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Air Pollution and Human Health: Empirical Evidence from Cameroon

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ABSTRACT

The purpose of this study is to examine the effects of air pollution on human health in Cameroon. Specifically, the paper sought to determine the effects of air pollution on human health in Cameroon. The study also identified the major sources of air pollution in Cameroon and assesses the effectiveness of existing air pollution control policies. The study made use of secondary data from 1980 to 2021 sourced from the National Institute of Statistics and world health organization. The research design adopted was the causal research design where the Auto Regressive Distributed Lag (ARDL) model was used to analyze the data. Both pre and post-test were done to validate the results. The cumulative sum of recursive residuals (CUSUM) and the CUSUM of square (CUSUMSQ) tests to assess the parameter constancy. The long run results revealed that carbon dioxide, methane and nitrous oxides all have a negative and significant impact on life expectancy in Cameroon. More specifically, long run results showed that, a unit increase in CO2 emission (LCO2) will reduces life expectancy by 0.127%, a unit increase in Methane emission (LMTHNE) will reduces life expectancy by 0.203% and a unit increase in Nitrous emission (LNITE) will reduces life expectancy by 0.017%. From a policy perspective, the government should encourage the planting of trees as the planting of one tree implies planting a life. Trees are important because they help to reduce the amount of carbon existing in the atmosphere.

1. INTRODUCTION

Common illnesses like cholera and typhoid fever swept over Europe in the Middle Ages. Human and animal wastes, as well as rubbish, contributed to the filthy conditions that led to these outbreaks. The bubonic plague, or "Black Death," broke out in 1347 and was transmitted by the bacteria Yersinia pest, which was carried by rats and disseminated by fleas. Conditions were unsanitary, so the disease-causing bacteria had a great place to grow and spread. In Asia, Africa, and South America, the Xenopsylla cheopis (oriental rat flea) is the vector for the plague. The virus may be spread across sexes (Markham et al., 2018).

The problem of pollution has emerged as one of the century's most pressing issues. It endangers the health of billions of people, threatens the stability of the planet's ecosystems, and stymies the economic and social growth of countries (Rockström et al., 2013). Industrial emissions, automobile exhausts, and dangerous chemicals have all contributed to a dramatic increase in pollution over the last century, and without concerted effort to reduce it, ambient air pollution is expected to climb by another 50% by 2050. Much of the growth will occur in the urban areas of poor and middle-income nations that are quickly modernizing their economies (Lelieveld et al., 2015).

Pollutants are a byproduct of human activity, particularly manufacturing and urban transportation. Primary and secondary pollutants are distinguished. Carbon monoxide (CO), nitrogen oxides (NOx), sulfur dioxide (SO2), volatile organic compounds (VOCs), and polycyclic aromatic hydrocarbons (PAHs) are all examples of the first class of pollutants, which are created directly (PAH). Compounds like ozone (O3), formed when nitrogen oxides (NOx) react with volatile organic compounds (VOCs), belong to the second category, which results from the interaction between main

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pollutants. The Lancet Commission on pollution and health estimates that nearly 9 million deaths a year may be attributed to deteriorating environmental conditions, with almost half of those deaths owing to ambient (outdoor) pollution. While monitoring stations may be found in most European towns, an estimated 790,000 Europeans die prematurely each year due to air pollution. Health outcomes are dominated by cardiovascular events, which account for between 40 and 80 percent of all health losses. The greatest rates of sickness and premature mortality are associated with poor air quality in cities in Sub-Saharan Africa (SSA) (Coker et al., 2018)

The chance of getting respiratory and cardiovascular problems has been shown to rise in several recent research (e.g., upon long term exposures to urban air). Those who are physically active, those who suffer from anterior lung disorders, young children, and the elderly are more likely to feel the consequences (Balali et al., 2016.) Kelly et al. (2014) found a link between urban AP and alterations in hematological parameters in healthy people, including an increase in white blood cell and platelet levels and a pro-inflammatory state connected to cardiometabolic risk factors. Whole white blood cell, lymphocyte, and eosinophil counts were all shown to be lower in exposed motorcycle drivers (MD) in Benin compared to uninfected controls (Dorothée & Aucouturier, 2011).

The pollution problems of emerging countries are complicated, substantial, and rapidly expanding, even as developed nations face mounting global environmental challenges (Marshall & Farahbakhsh, 2013). Foreign corporations who operate with little concern for the local environment exacerbate the negative effects of industrialization, urban growth, and mass consumer tendencies. Pollution in the environment is a major social problem because it may have a devastating effect on people's quality of life by destroying their houses and neighborhoods. It is important to note that the manner of growth in developing nations is also strongly linked to the pollution issues that these countries face. Despite this, a large number of developing nations either haven't created environmental pollution control measures or haven't given appropriate implementation mechanisms to guarantee that regulations are successful.

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There is little or no epidemiological data on the health impacts of urban pollution (including but not limited to "Air Pollution (AP), environmental pollution (EP), and water pollution (WP)") exist in Cameroon. Douala, Yaoundé, Buea, and Dchang are some of the worst affected cities in Cameroon due to the country's high levels of air pollution (AP), environmental pollution due to excessive household and industrial garbage, and water pollution caused by the dumping of waste and sewage into natural water sources (Njumbe, 2004). Exodus of individuals from rural regions towards cities has increased dramatically as people seek better living conditions there. Road traffic causes environmental pollution (EP), water pollution (WP), and air pollution (AP) since about 80% of Cameroon's industrial activity (in places like Douala and Limbe, for example) have access to a large seaport that supplies nearly all the nations in Central Africa. Thousands of unfit cars and motorcycles older than 15 years, many of which run on subpar gasoline, contribute significantly to the congestion in metropolitan areas. As a result, you're helping to worsen people's health by altering the air quality in these places, particularly their pulmonary and cardiovascular systems.

There has been a shocking lack of attention paid to pollution from industrial, automotive, and chemical sources in international development and global health agendas, as well as in the planning strategies of many nations, despite the severity of the problem. The rapid growth of population in Cameroon adds pressure to the environmental issue and its resource. Thus, this study sought to find out the effect of air pollution on human health in Cameroon.

2. LITERATURE REVIEW

Pope et al. (2002) assessed the association between fine particulate air pollution and mortality in the United States. The study used data from 90 metropolitan areas in the United States and estimated the daily levels of fine particulate matter. The researchers then used statistical models to assess the association between particulate matter levels and mortality. The study found that exposure to particulate matter was associated with increased mortality rates, particularly from cardiovascular and respiratory diseases.

Brook et al. (2010) reviewed the evidence linking air pollution to cardiovascular disease. The authors conducted a comprehensive review of the literature on air pollution and cardiovascular disease, including both observational and experimental studies. The review found that exposure to air pollution, particularly fine particulate matter, was associated with increased risk of cardiovascular disease and related outcomes such as heart attack and stroke.

Fonkoua et al. (2017) investigated the effects of air pollution on the respiratory health of school children in Douala, Cameroon. Cross-sectional study involving 394 school children who completed a respiratory questionnaire and had their lung function measured. Children exposed to high levels of air pollution had significantly lower lung function and higher prevalence of respiratory symptoms compared to those with lower exposure.

Higher levels of air pollution diminish worker productivity even when air quality is typically low, as shown by Neidell's (2017) research. Moreover, the study's findings implied that pollution might have a negative impact on worker output. People who were able to maintain their occupations are more likely to be healthy and productive as a consequence of the improvements in air quality and water quality brought about by successful environmental legislation. To develop effective environmental policy, it is crucial to take into account how much these improvements in worker productivity mitigate or even outweigh the negative consequences of regulation.

Aminde et al. (2018) investigated the effects of air pollution on maternal and child health in Cameroon. Cross-sectional study involving 197 pregnant women and their newborns who were followed up for six months. Maternal exposure to high levels of air pollution during pregnancy was associated with increased risk of preterm birth and low birth weight. Infants exposed to high levels of air pollution had increased risk of respiratory infections.

Liu et al. (2019) assessed the association between air pollution exposure and risk of dementia. The study used data from a large cohort of older women in the United States and estimated their exposure to particulate matter and nitrogen oxides. The researchers then used statistical models to assess the association between air pollution exposure and risk of dementia. The study found that higher levels of particulate matter and nitrogen oxides were associated with increased risk of dementia.

Tchinda Mouofo et al. (2020) assessed the effects of air pollution on respiratory health among residents of Douala, Cameroon. Cross-sectional study involving 386 participants who completed a respiratory questionnaire and had their lung function measured. Participants exposed to high levels of air pollution had significantly lower lung function and higher prevalence of respiratory symptoms compared to those with lower exposure.

Cui et al. (2021) assessed the association between air pollution exposure and risk of COVID-19 infection and severity. The study used data from over 5,000 COVID-19 patients in China and estimated their exposure to particulate matter and nitrogen dioxide. The researchers then used statistical models to assess the association between air pollution exposure and COVID-19 outcomes. The study found that higher levels of particulate matter and nitrogen dioxide were associated with increased risk of COVID-19 infection and severity.

3. METHODS AND PROCEDURES

Cameroon is a triangular shaped country of some 475,440 square kilometers and 420-kilometer coastline on the Atlantic Ocean. Cameroon is divided into four geographical zones, that is, the southern coastal lowland, the western highland, the central and southern plateaus and the Chad basin in the far north (Mark *et al.*, 2010). The causal research method was used for this investigation. The purpose of a causal survey is to identify the factors that lead to a certain outcome. When changes in one phenomena (the independent variable) cause or, on average, result in changes in another phenomenon (the dependent variable), this is known as a causal effect (from a nomothetic viewpoint). Secondary data was used for this study through time series data of all the variables from 1980 to 2021 were sourced from Cameroon’s National Institute of Statistics and World Health Organization datasets.

The functional relationship can be expressed as follows:

H = f(CO2, MTHNE, NITE, ORNT, AVA, GCF, C) ... ... (1)

The above relationship can therefore be linearized by taking natural logarithm (In) on both sides of equation (2), taking care of error term and the constant term; the above functional relationship becomes an econometric model as follows;

$$InH_t = \alpha_o + \alpha_1 lnCO2_t + \alpha_2 1nMTHNE_t + \alpha_3 1nNITE_t + \alpha_4 1nORNT_t + \alpha_5 1nAVAT_t + \alpha_6 1nGCF_t + \alpha_7 1nC_t + \mathcal{E}_t \quad …. …. …. ….\quad (2)$$

Where α_o is the constant term, α_1, α_2, α_3, α_4, α_5, α_6 and α_7 are the parameters to be estimated, t is the time component illustrating the time series structure of the data set used in this study.

The main priori expectation of the above model is that $\alpha_0 \neq 0$, $\alpha_1 \geq 0$, $\alpha_2 \geq 0$, $\alpha_3 \geq 0$ and $\alpha_{4,}\ \alpha_{5,}\ \alpha_{6,\ \alpha 7} \leq 0$.

To investigate the effects health and the various indicators of pollution, the technique of estimation adopted for this study was the Autoregressive Distributed Lag (ARDL) Approach to Co-Integration Testing or Bound Co-Integration Testing Approach. When one co-integrating vector exists, Johansen and Juselius (1990) co-integration procedure cannot be applied.

The ARDL Method to co-integration breaks out in conditions when there are a large number of co-integrating vectors. As a result, the method proposed by Johansen and Juselius (1990) is a viable option. The ARDL representation of the health outcome, land pollution, air pollution, and water pollution relationship can be constructed as:

$$\Delta lnH_t = \alpha_o + \alpha_1 lnCO2_{t-1} + \alpha_2 1nMTHNE_{t-1} + \alpha_3 1nNITE_{t-1} + \alpha_4 1nORNT_{t-1} + \alpha_5 1nAVAT_{t-1} + \alpha_6 1nGCF_{t-1} + \alpha_7 1nC_{t-1} + yECM_{t-1} + \mathcal{E}_t \quad .... (3)$$

In the above model, Δ is the first-difference operator, and as indicate long run coefficients. The hypothesis of no co-integration deals with H_0: $\alpha_1 = \alpha_1 = \alpha_1 = \alpha_1 = \alpha_1 = \alpha_{1=} \alpha_1 = \alpha_{1=} \alpha_1 = \alpha_{1=} 0$

Significance of lagged explanatory variable depicts short run causality while a negative and statistical significant ECT is assumed to signify long run causality. The short-run causality is thus determined from the following ARDL model;

$$\Delta lnHt = \alpha_o + \rho_5 lnCO2_{t-1} + \rho_5 1nMTHNE_{t-1} + \rho_5 1nNITE_{t-1} + \rho_5 1nORNT_{t-1} + \rho_5 1nAVAT_{t-1} + \rho_5 1nGCF_{t-1} + \rho_5 1nC_{t-1} + yECM_{t-1} + \mathcal{E}_t \quad …………………………………………….. (4)$$

Where, Δ is the difference operator, ECM representing the error - correction term derived from the long-run co-integrating relation from the above specified ARDL models (4). In equation, y should exhibit a negative and significant sign for causality to exist in the long run.

4. RESULTS

Unit root test

The unit root test show disparities of results per variable. The estimation results of the unit root test through the application of the Augmented Phillips-Perron (PP) stationarity test at 5% critical value is shown in Table 1 below. The estimation results revealed that variables like life expectancy (LHOLF), carbon dioxide emission (CO2), Nitrous emission (LNITE), gross foxed capital formation (LGFCF) agricultural value added (LAVA) where not stationary at level. This is due to fact that the null hypothesis of series containing unit root for these mentioned variables could not be rejected. All these variables become stationary at first difference. For variables like methane and oil rent, the null hypothesis of series containing unit root was rejected at level implying that they are stationary at level and as such follow an I(0) processes.

Table 1. Unit root test

Variable	Coefficient	P Value	Decision
LHOLF	-2.481876	.1275	
D(LHOLF)	-1.854552	0.030	I(1)
LCO2	-0.694220	0.4098	
D(LCO2)	-5.611322	0.0000	I(1)
LMTHNE	-3.034411	0.042	I(0)
LNITE	-1.372118	.5862	
D(LNITE)	-6.239532	0.0000	I(1)
LORNT	**-3.682257**	**0.0082**	I(0)
LAVA	-0.413100	0.8972	
D(LAVA)	-5.829714	0.0000	I(1)
LGCF	-1.471022	0.5366	
	-2.494791	0.0140	I(1)

With all the variables of the study following an I(0) and I(1) process, it validate the choice of the adopted methodology given that the ARDL approach requires variables to be integrated of order 0 or 1.

Cointegration test

Given that the chosen approach allows us to obtain results for both the short and long term, we use the bound test for cointegration to investigate the potential presence of a long run relation. To assess whether or not the variables are cointegrated, the ARDL Bound test compares the F-statistic value to the upper I(1) and lower I(0) critical bound values, as illustrated in Table 2 below. If the F-statistic is less than the lower critical limit I(0), then there is no co-integration between the variables; if it is more than the upper critical bound I(1), then there is co-integration; and if it is between these two critical values, then the conclusion is inconclusive. The null hypothesis state that there exists no long run relationship among the variables. From the bound test outcome presented in Table 2 the critical value of the F statistics stands at 6.558036 which is greater than the bounds critical values both for the lower and upper bounds of 2.26, 2.62, 2.96, 3.41 and 3.35, 3.79, 4.18 and 4.69 at 10%, 5%, 2.5% and 1% level of significant. This shows that we reject the null hypothesis and accept the existence of long run relation among the variables.

Table 2. Cointegration test result

ARDL Bounds Test		
Null Hypothesis: No long-run relationship exists		
Test Statistic	Value	K
F-statistic	6.558036	5
Critical Value Bounds		
Significance	I0 Bound	I1 Bound
10%	2.26	3.35
5%	2.62	3.79
2.5%	2.96	4.18
1%	3.41	4.68

Regression result of ARDL model

The ARDL Model for the dependent variable LHOLF is presented on Table 2. From the outcome, the past value of health outcome up to the 4 lags, we observed a heterogeneity in human health outcome within the short run life expectancy that is positive effect for current, first and third lag and rather a negative effect for the second and fourth lag. But this outcome is only observed to be statistically significant for the first, third and fourth lag value at 1%, 5% and 10% respectively. For CO2 emission variable, it was observed to have a negative effect on life expectancy for the current value and the first lag at 1% level of significant.

Short run outcome

The short run results of the ARDL model is presented in Table 3. From the outcome, the past value of health outcome (life expectancy) up to the 3 lags, we observed the present of heterogeneity in outcome within the short run life expectancy that is positive effect for current and first lag and third rather a negative effect for the second lag. But this outcome is only observed to be statistically significant for the third lag value at 5%. For CO2 emission variable, it is observed to have a short run negative effect on life expectancy for the current value and the first lag in the short run at 1% level of significant. In the same vein, methane is having a short run negative effect on life expectancy for its current value and this value is seen to be significant at 1%.

Table 3. Short run results

Short run coefficient				
Variable	Coefficie nt	Std. Error	t-Statistic	Prob.
LHOLF (-1)	0.157069	0.163499	0.9607	0.3452
LHOLF (-2)	- 0.149919	0.180953	-0.8285	0.4147
LHOLF (-3)	0.815039	0.374910	2.1740	0.0386
LCO2	- 0.018864	0.005513	-3.4219	0.0020
LMTHNE	- 0.030093	0.010777	-2.7925	0.0095
LNITE	0.002524	0.002755	0.9163	0.3676
LAVA	0.020952	0.009804	2.1371	0.0418
LGCF	0.002664	0.002625	1.0147	0.3193
C	- 0.147959	0.023177	-6.3840	0.0000
Observation	**37**	**37**	**37**	**37**
Cointeq = LHOLF - (-0.1275*LCO2 -0.2034*LMTHNE + 0.0171*LNITE +0.1416*LAVA + 0.0180*LGCF -2.5508)				

Further, for Nitrous oxide emission the current value has a positive effect on life expectancy. However, only the current value of nitrous emission and the third lag is observed to be statistically insignificant. For the control variable used in this study, agricultural value added is seen to have positive effect for its current and first lag on life expectancy. But this coefficient is significant at 5%. Furthermore, looking at the outcome of gross fixe capital formation, we observed a positive effect on current and first lag. Finally, the coefficient of the error correction term is negative (-0.147959) and statistically significant at 1%. This shows that there is convergence from short run disequilibrium to long equilibrium. The rate of convergence is relatively high and stands at 14.7%.

Long run outcome

The long run results reveal that LCO_2 and LMTHNE, has a negative and significant impact on life expectancy however, LNITE, LAVA and LGCF has a positive effect on life expectancy. More specifically, long run results reveal that, a unit increase in CO2 emission (LCO2) will reduce life expectancy by 0.127%, a unit increase in Methane emission (LMTHNE) will reduce life expectancy by 0.203%, a unit increase in Nitrous emission (LNITE) will reduce life expectancy by 0.017%. For agricultural value added, a unit increase in agricultural value added (LAVA) will reduces life expectancy by 0.142%. finally results of Table 4 further depicts that a unit increase in gross fixed capital formation (LGCF) will reduce death rates by 0. 018%.

Table 4. Long relation

Long Run Coefficients				
Variable	Coefficient	Std. Error	t-Statistic	**Prob.**
LCO2	-0.127492	0.028674	-4.446286	**0.0001**
LMTHNE	-0.203391	0.073598	-2.763534	**0.0102**
LNITE	0.017060	0.017627	0.967809	**0.3417**
LAVA	0.141606	0.073022	1.939223	**0.0630**
LGCF	0.018003	0.017991	1.000638	**0.3259**
C	-2.550827	1.051175	-2.426643	**0.0222**
observation	**37**	**37**	**37**	**37**

The most widely used continuous probability distribution, the standard normal distribution, has a bell-shaped density curve that can be defined in terms of the mean and standard deviation (mean and SD), and outliers in the data set have little to no effect on the mean. If a continuous data is followed normal distribution, then 68.2%, 95.4%, and 99.7% observations are lie between mean ± 1 SD, mean ± 2 SD, and mean ± 3 SD, respectively. The Jacque Berra test for normality presented in Figure 1 below, shows that the null hypothesis of the model being normal is not rejected. This shows that our estimated model is normally distributed.

Normality test

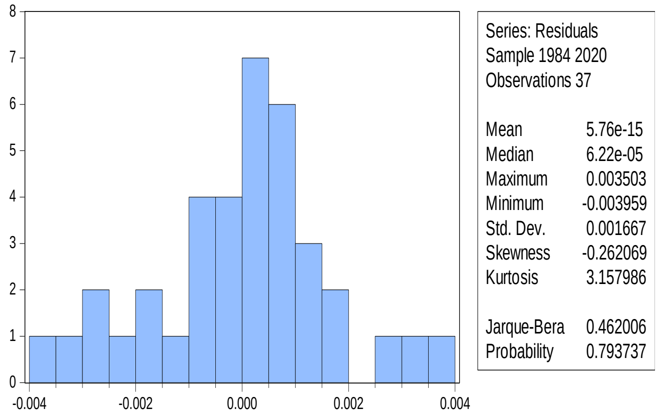

Fig. 1. Normality test

Serial correlation test.

Table 5 below displays the results of the Breusch-Godfrey serial correlation LM test, which demonstrate that no serial correlation exists in the model. The F-Statistic probability value verifies that the residuals lacked any serial dependence. We conclude that there is no serial correlation of residuals since the F-statistic coefficient is too little to do so.

Table 5. Serial correlation test Breusch-Godfrey

Breusch-Godfrey Serial Correlation LM Test:			
F-statistic	0.121268	Prob. F (2,25)	0.8863
Obs*R-squared	0.355503	Prob. Chi-Square (2)	0.8372

Heteroskedasticity test

The Glejser test for Heteroskedasticity test the existence of a constant variance as a null hypothesis. Since one of the key assumptions of the classical linear regression models is that of constant variance the no conformation of Heteroskedasticity will imply spurious regression and biased outcomes. The outcome of the Glejser for Heteroskedasticity test in Table 6 shows from the F statistics, the null hypothesis of a constant variance cannot be rejected and as such we conclude that there is the absence of Heteroskedasticity.

Table 6. Glejser test of Heteroskedasticity

Heteroskedasticity Test: Breusch-Pagan-Godfrey			
F-statistic	1.524288	Prob. F (9,27)	0.1897
Obs*R-squared	12.46575	Prob. Chi-Square (9)	0.1883
Scaled explained SS	26.70672	Prob. Chi-Square (9)	0.0016

The first objective was to examine the effect of carbon dioxide emission on life expectancy in Cameroon. As regard to this, the short and long run analysis both indicated a negative effect of carbon dioxide emission and life expectancy in Cameroon. This is because carbon monoxide (CO) has a far higher affinity for hemoglobin (the body's oxygen carrier) than oxygen does, reducing life expectancy by around a year for every 1 L rise in CO2 emissions. Poisoning levels may range from moderate to severe depending on the amount of CO present and the length of time it is inhaled. Pain in the head and neck, lightheadedness, weakness, nausea, vomiting, and eventually loss of consciousness are all possible side effects of carbon monoxide overdose. There is a high degree of similarity between these signs and those of other conditions, such as food poisoning and the flu. Loss of oxygen owing to CO's competitive binding to the heme groups in hemoglobin is the mechanism by which this toxicity is induced. Pope et al. (2002) found that exposure to particulate matter was associated with increased mortality rates, particularly from cardiovascular and respiratory diseases.The findings confirmed the growing body of research demonstrating the detrimental effects of air pollution on human health, especially the respiratory, cardio-vascular, and neurological systems. Further results also showed that Carbon monoxide have the highest impact on life expectancy. The study by Neidell (2017) on Air pollution and death rates confirmed this as the author discovered that higher levels of air pollution reduces life expectancy. Liu et al. (2019) found that higher levels of particulate matter and nitrogen oxides were associated with increased risk of dementia. Fonkoua et al. (2017) Children exposed to high levels of air pollution had significantly lower lung function and higher prevalence of respiratory symptoms compared to those with lower exposure.

The second objective was aimed at determining the extent to which methane emission affect life expectancy in Cameroon. The short and long run ARDL results indicated a negative relationship between methane emission and life expectancy in Cameroon. To put it another way, a 0.203% drop in life expectancy is associated with a 1% rise in methane emissions (LMTHNE). This is due to the fact that inhaling large concentrations of methane may limit the body's supply of oxygen. In addition to altering one's disposition, this may cause one to slur their words, have trouble seeing clearly, forget things, feel sick, throw up, or have a headache. While methane is directly toxic to people, it also has a significant impact on climate change since it is a powerful greenhouse gas. Reducing human-caused methane emissions by 45 percent in this decade might save 255,000 premature deaths and 775 thousand asthma-related hospital visits, according to a worldwide methane study. Brook et al. (2010) found that exposure to air pollution, particularly fine particulate matter, was associated with increased risk of cardiovascular disease and related outcomes such as heart attack and stroke. Aminde et al. (2018) revealed that maternal exposure to high levels of air pollution during pregnancy was associated with increased risk of preterm birth and low birth weight.

The last objective was to examine the extent to which nitrous oxide emission affect life expectancy in Cameroon. Following the ARDL regression carried out, results showed a positive effect of nitrous oxide emissions and life expectancy in Cameroon. That is to say, a unit increase in Nitrous emission (LNITE) will reduces life expectancy by 0.017%. the logical explanation for this lies in the fact that breathing nitrous oxide can cause dizziness, unconsciousness and even death. Long term exposure to this oxide can cause injuries to the body. Also, the release of nitrogen in to the atmosphere combines with water to form ammonic acids which is acidic in nature. That is why drinking rain water sometimes is usually discouraged especially in industrial zones like Douala. Yasmin (2002**)** look at International environmental law and global public health observed that, the environment continues to be a source of ill-health for many people, particularly in developing countries. To Yasmin (2002), Africans are facing deaths caused by the reactions of nitrous emissions with other gases in the atmosphere. Yasmin emphasized that Africans though Africans contribute a very small part of the world's pollution, they pay the highest price because of lack of technological and health facilities to protect them. Cui et al. (2021 found that higher levels of particulate matter and nitrogen dioxide were associated with increased risk of COVID-19 infection and severity. Tchinda Mouofo et al. (2020) exposed to high levels of air pollution had significantly lower lung function and higher prevalence of respiratory symptoms compared to those with lower exposure.

5. CONCLUSION

Examining how air pollution affects people's health in Cameroon was the primary motivation for this research. The research employed secondary data from the National Institute of Statistics and the World Health Organization from 1980 to 2021, analyzing it using an Auto Regressive Distributed Lag (ARDL) model to get the job done. The Ng-Perron method and the DickyFuller generalized least square (DF-GLS) are used to test for unit roots. Two common ways to check for parameter consistency are the cumulative sum of recursive residuals (CUSUM) and the CUSUM of square (CUSUMSQ). To determine whether the error term has a constant variance, we employed the white test for heteroscedasticity. In the end, the Akaike information criterion (AIC) or the Bayesian information criterion (BIC) are used to determine the optimal lag time.

From a policy perspective, the government should encourage the planting of trees as the planting of one tree implies planting a life. Trees are important because they help to reduce the amount of carbon existing in the atmosphere. Notice that, all the components of pollution all have carbon as an element. Reducing the carbon available in the atmosphere therefore reduces pollution. These trees use carbon as an ingredient for their growth. Given the results, it was recommended that the government should make it possible for the increased pollution in our cities to be reduced. This can be done by avoiding burning plastics. This can be done by encouraging youths to take up initiatives aimed at recycling these plastics. Efforts have been made by young Cameroonians to get rid of plastic by transforming them in to tiling and building bricks. The government can encourage these initiatives by providing them with the necessary finances to go big since they are still operating on a small scale.

REFERENCES

Aminde, L. N., Tindong, M., Ngwasiri, C. A., & Noubiap, J. J. (2018). Effects of air pollution on maternal and child health in Cameroon. International Journal of Environmental Research and Public Health, 15(11), 2397.

Brook, R. D., Rajagopalan, S., Pope, C. A., Brook, J. R., Bhatnagar, A., Diez-Roux, A. V., ... & Silverman, F. J. (2010). Particulate matter air pollution and cardiovascular disease: an update to the scientific statement from the American Heart Association. Circulation, 121(21), 2331-2378.

Chang, T. Y., Graff Zivin, J., Gross, T., & Neidell, M. (2019). The effect of pollution on worker productivity: evidence from call center workers in China. American Economic Journal: Applied Economics, 11(1), 151-72.

Coker, O. O., Dai, Z., Nie, Y., Zhao, G., Cao, L., Nakatsu, G., ... & Yu, J. (2018). Mucosal microbiome dysbiosis in gastric carcinogenesis. Gut, 67(6), 1024-1032.

Crossett, L. S., Sinha, R. K., Sechriest, V. F., & Rubash, H. E. (2002). Reconstruction of a ruptured patellar tendon with achilles tendon allograft following total knee arthroplasty. JBJS, 84(8), 1354-1361.

Crossett, L. S., Sinha, R. K., Sechriest, V. F., & Rubash, H. E. (2002). Reconstruction of a ruptured patellar tendon with achilles tendon allograft following total knee arthroplasty. JBJS, 84(8), 1354-1361.

Cui, Y., Zhang, Z. F., Froines, J., Zhao, J., Wang, H., Yu, S. Z., & Detels, R. (2003). Air pollution and case fatality of SARS in the People's Republic of China: an ecologic study. Environmental Health, 2(1), 15.

Dorothée, G., & Aucouturier, P. (2011). Les réponses immunitaires adaptatives contre le peptide amyloïde Aβ dans la maladie d'Alzheimer-Leçons et perspectives. médecine/sciences, 27(11), 938-940.

Fonkoua, M. C., Nkengfack, G. P., & Ngondi, J. L. (2017). Air pollution and respiratory health of school children in Douala, Cameroon. Environmental Health Insights, 11, 1178630217690777.

Lelieveld J, Evans JS, Fnais M, Giannadaki D, Pozzer A. (2015). The contribution of outdoor air pollution sources to premature mortality on a global scale. Nature 525:367–371; doi:10.1038/nature15371

Lelieveld, J., Evans, J. S., Fnais, M., Giannadaki, D., & Pozzer, A. (2015). The contribution of outdoor air pollution sources to premature mortality on a global scale. Nature, 525(7569), 367-371.

Lelieveld, J., Evans, J. S., Fnais, M., Giannadaki, D., & Pozzer, A. (2015). The contribution of outdoor air pollution sources to premature mortality on a global scale. Nature, 525(7569), 367-371.

Liu, C., Chen, R., Sera, F., Vicedo-Cabrera, A. M., Guo, Y., Tong, S., ... & Ezzati, M. (2019). Ambient particulate air pollution and daily mortality in 652 cities. New England Journal of Medicine, 381(8), 705-715.

Mark, D., Haeberle, S., Roth, G., Von Stetten, F., & Zengerle, R. (2010). Microfluidic lab-on-a-chip platforms: requirements, characteristics and applications. Microfluidics based microsystems: fundamentals and applications, 305-376.

Markham, K. E., & Sangermano, F. (2018). Evaluating wildlife vulnerability to mercury pollution from artisanal and small-scale gold mining in Madre de Dios, Peru. Tropical Conservation Science, 11, 1940082918794320.

Markham, K. E., & Sangermano, F. (2018). Evaluating wildlife vulnerability to mercury pollution from artisanal and small-scale gold mining in Madre de Dios, Peru. Tropical Conservation Science, 11, 1940082918794320.

Marshall, R. E., & Farahbakhsh, K. (2013). Systems approaches to integrated solid waste management in developing countries. Waste management, 33(4), 988-1003.

Neidell, M. J. (2017). Air pollution, health, and socio-economic status: the effect of outdoor air quality on childhood asthma. Journal of health economics, 54, 1-12. doi: 10.1016/j.jhealeco.2017.03.002.

Njumbe, E. S. (2004). The prevalence, distribution, and fate of organic and inorganic contaminants in the Douala drainage basin, SW Cameroon. The University of Manchester (United Kingdom).

Pope Iii, C. A., Burnett, R. T., Thun, M. J., Calle, E. E., Krewski, D., Ito, K., & Thurston, G. D. (2002). Lung cancer, cardiopulmonary mortality, and long-term exposure to fine particulate air pollution. Jama, 287(9), 1132-1141.

Rockström J, Steffen W, Noone K, Persson Å, Chapin III FS & Lambin EF (2013). A safe operating space for humanity. Nature.

Rockström, J., Sachs, J. D., Öhman, M. C., & Schmidt-Traub, G. (2013). Sustainable development and planetary boundaries. Sustainable Development Solutions Network..

Rockström, J., Sachs, J. D., Öhman, M. C., & Schmidt-Traub, G. (2013). Sustainable development and planetary boundaries. Sustainable Development Solutions Network..

Schirnding, Y. V., Onzivu, W., & Adede, A. O. (2002). International environmental law and global public health. Bulletin of the World Health Organization, 80(12), 970-974.

Tchinda Mouofo, J. W., Temfack, E., Tchatchoua, A. P., & Tchoua Kemayou, G. (2020). Effects of air pollution on respiratory health in Douala, Cameroon. The Pan African Medical Journal, 37, 226.

WHO (2018). Burden of disease from the joint effects of household and ambient air pollution for 2016. World Health Organization (WHO), Geneva.https://www.who.int/airpollution/data/AP_joint_effect_BoD_results_May2018.pdf

Xia, M., & Xu, Z. (2011). Hesitant fuzzy information aggregation in decision making. International journal of approximate reasoning, 52(3), 395-407.

Yasmin, F. (2002). Globalization and its impact on education with specific reference to Sri Lanka. International Review of Education, 48(4), 265-284. doi: 10.1023/A:1015530510262.

Yasmin, S., & D'Souza, D. (2010). Effects of pesticides on the growth and reproduction of earthworm: a review. Applied and Environmental soil science, 2010.

Zhong, S., Yu, Z., & Zhu, W. (2019). Study of the effects of air pollutants on human health based on Baidu indices of disease symptoms and air quality monitoring data in Beijing, China. International journal of environmental research and public health, 16(6), 1014.

Zivin, J. G., & Neidell, M. (2012). The impact of pollution on worker productivity. American Economic Review, 102(7), 3652-3673.