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# THE INDUSTRIALIZATION AND ENVIRONMENTAL HEALTH NEXUS IN NIGERIA

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## Abstract

*Experience has shown that industry is a major catalyst that drives the engine of economic growth and development. It is in recognition of this that nations world over have pursued and continue to pursue policies and programmes that encourage the rapid industrialization of their respective economies. Nigeria, for instance has pursued the goal of industrialization since the 1960s and even so, more rigorously since the 1970s through the indigenization policy; among others. No doubt, the process of resource utilization which is the orb of industrialization involves interaction with and transformation of some aspects of both the natural and man-made environment. This process is usually accompanied with some pathological and physiological impacts that are potentially hazardous to human health and wellbeing. Sadly, however, the various attempts at and phases of industrialization in Nigeria have paid only very little attention to issues bothering on environmental health. Such lopsided pattern of industrialization which tends to target only economic and social dimensions at the expense of the environment from which resources are derived have posed considerably serious challenges to human health. Given the critical role that the health status of individuals play in their contribution to national productivity, it becomes imperative that any meaningful attempt at industrialization will only be sustainable by a trade-off between the pursuit of the benefits of a higher level of industrialization and environmental degradation. Such trade-offs will necessarily require that while pursuing efficient production and marketing goals, industries should as well give priority considerations to environmental and human health protection. The question, therefore is; "to what extent can the goal of industrialization be achieved without constituting a menace to environmental health?" The objective of this study is to examine the extent to which industrial activities impact on the environment and human health. Data collected from various secondary sources for the period 1981 to 2015 would be analysed with the Co-integration and Error-Correction Mechanism. It is expected that the findings will reveal the link between industrialisation and the state of well-being of the environment thus*

*underscoring the imperative of environmental preservation in the quest for industrial development and economic growth and development.*

***Keywords:*** *Industrialization, Environment, Health, Co-integration, ECM, Industrial Development, Economic Growth and Nigeria*

## Introduction

Industrialization plays a pivotal role in the economic development of any nation. Rapid growth in industrial productivity attributed to the introduction of new and more efficient technologies has been closely associated with environmental pollution and degradation. The discharge of hazardous industrial wastes into land, water and air poses serious environmental health challenges in many parts of the world especially the less developed countries where appropriate technological methods of converting such hazardous wastes to other useful production and consumption materials are still largely elusive. Industrial processes which involve extracting and transforming natural resources into finished products constitute direct interference with the physical environment and by so doing generate toxic effluents that negatively impact on the health status of the human population.

The unsustainable human development activities of the past, which focus on economic and social elements to the neglect of the environment, have caused serious ecological and human health problems and worsened poverty in the process especially in third world countries (Osibanjo, 2014). Available data on industrial practices and their impact on the environment in Sub-Saharan Africa, shows that the aggregate volume of industrial pollution is relatively small when compared in with the overall size of the industry, however, pollution intensity is among the highest when controlling for other factors such as the level of development or size of the economy (UNIDO, 2004).

Asad, et al, (2013) defined the environment as the sum of all physical and social circumstances that surround a person and can affect that person's health and a healthy environment as one which provides the individual with chances for safety and social interface that enhance their health and wellbeing. They also asserted that a healthy worker is the key factor for maintainable social and economic growth because he contributes substantially to the wealth of the industries**.** The most widely acceptable definition of health attributed to the World Health Organization (WHO) emphasizes "a state of complete physical, mental and social wellbeing" (WHO, 1948). This unique combination of physical, mental and social wellness is sin qua non for any individual's meaningful contribution to productivity and economic growth. Given the key role that the health status of a nation plays in efficient capacity utilization and consequently, nation building, it becomes imperative that anything that impacts on people's health should command considerable attention. Sadly, however, that is hardly the case with the toxic effluents resulting from industrial activities and which badly degrade our environment and pose serious health challenges to the human populace.

In a bid to checkmate this menace and to safeguard the quality of life of present and future generations, some have recommended policy initiatives that will maintain and/or improve on the quality of the environment, the installation of pollution-control equipment, the spreading of industries away from already congested areas, the initiation of environmental impact and epidemiological studies in polluted areas, a radical change in the existing methods of industrial production and the pattern of consumption etc.

The requirement of Environmental Impact Statement before development under the Federal The Environmental Protection Act of 1987 initiated by the federal government of Nigeria is a very laudable initiative towards the control of the hazardous effects of industrial pollution. However, many years after the promulgation of this law, many communities are still having to live with serious environmental challenges due to industrial activities implying continuous depletion of environmental resources, pollution of surface and underground water, and visual ugliness among others. All these have considerable implication on well-being and health of communities where such industries are located (Afolabi, et al, 2012).

## The Literature

This section focuses on the review of some studies that have attempted to establish the relationship between industrialization and environmental health as well as environmental health; beginning with some conceptual clarifications.

Last (1995) defined environment as the physical, biological, social, and cultural factors (all of which are external to the individual host), which can influence health status in populations. Environment thus includes such elements like land, water, atmosphere, vegetation, climate, animals and plants surrounding the human population and the interrelationships which exists among them.

Moeller (2005) defined environmental health in its broadest sense, as "the segment of public health that is concerned with assessing, understanding, and controlling the impacts of people on their environment and the impacts of the environment on them". Environmental health as an integral branch of public health thus focuses on those aspects of both the natural and manmade environment including quality of life, that are determined by physical, biological, social, and psychosocial factors that may impact on human health.

Environmental health hazards are many and largely varied. Afolabi, et.al. (2012) have identified continuous depletion of environmental resources, pollution of surface and underground water, and visual ugliness as environmental health hazards which have considerable implication on the health and well-being of persons and communities where industries are located.

Traditional environmental health hazards include malaria, safe drinking water, and basic sanitation, while modern environmental health hazards include pesticides, air toxics, and heavy metals such as Pb and Hg, some of which are readily available in such

consumer goods as food items, herbal remedies, household paint, and crayons (Nweke &Sanders, 2009).

Other forms of environmental hazards associated with industrial activities have been identified as noise, vibrations, greenhouse effect, radiation, chemicals like chromium compounds, electromagnetic radiation and microbiological and social problems like stress and fatigue (Magsi, 2015).

It has been asserted that all human activities carried out for the purpose of meeting social needs and advancing the course of economic growth of a country have direct and indirect impacts on the environment (Awan, 2013). Industrial activities constitute a major source of such influence on the environment. Moeller (2005) noted that all over the world there has been a continuous decline in the quality of life in urban centres, implying that many cities especially those that are heavily industrialized are now considerably noisy, congested, frustrating, and unhealthy. Thus, the need for sustaining environmental quality in the course of exploration and utilization of resources cannot be overemphasized.

In the course of time, industrial activities have impacted on the environmental health. The literature is replete with studies on the impact of industrialization on the environment, health and wellbeing of the in-dwelling human population. Some of the studies focused on the positive impacts of industrialization on environmental health while others focused on the negative consequences of same.

McMichael (2000), asserted that the combination of industrialization, crowding, waste generation, dense transport systems, compounded by poverty in both developing countries the inner urban cities of developed countries accounts for a number of environmental health hazards. He furthers identified three pathways through which the urban industrialized environment impacts on human health, namely; the social changes such as high levels of tobacco smoking and alcohol drinking, rape and murder, traffic injuries, fatalities, depression and adult obesity which alter the behavioural based risks to health; the exposure of the physical environment to various microbiological and chemical hazards such as, respiratory and enteric infections, infections and diseases which result from poor sanitation, unsafe drinking-water, dangerous roads, polluted air and inadequate sewage and solid wastes removal system; and the disruption of the life-support systems of the biosphere.

Some policies, practices and technologies designed and implemented for the purpose of promoting wellbeing and economic development often result in unintended adverse environmental health consequences. Such is the case with industrial activities especially in societies where there are no appropriate policies in place to ensure environmental protection.

Alege and Ogundipe ( 2013) posited that growth in industrial activities is associated with increases in environmental damage as a result of more intensive use of natural resources, more emission of toxic substances, the use of more efficient but relatively

dirty technologies, and the pursuit of higher productivity in output and without recourse to the environmental consequences of such advancement.

McMichael (2000) asserts that the general absence of air quality controls in the industrialized cities of the developed nations, particularly 20th century Europe and North America led to the increased levels of air pollution. As a result, new legislations were instituted and subsequently, the nations remarkable drop in air pollution from air pollutants such as smoke emissions William Blacks' "dark satanic mills" and sulphur dioxide emissions.

Afolabi, et. al (2012), using survey method and frequency distribution analytical tool, that other residents in Ewekoro community where a cement factory is located, were exposed to land, water, air and noise pollution resulting with prevalence of such ailments like asthma, heart diseases, skin cancer and diarrhoea. The implication of these findings is that citing certain kinds of industries near residential areas without appropriate measures in place to minimize their environmental impacts often exposes the residents to some health and environmental challenges. This suggests the need for the control of dust, vibrations and other emissions, retrieval and transformation of quarry sites into parks and gardens, provision of super active dust control equipment, and the implementation of Environmental Impact Assessment of cement industries.

In a related study in Bhalwal, Pakistan, Asad, et al (2013), found out that the health of factory workers is badly affected because they usually worked long hours in unsafe conditions without using protective devices and are therefore highly vulnerable to chemical pollution, noise pollution, air pollution and excessively high temperatures, all of which give room for various ailments and diseases. This implies that working conditions as well as the state of the physical environment in which industries are located have a direct relationship with the state of health of the workers. They, therefore, recommend that facilities that enhance health should be made assessable to workers, while simultaneously reducing their burden of excess physical workload.

## Theoretical Framework*

The IPAT framework is the take-off point of this study. It was developed in a seminal paper by Ehrlich and Holdren (1971). This is the basis for the Fang, Miller and Teh (2012) proposed empirical framework and is based on the Environmental Kuznets Curve with an identity equating the environmental impact with the product of population affluence and technology. (See Aleghe and Ogundipe, 2013).

Chertow (2001) proposes that IPAT can be written as:

$$I = P * A * T \qquad (3.1)$$

Where; P*T = GDP, T = the technology factor $T$ and is the ratio of the environmental impact to GDP.

According to Aleghe and Ogundipe (2013), the Environmental Kuznets Curve hypothesis is a statement about $T$. The hypothesis states that "… $T$ is a function of $A$ that increases

at small values of *A* and declines at high values of *A"* and the functional form which captures any environmental Kuznets curve must reflect this relationship.

A reduced form of a non-linear relationship between environmental pollution and per capita income was specified by Grossman and Krueger (1995). The level of pollution was specified, relating the level of pollution to the level of income per capita. The specification is given linearly as:

$$COE_t = \alpha_0 + \alpha_1 Y_t + \alpha_2 Y^2_t + X_t + \varepsilon_t \qquad (3.2)$$

where t=1,...,T, refers to time, $COE_t$ = measure of pollution level (CO2 emission), $Y_t$ = per capita GDP, $Y^2_t$ = its geometric transformation, $X_t$ = vector of other covariates, $\varepsilon_t$ = normally distributed stochastic term.

According to Aleghe and Ogundipe (2013) a number of studies following from above, have been criticized because of the omission of some relevant explanatory variables. They suggested the need for the inclusion of an indicator of trade openness because of the so-called "pollution haven" or environmental dumping hypothesis (Galeotti et al., 2006; Hettige et al., 1992; Kaufmann et al., 1998; Suri and Chapman, 1998); and allowance be made for the inclusion of the role of institutions. Institutional quality because they play important roles in the management of an economy

Therefore, drawing from Grossman and Krueger (1995) as adapted by Aleghe and Ogundipe (2013), the following model is specified for this study.

$$COE_t = \alpha_0 + \alpha_i \Sigma X_i + \varepsilon_t \qquad (3\ 3)$$

Where; COE = environmental health proxied by carbon dioxide emission which is the main component of greenhouse pollution and environmental hazard and $X_i$ = vector of explanatory variables. The vector of explanatory variables includes industrial production (INDQ), the variable whose nexus with the dependent is the focus; degree of openness of the economy ()to capture the effect of the activities of transnational corporations; and population size.

## Methodology

This research made used of Co-integration technique and Error-Correction Mechanism. The cointegration technique, accompanied by the Error Correction Mechanism (ECM) was utilized in the empirical analysis of the data used in this study. This technique was preferred because of its ability to eliminate the linear trends that characterize and generally render non-stationary (that is, makes the mean of the variables not to be constant over time) time series economic variables. Such tendency to trend through time that is frequently exhibited by many time series economic variables if not properly eliminated invariably yields spurious regression results. The ECM helps to recover the long-run information lost in the course of differencing the variables to obtain

stationarity. The model rectifies this problem by introducing an error correction term derived from the long-run equation based on economic theory. It enables us to gauge the speed of adjustment of COE to its long-run equilibrium and gives the proportion of disequilibrium errors accumulated in the previous period that are corrected in the current period. The E-views 9.0 software was utilized because of its robustness in time series analysis.

**This section drew much from Aleghe and Ogundipe (2013).*

## Empirical Analysis and Discussion

### Presentation of Results

The results from the empirical analysis are summarized as follows: The mean, Skewness and Kurtosis statistics suggest that data are normally distributed with respect to two variables; namely, COE and GDPPC whereas INDQ, POP and OPEN are not normally distributed. The standard deviation shows that there is minimum variance and as such the model boasts of high reliability. The correlation tests suggest that whilst a negative and weak relationship exists between COE and OPEN, COE has a positive and strong relationship with GDPPC, INDQ and POP. The granger causality tests show that causality is bi-directional between COE and INDQ whereas it is unidirectional and runs from COE to GDPPC, POP and OPEN respectively.

In order to establish the stationarity of the variables used in this study, the Augmented Dickey Fuller (ADF) test was used to test for unit roots. Table 1 below presents a summary of the results at 5% significant level.

**Table 1: Summary of Unit Root tests for Stationarity at 5% level of significance**

| Variables | ADF Test Stat. | Critical Values (5%) | Remarks | Variables | ADF Test Stat. | Critical Values (5%) | Remarks |
|---|---|---|---|---|---|---|---|
| **COE** | -2.123 | -3.544 | NS | DCOE | -5.672 | -3.548 | S |
| **GDPPC** | -2.797 | -3.548 | NS | DGDPPC | -5.723 | -3.548 | S |
| **INDQ** | -2.812 | -3.563 | NS | DINDQ | -5.500 | -3.553 | S |
| **POP** | -0.626 | -3.563 | NS | DPOP | -4.142 | -3.595 | S |
| **OPEN** | 0.497 | -3.588 | NS | DOPEN | -3.962 | -3.588 | S |

**Source: Authors' computation (2017)**

**Note: S=Stationary, N.S=Non-Stationary, D=First difference operator**

From table 1 above, shows that all variables COE, GDPPC, INDQ, POP and OPEN are not stationary in levels; the reason being that the absolute magnitude of the ADF test statistics are smaller than the absolute magnitude of the critical values at 5% for all the variables. However, at first difference, all the variables attained stationarity; the absolute magnitude of the ADF test statistics being larger than the absolute magnitude of the critical values at 5% for all the variables. Thus, we state that all the variables are

integrated of order one, that is (I{1}). Having achieved stationarity in first differences in respect of all the variables, it becomes imperative to perform the cointegration test to determine the long-term trends in the variables.

### Residual Cointegration Test (Engel – Granger Cointegration) – Testing For the Unit Root of Residuals

In extant literature, two or more variables are said to be co-integrated if it is established that a long-run relationship exists between or among them. The results of the Engel – Granger Cointegration Test for the unit root of residuals are presented in table 2 below.

**Table 2: Summary of Unit Root Test for Residuals**

| Variable | t-Statistic | Critical Value (5%) | Remark |
|---|---|---|---|
| **Residual** | -5.318950 | -3.552973 | S |

**Source: Authors' computation (2017)**

**Note: S=Stationary**

Since all variables were differenced stationary and of equal degree we carried out a cointegration test and found that the variables are cointegrated. Table 2 above shows that the magnitude of the t-statistic of the residual is larger than the critical value of the residual at 5% indicating that there is a common stochastic drift among the variables of interest in this research. In other words, in Nigeria, a stable and long-run relationship exists between COE and its determinants as specified in the empirical model utilized in this study. Given the robustness of these empirical findings, we can now comfortably proceed to conduct an ECM test.

### The Parsimonious ECM

Having achieved cointegration of the variables at first difference, we formulated the ECM which was estimated with E-Views 9.0 software. The results of the parsimonious ECM is presented in table 3 below

**Table 3: Short-run Relationship**

| INDEPENDENT VARIABLES | COEFFICIENTS | STD ERRORS | t- RATIOS | PROBABILITY |
|---|---|---|---|---|
| C | -4.902566 | 18.35712 | -0.267066 | 0.7917 |
| LINDQ | 0.343206 | 0.915487 | 0.374889 | 0.7110 |
| LGDPPC | -0.108318 | 1.084047 | -0.099920 | 0.9212 |
| LPOP | 0.506335 | 1.011374 | 0.500640 | 0.6212 |
| LOPEN | -0.291027 | 0.166552 | -1.747360 | 0.0934 |
| ECM(-1) | -0.257000 | 0.000409 | -0.627956 | 0.0020 |

| | |
|---|---|
| R-squared | 0.768007 |
| Adjusted R-squared | 0.700342 |
| F-statistic | 11.35019 |
| Prob(F-statistic) | 0.000003 |
| Durbin-Watson stat | 1.633069 |

*Source: Authors' Computation (2017)*

## Discussion of Results

From table 3 above, the coefficient of determination ($R^2$) of 0.768007 shows that about 77% of the systematic variation in COE is collectively explained by the four regressors specified in the model, namely; INDQ, GDPPC, POP and OPEN. The remaining 23% of the systematic variation in COE cannot be explained by this model and is thus attributed to the error term. The adjusted coefficient of determination of 0.700342 implies that the explained systematic variation is about 70%. Judging by the $R^2$ and its adjusted counterpart, We therefore, conclude that the estimated parsimonious model exhibits a relatively high predictive power and can be of immense use in forecasting of future levels of environmental health or back-casting of same in the sphere of policy making. The F-statistic of 11.35019 with $\text{þ} = 0.00000$ shows that a systematic and significant linear relationship exists between the regressand and the specified regressors.

Examining the impact of each of the regressors on the regressand, we observed that the estimated coefficients of three of the regressors, namely; IND, GDPPC, and POP conform with a priori expectations in signs whereas the estimated coefficients of OPEN does not conform with a priori expectations in signs. The DW statistic indicates absence of autocorrelation in the model and the ECM coefficient is negative, and statistically significant at 5% ($P = 0.000$). Thus, about 26% of the deviation of COE from its long-run equilibrium value will be reconciled per annum.

The long run result show that all variable are jointly significant in determining COE and they account for approx. 75% variation in COE however only OPEN is statistically significant.

## Summary and Conclusion

Experience has shown that industry is a major catalyst that drives the engine of economic growth and development. It is in recognition of this that nations world over have pursued and continue to pursue policies and programmes that encourage the rapid industrialization of their respective economies. Nigeria, for instance has pursued the goal of industrialization since the 1960s and even so, more rigorously since the 1970s through the indigenization policy; among others. No doubt, the process of resource utilization which is the orb of industrialization involves interaction with and transformation of some aspects of both the natural and man-made environment. This process is usually accompanied with some pathological and physiological impacts that are potentially hazardous to human health and wellbeing.

Sadly, however, the various attempts at and phases of industrialization in Nigeria have paid only very little attention to issues bothering on environmental health. Such lopsided pattern of industrialization which tends to target only economic and social dimensions at the expense of the environment from which resources are derived have posed considerably serious challenges to human health. Given the critical role that the health status of individuals play in their contribution to national productivity, it becomes imperative that any meaningful attempt at industrialization will only be sustainable by a trade-off between the pursuit of the benefits of a higher level of industrialization and environmental degradation. Such trade-offs will necessarily require that while pursuing efficient production and marketing goals, industries should as well give priority considerations to environmental and human health protection.

The future scale of environmental and health problems from industrialization in developing countries like Nigeria will depend greatly on policy actions taken today.

If current production practices remain the norm, air pollution and toxic effluents from industrial production are likely to increase rapidly. If, choices are made to invest in more efficient and less-polluting technologies, many of industrialization's negative impacts on health could be avoided.

Decisions regarding the location sites of those industries, the technologies used and the type of precautions for occupational safety could have a tremendous impact on the environment and ultimately on the future health of the people who live and work there.

The governments of the country should take actions against environmental degradation, and to take actions against the violators of the rules regarding the environmental protection.

In this regard, it is imperative that each economic project (industries, firms or any business plan) must have a plan to take care of environmental treatment for damages they may cause; each business in operation must have a plan and follow-up procedure for waste and sewage treatment.

Scientific research on environmental protection should be encouraged.

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