Journal of Sciences and Multidisciplinary Research
Volume 6, No. 2, 2014
ISSN: 2277-0135

THE RELATIONSHIP BETWEEN AIR QUALITY AND HUMAN CAPITAL DEVELOPMENT IN NIGERIA: 1980-2012

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Abstract: Human capital development is very important to the development of any nation. However, several factors may hinder this development and the quality of air is a factor. While many studies have looked at the relationship between air quality and economic growth, few studies have examined the causal link between air quality and human capital particularly, Nigeria, hence this study. We assessed the trends of carbon dioxide emissions, life expectancy and primary school enrolment. This was with a view to determining the direction of causality between carbon dioxide emissions, life expectancy and primary school enrolment. The study period is from 1980 to 2012. The results showed that a one-way causality was running from carbon dioxide to life expectancy and a one-way causality was running from primary school enrolment to carbon dioxide emissions. The government need to put up and implement policies that will reduce the carbon dioxide emissions since this will eventually improve the human capital development in Nigeria.

Keywords: Relationship, Air Quality, Human Capital, Development and Nigeria

INTRODUCTION

Air quality has been one of the most challenging issues in recent years and the developing countries are not left. This is because air pollution is detrimental, it increases vulnerability, undermine system health and reduce resilience. Each socio-economic development path (driven by the forces of population, economy, technology, and governance) gives rise to different levels of greenhouse gas emissions. These emissions accumulate in the atmosphere, increasing the greenhouse gas concentrations and disturbing the natural balance between incident solar radiation and energy re-radiated from the earth. Such changes give rise to the enhanced greenhouse effect that increases radiative forcing of the climate system. The resultant changes in climate will persist well into the future, and impose stresses on the human and natural systems. (Munasinghe, 2003). Larger stocks of human capital are associated with better environmental conditions. Human capital is a key component of economic growth and welfare. Human capital investments directly affect the performance of the economy and the output growth rate. Investing in human capital is a key to sustaining increases in labour productivity and economic growth. Human health is an important part of human capital and in this sense, environmental protection can be seen as a factor that promotes health. There is the link between pollution and poor health and the efforts to reduce pollution can be seen as an investment in human capital and a tool to promote economic growth. (Graff Zivin and Neidell, 2012). Also, Human capital accumulation also has a positive effect on the up-gradation of the environmental quality. Education makes the people aware of the environmental problems and of the importance of protecting environment; and the educated people can protect the environment in a scientific way (Gupta and Chakraborty 2014). Lan (2013) stated that people with higher education are more likely to be more aware of and evaluate environmental issues differently compared to those with less education, with people with higher human capital more sensitive to surrounding environmental quality. Environmental degradation reduces the efficiency of human capital through direct and indirect impacts on health, both acute and

chronic effects. Direct negative effects are associated with exposure to hazard and illness. Exposure to lead, nitrogen oxides (NOx), sulfur dioxide (SO2) and other chemicals are examples of the direct effects of environmental degradation on current human capital investments. Indirect long term effects are generally associated with nutrition quality, pesticide use, and water and air quality and they are again related with health problems. (Sapci and Shogren, 2014). While many studies have investigated on air quality and economic growth, the relationship between air quality and human capital, have been largely ignored in the literature. This is obvious in the literature reviewed in the next section. This study focused on the association between air quality and human capital in Nigeria. Investment in human capital can be divided into two main aspects, which are education and health. Hence, this study looked at education and health as forms of human capital in Nigeria. This study is presented as follows; section one is introduction, while in section two, the relevant literature were reviewed. Data and methodology were stated in section three and in section four, data analysis, results and discussions were presented. Lastly, conclusions were drawn in section five.

LITERATURE REVIEW

Several studies have investigated the relationship between pollution and income mainly focusing on the environmental Kuznets curve. The Environmental Kuznets Curve (EKC) had been popularly referred to in the recent years on studies between growth and environment. The EKC curve originated from Kuznets (1955) who hypothesized in 1954 that income inequality first rises in early years of eco growth and then fall in the course of economic development. Since then, researchers have investigated the validity of this hypothesis. For instance, Phimphanthavong (2013) examined the relationship between economic growth and environmental degradation in Laos. Using CO_2 to capture environmental conditions, the study confirmed the EKC hypothesis that at the early stage economic growth increases environmental degradation. Richard, Jeon and McCubbin (1997) looked at seven types of air emissions across the 50 US states. The seven major pollutants are greenhouse gases, air toxics, carbon monoxide, nitrogen oxides, sulphur dioxide, volatile organic carbon and particulate matter less than ten microns in diameter. They found that all the seven pollutants decrease with increasing per capita income. Similarly, Jo and Hong (2000) examined the relationship between economic growth and air pollution in both SO_2 ad NO_2 in Korea. They found out an inverted U-shaped between economic growth and air pollution. Aka (2008) examined the impact of trade openness and economic growth on air pollution in sub-Saharan Africa, from 1961 to 2003. Using an Autoregressive Distributed Lag (ARDL) model to analyze the short run and long run impact, the study revealed a 1% increase in economic growth, leads to 1.04% increase in CO_2 emissions and a 1% increase in trade intensity accounted for 0.15% decrease in pollution. Also, in the long run, a 1% increase in GDP per capita contributes to 1.8% increase in air pollution while a 1% increase in trade intensity leads to 0.5% decrease in CO_2 emission. In the same vein, Mehrara, Karsalari and Musai (2014) examined the relationship among environment, economic growth and openness in Iran between 1970 and 2011. They employed the ARDL model, and they a cointegrating relationship among the variables. Their results revealed that GDP contributed to CO_2 emissions both in the short run and long run. However, openness had a weak impact on the CO_2 growth in the long run. Several other studies have focussed on the air quality and economic growth. (see Dinda 2009, Akintunde 2012, Akpan and Chuku 2011, Lee, Chung and Koo 2005)

According to Lucas (1988), human capital is defined as human knowledge and skills accumulated by individuals (or groups of individuals). Increased human capital makes a person

a more effective worker. An individual can continuously choose between an allocation of time devoted to production and to human capital accumulation. Human capital is accumulated with constant relative returns. In addition to the effective work force and physical capital, there is a positive external effect in the production. This is the average level of human capital. In the model, the endogenous economic growth rates vary between the unregulated and the optimal case. Thus, according to Lucas' model, a society can enhance economic growth by using more resources in human capital accumulation. Both Lucas (1988) and Romer (1986) concluded that population growth contributes to growth in consumption per capita because of increasing returns. Their analyses do not, however, include environmental aspects. (Rosendahl, 1994). However, Rosendahl incorporated the interactions between the environment and economic activity into an endogenous growth model. Lavy, Ebenstein and Roth (2012) evaluated the effect of pollution exposure on cognitive performance using standardized test scores among Israeli high school, high-stakes tests from 2000 from 2002. They focussed on fine particulate matter ($PM_{2.5}$) and carbon monoxide (CO). They found out that the two air pollutant had a significant negative relationship with test scores. From the literature reviewed, it could be gathered that few studies have looked at air quality and human capital development, hence this study.

DATA AND METHODOLOGY

Secondary data were used for the study. The data were sourced from world development indicators published by the World Bank. The CO_2 emission per capita was used as a proxy for air quality, life expectancy was used to measure health component of the human capital while primary school enrolment was used to measure the education component of the human capital. In order to establish a relationship between air quality and human capital development, line graphs, scatter diagrams and Granger causality test were employed. The study covered the period between 1980 and 2012 in Nigeria. The Augmented Dickey Fuller Test was used to test the time series properties of the variables, to ascertain their level of stationarity. The Granger (1969) model was adopted and it is written as;

$$\text{Log(life)} = \emptyset_i \sum_{i=1}^{n} \propto i\, Log(CO2)_{t-i} + \sum_{j=1}^{n} \beta j\, Log(life)_{t-j} + U_{1t} \quad \text{----------(1)}$$

$$\text{Log(CO2)} = \emptyset_i \sum_{i=1}^{n} \delta i\, Log(life)_{t-i} + \sum_{j=1}^{n} \theta j\, Log(CO2)_{t-j} + U_{2t} \quad \text{----------(2)}$$

$$\text{Log(life)} = \emptyset_i \sum_{i=1}^{n} \propto i\, Log(schl)_{t-i} + \sum_{j=1}^{n} \beta j\, Log(life)_{t-j} + U_{1t} \quad \text{----------(3)}$$

$$\text{Log(schl)} = \emptyset_i \sum_{i=1}^{n} \delta i\, Log(life)_{t-i} + \sum_{j=1}^{n} \theta j\, Log(schl)_{t-j} + U_{2t} \quad \text{----------(4)}$$

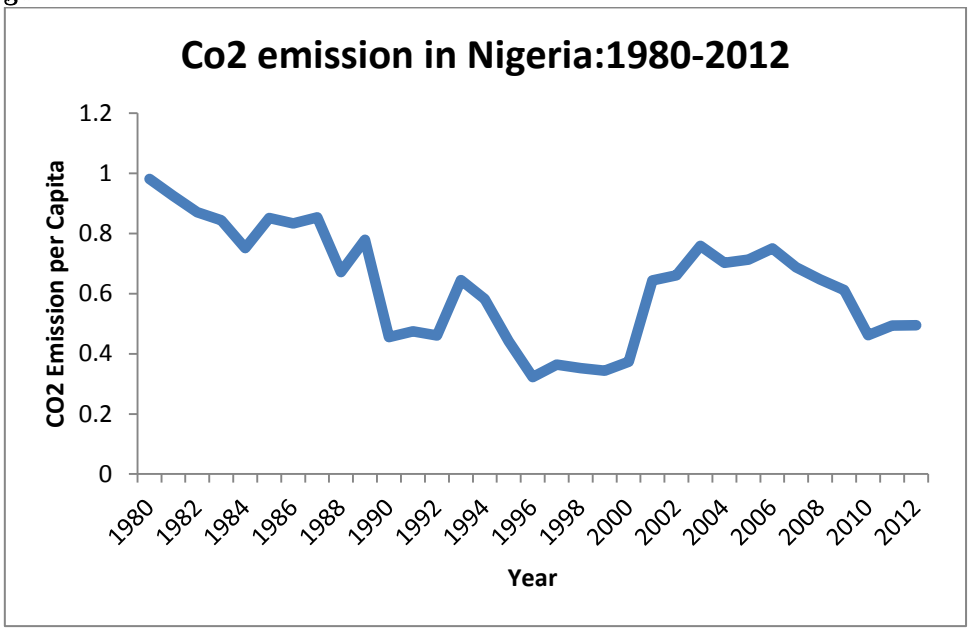
Where, life is the life expectancy at birth, CO2 is the CO2 emissions per capita and schl is the primary school enrolment.

ANALYSIS, RESULTS AND DISCUSSION

In this section, the first thing was to discuss the trends of all the variables namely; CO2 emissions per capita, life expectancy and primary school enrolment. Figure 1 shows the trend of carbon dioxide emissions per capita in Nigeria from 1980 to 2012. There was a reduction in the carbon dioxide emissions in the 80s and 90s. This could be as a result of the oil glut in the mid 80s that led to the incident of structural adjustment programme (SAP). At this time, the economy was in low ebb and industries were folding up. This period also witnessed the military rule when there was a lot of tension and political instability. Investors didn't find the country suitable for business. However, by 2000 carbon dioxide emissions started to rise, investors were coming in, there was also a change from military rule to democratic rule. In Niger Delta, there

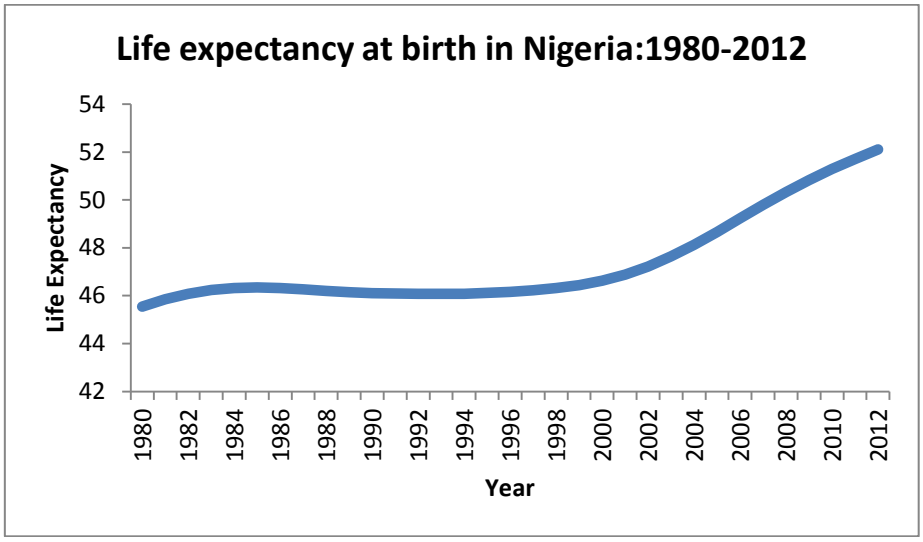
was a lot of gas flaring from the oil companies and this contributed to the increase in the carbon dioxide emissions. By 2000, the emissions set to decline.

Figure 1



Source: WDI, 2013

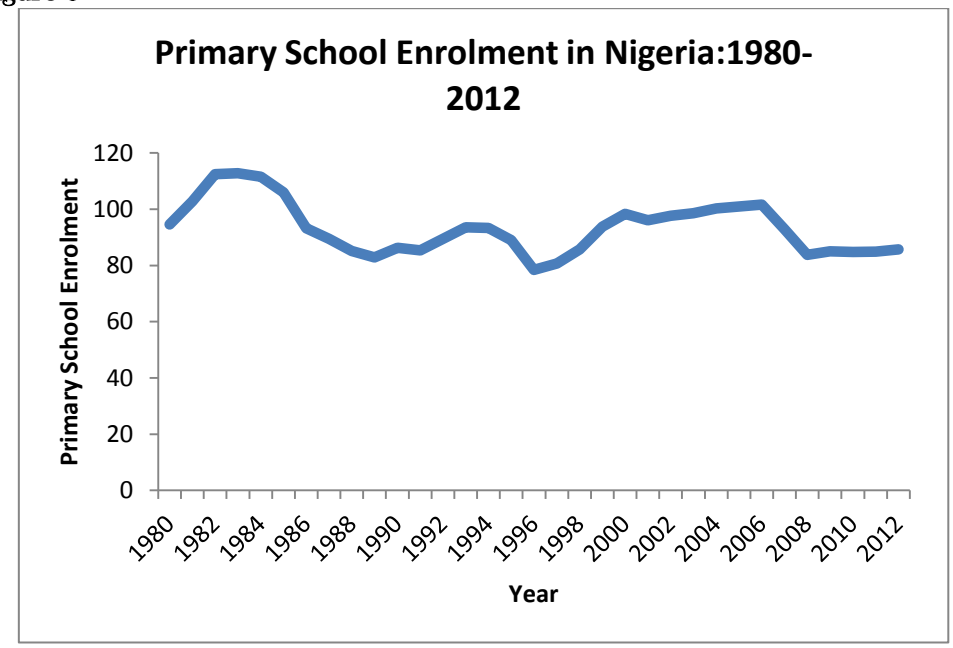
Figure 2



Source: WDI, 2013

Figure 2 shows the life expectancy at birth in Nigeria from 1980 to 2012. There have not been significant increases in the life expectancy at birth between 1980 and 2000. However, by 2003 there was an appreciable increase in the life expectancy. This period also witnessed increase in government spending on health in Nigeria.

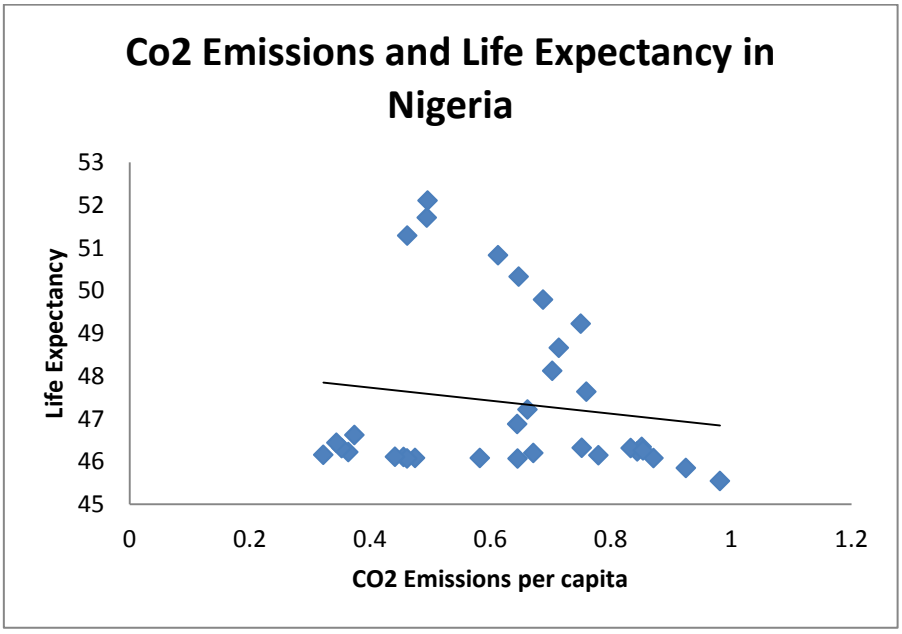
Figure 3



Source: WDI, 2013

Figure 3 presents the trend of primary school enrolment in Nigeria from 1980 to 2012. The primary school enrolment has not really improved over the years. In fact, by 2008 there was a drop in the primary school enrolment. The crisis of insurgency could account for this drop because of the unrest, people might be afraid to send their children to school. Also, the northern part of Nigeria is also known for where children of school age especially boys are not going to school. They are commonly called the Almajiris.

Figure 4

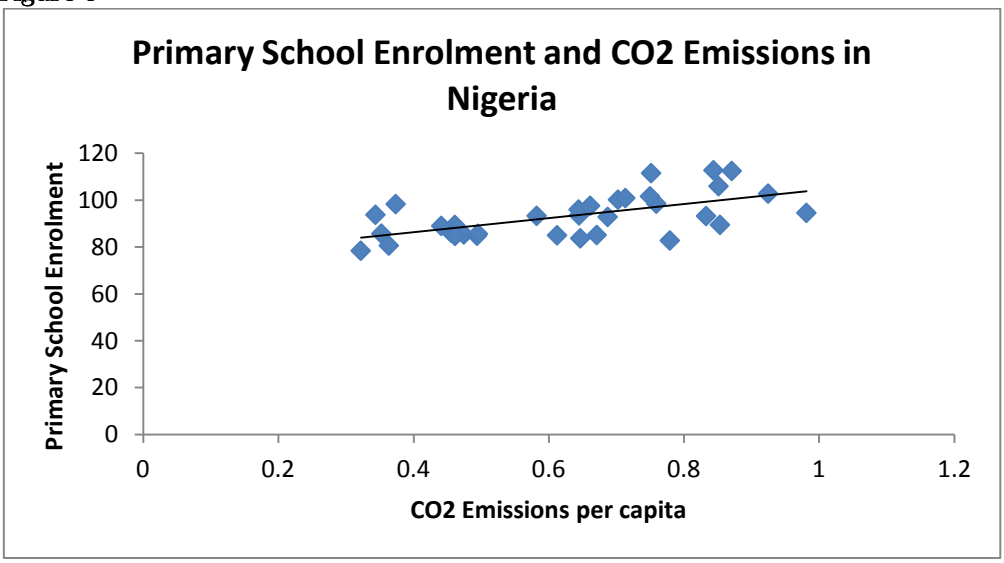


Source: WDI,2013

Figure 4 presents the scatter plot between carbon dioxide emissions and life expectancy. It can be gathered that the life expectancy is increasing as the carbon dioxide emissions is reducing. This suggests that the reduction in carbon dioxide could actually boost peoples' health.

Figure 5 shows the scatter diagram between primary school enrolment and carbon dioxide emissions. This suggests that as education is improving, carbon dioxide is increasing. When people are educated they could have the opportunity to own cars and this could add to the emissions. Also, educated people can go into various types of businesses. For instance, most entrepreneurs in Nigeria depend on generating sets to power their machines. These generating sets emit fumes and this could increase the emissions in the long run

Figure 5



Source: WDI, 2013

UNIT ROOT TEST

In order to test for the direction of causality between the variables, the first step was to test the time series properties of the variables. They are presented in table 1.

Table 1: Augmented Dickey Fuller (ADF) Test

Series	Levels	First Difference
Log(CO2)	-2.20	-6.37
Log(life)	0.25	0.34
Log(schl)	-3.2	-3.47

Critical Values: 5%=2.94
Source: Authors' Computation

From table 1, it can be gathered that only the CO2 emissions is an I(1) series. The other variables are not. This implies that the long run relationship could not be established between the variables. However, table 2 presents the Granger causality test that gives the direction of causality in the short run.

Granger Causality Test

Table 2: Results from the Granger Causality Tests

Regression	F-Statistic	P-value	Decision
Log(life) does not Granger cause log(CO2)	1.22	0.31	Do not Reject
Log(CO2) does not Granger cause log (life)	12.45	0.002	Reject
Log(schl) does not Granger cause log(CO2)	5.15	0.01	Reject
Log(CO2) does not Granger cause log(schl)	0.9	0.41	Do not Reject

Source: Authors' Computation

From table 2, the null hypothesis that life expectancy does not Granger cause CO2 emissions was not rejected. However, the null hypothesis that CO2 does not Granger cause life expectancy was rejected. This is because the F-Statistics was significant at 5%. This implies that there is a unidirectional causality between CO2 emissions and life expectancy. It means that the direction of causality runs from carbon dioxide emissions to life expectancy. This buttresses the fact that carbon dioxide emissions go a long way to affect human health. The null hypothesis that primary school enrolment does not Granger cause CO2 was rejected. While the null hypothesis that CO2 does not Granger cause primary school enrolment was not rejected because the F-Statistic was not significant at 5%. This shows that there exist a one-way causality between primary school enrolment and carbon dioxide emissions. This means that education has a lot to do in improving the air quality in Nigeria.

CONCLUSION

The study investigated the association between air quality and human capital in Nigeria from 1980 to 2012. The study made use of line graphs, scatter plots and Granger causality test to achieve the objective. Life expectancy and primary school enrolment were used as a proxy for human capital while CO2 emission was used to measure the air quality. In the short run, there was one-way causality between carbon dioxide and life expectancy at birth and likewise there was one-way causality between primary school enrolment and carbon dioxide emissions. In order to improve human health, there is the need to reduce the emissions that are injurious to health. When people are educated, they will be well informed and they will not venture into things that will increase the emissions. Finally, the government need to set up policies that will improve the air quality in Nigeria because it will eventually boost human capital development in Nigeria.

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Reference to this paper should be made as follows: Akintunde T.S., Akanbi B.E. and Satope, B.F. (2014), The Relationship Between Air Quality and Human Capital Development in Nigeria: 1980-2012. *J. of Sciences and Multidisciplinary Research,* Vol. 6, No. 2, Pp. 95 – 103.