in Nigeria during the period of study.

(iii) Particulate Matter ($PM_{2.5}$) and Life Expectancy (LEX) in Nigeria

The result of the Toda-Yamamoto causality test reveals that there is no causal relationship between Particulate Matter ($PM_{2.5}$) and life Expectancy (LEX) with direction from Particulate Matter ($PM_{2.5}$) to Life Expectancy (LEX) in Nigeria within the period of study. This is shown by the chi-square value of 0.018749 and probability value of 0.9907 which is greater than 0.05 percent. This implies that Particulate Matter ($PM_{2.5}$) does not contribute or result to a reduction in Life Expectancy (LEX) in Nigeria during the period of study.

(iv) Government Expenditure on Health (GXH) and life Expectancy in Nigeria

The result of the Toda-Yamamoto causality test reveals that there is no causal relationship between Government Expenditure on Health (GXH) and life Expectancy (LEX) with direction from Government Expenditure on Health (GXH) to Life Expectancy (LEX) in Nigeria within the period of study. This is shown by the chi-square value of 3.839008 and probability value of

0.1467 which is greater than 0.05 percent. This implies that Government Expenditure on Health (GXH) does not contribute or result to a reduction in Life Expectancy (LEX) in Nigeria during the period of study.

(v) Life Expectancy (LEX) and carbon dioxide (CO2) in Nigeria.
The result of the Toda-Yamamoto causality test reveal that causality exit between Life Expectancy (LEX) and Carbon dioxide (CO_2) emission in Nigeria during the period of study or there exist a unidirectional casualty which run strictly from (LEX) to CO_2 with chi-square value of 11.00385 and probability value of 0.0041. This implies that increase in Life Expectancy (LEX) result to an increase in the emission of Carbon dioxide (CO_2) in Nigeria during the period of study.
(vi)**Nitrous Oxide (N_2O) and Carbon Dioxide (CO_2) in Nigeria.**
The result of the Toda-Yamamoto causality test reveals that there is no causal relationship between Nitrous Oxide and Carbon dioxide (CO_2) in Nigeria during the period of study. This is shown by the chi-square value of 0.458490 and probability value of 0.7951. However since the probability value is greater than 0.05% this implies that Carbon dioxide (CO_2) emission does not contribute to Nitrous Oxide (N_2O) emission in Nigeria during the period of study.
(vii) **Particulate Matter ($PM_{2.5}$) and Carbon dioxide (CO_2) Emission in Nigeria**
The result of the Toda-Yamamoto causality test reveals that there is no causal relationship between Particulate Matter ($PM_{2.5}$) and Carbon dioxide (CO_2) in Nigeria during the period of study. This is shown by the chi-square value of 0.332499 and probability value of 0.8468. Consequently, since the probability value of 0.8468 is greater than 0.05%. This implies that Particulate Matter ($Pm_{2.5}$) does not contribute or result to Carbon dioxide(CO_2) emission in Nigeria during the period of study.
(viii) **Government Expenditure on Health and Carbon dioxide (CO_2) in Nigeria.**
The result of the Toda-Yamamoto causality test reveals that there is no causal relationship between Government Expenditure on Health (GXH) and Carbon dioxide emission in Nigeria during the period of study. This is shown by the chi-square value of 0.307728 and probability value of 0.8574. However, since the probability value is greater than 0.05% percent, the implication is that Government Expenditure on Health (GXH) does not contribute to Carbon dioxide (CO_2) emission in Nigeria during the period of study.
(ix) **Life Expectancy (LEX) and Nitrous oxide (N_2O) in Nigeria**.
The result of the Toda-Yamamoto causality test reveal that causality exit between Life Expectancy (LEX) and Nitrous oxide (N_2O) emission in Nigeria during the period of study or there exist a unidirectional casualty which run strictly from (LEX) to N_2O with chi-square value of 7.753813 and probability value of 0.0207.This implies that increase in Life Expectancy (LEX) result to an increase in the emission of Nitrous oxide (N_2O) in Nigeria during the period of study.

5. Conclusions and Recommendations

5.1 Conclusion
The study examined the health outcomes of environmental pollution in Nigeria spanning from 1981-2019. In order to achieve the objectives annual time series data of Life Expectancy (LEX)

which was modeled as the response variables and Carbon dioxide emission (CO_2), Nitrous Oxide (N_2O), Particulate Matter of less than 2.5 diameter $PM_{2.5}$ and Government Expenditure on Health (GXH) which acted as the explanatory variable The analysis was carried out using Toda-Yamamoto modeling technique to establish the result.

From the findings of the study it could be concluded on the basis of which appropriate policy recommendation were proffered as follows:

i. Carbon dioxide (CO_2) does not have a casual effect on life expectancy in Nigeria during the period of study. Implying that carbon dioxide emission (CO_2) does not result to a reduction in life expectancy in Nigeria during the period of study.
ii. Nitrous Oxide does not result to a reduction in life Expectancy (LEX) in Nigeria during the period of study. Implying that Nitrous Oxide (N_2O) does not result to a reduction in Life Expectancy (LEX) in Nigeria during the period of study.
iii. Particulate Matter ($PM_{2.5}$) emission does not have a causal effect on Life Expectancy (LEX) in Nigeria within the period of study. Implying that Particulate Matter ($PM_{2.5}$) emission in Nigeria does not result to a reduction in Life Expectancy in Nigeria.
iv. Government Expenditure on Health does not have a causal effect on Life Expectancy in Nigeria in the period of study. Implying that Government Expenditure in health (GXH) does not result to a reduction in life expectancy in Nigeria during the period of study.
v. Life expectancy has a casual effecton Nitrous oxide (N_2O) emission in Nigerians during the period of study. Implying that increase in life. Expectancy in Nigeria result to continuous emission of Nitrous oxide (N_2O) in Nigeria within the period of study.
vi. Life expectancy (LEX) has a causal effect on Particulate Matter ($PM_{2.5}$) in Nigeria during the period of study. Implying that increase in life expectancy in Nigeria result to continuous emission of particulate matter in Nigeria during the period of study.
vii. Particulate Matter ($PM_{2.5}$) has a causal effect on Government Expenditure on Health (GXH) in Nigeria during the period of study. Implying that increasein Particulate Matter ($PM_{2.5}$) emission result the government to make expenditure on health.

Having examined the target variables, the findings according to Toda-Yamamoto estimation technique reveals that environmental pollution did not result to a reduction in life expectancy in Nigeria during the period of study in Nigeria. Consequently, despite the target variables additional findings using the Toda-Yamamoto estimation technique reveals as follows; Life expectancy (LEX) has a causal effect on Carbon dioxide (CO_2) emission in Nigeria during the period of study. Implying that increase in life expectancy (LEX) result to continuous emission of Carbon dioxide (CO_2) in Nigeria in the period of study.
Environmental pollution increase in life expectancy contributes to environmental pollution in Nigeria.
Nevertheless, the current life expectancy for Nigeria in 2023 is 55.75 years, a 0.57% increase from 2022. The life expectancy for Nigeria in 2022 was 55.44 years, a 0.57% increase from 2021. Whereas, Monaco, Iceland and Japan are among the top three countries with the lowest infant mortality rates with around 2 infant deaths per 1,000 infants within their first year of life. Generally, the countries with the lowest infant mortality also have some of the highest average

life expectancy.

5.2. Recommendations

The following recommendations are made based on the findings of the study.

i. Products that utilize solar energy, wind energy, Hydro energy and other renewable product should be made tax free, in order to encourage mass production.

ii. Tree planting is one of the best means of mitigating the impact of environmental pollution because of its absorptive nature. On this note, tree planting should be made a priority in the local, state and federal levels.

iii. The presence of Atmospheric Particulate matter ($PM_{2.5}$) is not healthy for any country. On this premise, the government should through the Ministry of health sensitize the public on the dangers of the pollutants.

iv. The government should implement the gas flaring prohibition act promulgated in 2005 and strongest penalty be melted on any company that flout the law.

v. Green entrepreneurship should be promoted for the sustainability, survival and success of intrapreneurs in line with the people, planet and profit both in the short-term and long-term.

5.3 Contribution to Knowledge

This study contributes to knowledge in the following ways:

The study investigates the effects of environmental pollution on health outcomes in Nigeria. The study specifically takes into consideration pollution impacts on life expectancy, maternal mortality and infant mortality in Nigeria spanning over a period of 1981 to 2019.

The findings of the study reveals that environmental pollution does not impact on life expectancy of Nigeria within the period of study (1981-2019/2020-2023) but rather increase in life expectancy reveal a negative impact on the environment.

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