Climate Change and Air Pollution: Implication for Human Health and Environment in Rivers State

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I.INTRODUCTION

The importance of sustainability is geared towards development that meets the needs of the present without compromising the ability to also meet future needs and that is why all nations of the world are finding solutions to reduce the impact of climate change and air pollution in the environment. Climate change and air pollution are very important environmental problems facing nations and cities of the world. Climate change has widespread impacts on human and natural ecosystems across the globe. The US and other nations of the world are experiencing its impact but Africa has been considered to be the world's most endangered region due to the tender or fragile nature of its ecosystem and economy [1]. Climate change refers to a shift in the state of the climate that can be identified using statistical tests by changes in the mean or the variability of its properties that persists for an extended period typically in number of decades due to natural variability or as a result of human activities [1]. Climate change alters the composition of the global atmosphere over comparable time periods [2]. Thus, climate change describes the current trend toward higher average of global temperatures and accompanying environmental shifts such as rising sea levels and more severe storms, floods, droughts and heat waves [3]. The phenomenon is basically is a statistically observed change in the climatic elements of a country or region over a period of time.

Air Pollution is the introduction of contaminants into the natural environment. It is the presence of substances or particles in the air that pose danger, damage and disturbance to humans, flora as well as fauna. Air pollution results from degradation of air quality with negative effects on human health and the natural as well as built environment due to the introduction (by natural processes or human activities) into the atmosphere of substances in the form of gases and aerosols which have a direct primary pollutants or indirect secondary pollutants with resultant harmful effect [4].The effects of gases emitted to the atmosphere is a problem that is facing all the nation of the world. Aerosols are known as suspension of airborne solid or liquid particles with a typical size between a few nanometers and 10μm that reside in the atmosphere for at least several hours [5]. It may be of natural or anthropogenic origins and can influence climate in several ways: through the interactions that scatter and absorb radiation or through interactions with cloud microphysics and other cloud properties. Thus, it can occur through deposition on snow or ice-covered surfaces thereby altering their albedo and contributing to climate feedback [4]. Atmospheric carbonaceous aerosols constitute a significant part of the atmospheric aerosols; while a large part of them consists of an organic material [6].The carbonaceous atmospheric particulate matter consists of black carbon known as Elemental Carbon (EC) and a variety of organic compounds. Aerosol Black Carbon (BC), produced mainly due to incomplete combustion of fossil fuel or biomass is amongst the strongest contributors to the radioactive warming of the atmosphere [1]. Findings showed that the current illegal artisanal refining of crude oil siphoned from pipelines crisscrossing the coastal areas of Port Harcourt is the reason for the incidence of soot in the lower troposphere of the city[11] [13].

Air pollution is a major environmental health problem affecting every nation of the world. The World Health Organization (WHO) guideline states that daily exposure to particulate matter $PM_{2.5}$ per cubic meter of air should not exceed 25 micrograms, yet this figure is surpassed in many cities around the world [7]. Ambient outdoor air pollution in both cities and rural areas was estimated to cause 4.2 million premature deaths worldwide per year in 2016; this mortality is due to exposure to small particulate matter of 2.5 microns or less in diameter ($PM_{2.5}$), which causes cardiovascular and respiratory disease and cancers [7]. Air becomes polluted when it carries gaseous and particulate matter at levels which they become objectionable; capable of causing discomfort, harm to man and his environment as well as his amenities .The impact of climate change, pollution on quality of air in Port Harcourt metropolis and surrounding towns as well as other parts of the Niger Delta have been studied by various scholars, who rank the region's air quality amongst the top 10 most polluted regions in the world [8-13] and revealed evidence of climate change in the city [14]. Meanwhile, the generation of other pollutants, such as Nitrogen Oxides (NO and NO_2), Sulfur Oxides (SO_2 and SO_3) and particulate matter is the main reason the air is contaminated.

II. CAUSES OF CLIMATE CHANGE

Climate change is caused by two factors: through the natural processes and through anthropogenic actions. Furthermore, there is the opinion that internal changes to the climate system such as variations in ocean currents or atmospheric circulation can also result in climate variability or change [15]. Climate

can be confronted by natural factors which are external to it, which may include volcanic activities, solar output and the earth's revolution [1] [15].

In terms of the earth's energy balance, these factors primarily influence the amount of incoming energy. Changes in solar irradiance has added to climate trends over the past century but since the Industrial Revolution, the result of additions of greenhouse gases (GHGs) to the atmosphere has been about ten times that of changes in the Sun's output but scientist believe that human activities can very likely explain most of the global warming [15].

Scientists believe that human activities over the past century have contributed to climate change through GHGs emissions. It is observed that human influence on the climate system is clear, and recent anthropogenic emissions of greenhouse gases are the highest in history [4]. These GHGs come majorly from fossil fuels in quests for energy production, even though deforestation, industrial activities and some agricultural practices emit GHGs gases into the atmosphere. The greenhouse gases are carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O). Although CO_2 is the main gas contributing to climate change, it is not harmful to human health. These GHGs form a blanket layer in the upper atmosphere that traps heat and causes warming of the earth. This occurrence is called the greenhouse effect and is natural and necessary to support life on Earth. The figure 1, demonstrates in pictorial form, the greenhouse effect where GHGs absorb and re-emit radiant energy escaping from the earth's atmosphere into deep space.

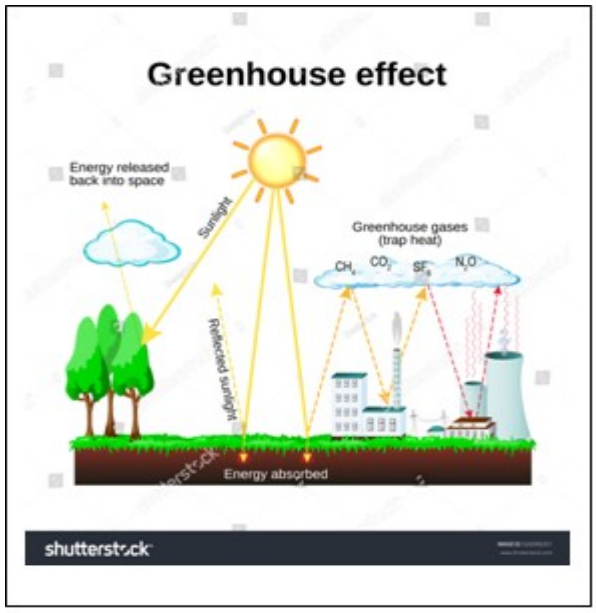

Figure1: Green House Effect
Source: shutterstack

However, increase in the concentration of GHGs in the atmosphere as a result of human activities has led to changes in the Earth's climate system and leading to dangerous effects to human health, welfare and to the ecosystems. These Anthropogenic greenhouse gas emissions have increased since the pre-industrial era driven largely by increased economic activities and population growth. Historically, emissions have driven atmospheric concentrations of carbon dioxide, methane and nitrous oxide to levels that are unprecedented in at least the last 800,000 years, leading to an uptake of energy by the climate system [4].

III. SOURCES OF EMISSION INTO THE ATMOSPHERE

The main sources of atmospheric contamination are tropospheric Ozone gases (O_3), Sulfur Oxides (SO_2 and SO_3), Nitrogen Oxides (NO and NO_2), Benzo Pyrene (BaP) Methane (CH_4). Methane is not harmful to human health at moderate doses. However, methane has a very important indirect human health impact, because it is a precursor to ground-level ozone (O_3) also known as tropospheric ozone which causes asthma and other respiratory diseases and Black Carbon (BC) known as soot which is a component of fine particulate matter ($PM_{2.5}$). Particulate matter is the air pollutant that is most harmful to human health and the primary driver of air pollution-induced mortality [16].

The two air pollutants that are of great concern to public health are surface ozone and particulate matter resulting mainly from emissions caused by the burning of fossil fuels including emissions generated by transport, industrial processes, burning of forests, aerosol use, and emissions from gas turbines to generate power for production facilities and residential quarters. The major source in Port Harcourt however is traceable to illegal artisanal refining of crude oil (Plate 1).

Plate 1: Illegal refining Source: The Atlantic

The presence of the soot constitutes hazards of air pollution and thus has notable effects on the air quality, visibility and contributes immensely to the changing climate impacts in Port Harcourt. Several coastal communities contiguous to the artisanal refineries whose activities generate the most part of this air pollution dilemma are constantly fumigated with the black soot and the experience continuous showers of soot deposits, enveloping every sphere their daily existence [17].

Results from the investigations into the composition of the black soot in Port Harcourt revealed that lead (Pb), Nickel (Ni), Cobalt (Co) and Polycyclic Aromatic Hydrocarbons (PAHs) all exceed the WHO/EPA allowable limits which is estimated at reducing annual average fine particulate matter ($PM_{2.5}$) concentrations from levels of 35 $\mu g/m^3$, common in many developing cities, to the WHO guideline level of 10 $\mu g/m^3$, could reduce air pollution-related deaths by around 15% [7] [10] [18].

IV. IMPACT OF CLIMATE CHANGE AND AIR POLLUTION ON HEALTH AND THE ENVIRONMENT

Climate change impacts result in increased surface/ambient air temperatures, changes in pattern of precipitation, melting of glaciers, increased temperatures of the sea surfaces, rising sea level around the world, acidification of the oceans due to elevated level of absorbed carbon-dioxide from the atmosphere as they determine responses of plants and animals [1] [19]. Climate change causes drought, flooding, deforestation, homelessness and extinction of animal and plant species resulting in famine and disease. Incidentally, the concentration of the GHGs in the atmosphere is on the increase and this implies greater future warming and further changes in the climate of the world and can obstruct the target of keeping global temperature rise to 1.5˚C below pre-industrial era levels. Urgent action is therefore needed over the next 12 years if there is to be any chance of achieving this target [4]. In Port- Harcourt, temperature for the past two decades has been on the increase, while annual mean rainfall is decreasing [14].

Air pollution impacts on plants (crops) through the deposition of oxides of carbon, nitrogen, sulphur and Volatile Organic Compounds (VOCs) in the aerosols on plant leaves, acidification of soils and water bodies, will ultimately lead to poor crop yield, fish catch, dwindling agricultural productivity and livelihood. It increases the health hazards expressed as heightened respiratory diseases especially in children and the elderly, and the risk of developing mutations, carcinogenesis in the long term and teratogenicity possibilities in developing fetuses as a result of constant inhalation of these carbonized aerosols [16]. It also causes rapid deterioration of amenities such as car chassis, roofing sheets and other metallic and nonmetallic materials, increased cost of house care as constant cleaning and washing of household ware is required and it reduces the aesthetic value of our surroundings due to the deposition of the black soot on all surfaces.

V. THE ENVIRONMENTAL AIR QUALITY

The air quality of an environment is tied to the atmospheric processes of the location and poor air quality is when the emissions of nitrogen oxides, methane and other harmful gases are above levels acceptable for human health. Ground-level (Tropospheric Ozone) is a serious pollutant produced from other gases under favorable conditions, which at high levels damages human health and vegetation, including crop yields but stratospheric ozone which forms naturally in the upper atmosphere and protects us from the sun's harmful ultraviolet rays. It is therefore important to note that the changing environmental conditions, including rising temperatures caused by climate change, are expected to increase concentrations of ground level ozone [20]. The air over the Niger Delta region which Port Harcourt city is integrated in terms of the weather systems does attenuate and sometimes enhance emissions dispersion [13]. In Port Harcourt, studies revealed that the air quality in the city is polluted and poses a major risk to human health; long-time exposure may exacerbate cases of respiratory and cardiovascular problems among the exposed population [21]. The level of concentration of black carbon at different land use areas of Port Harcourt city is relatively very high with minimum mean value of 2.33 ± 1.66 $\mu g/m^3$ and maximum mean value of 4.66 ± 5.43 $\mu g/m^3$ in the morning hours and in the evening period it has minimum mean of 1.25 ± 0.62 $\mu g/m^3$ and maximum mean of 4.75 ± 3.13 $\mu g/m^3$ respectively [22]. There is urgent need to reduce the emissions of these hazardous gases in to the atmosphere.

VI. POLICIES THAT CAN BE ADAPTED TO REDUCE AIR POLLUTION

There are many examples of successful policies in transport, urban planning, power generation and manufacturing industry that can reduce air pollution. Most sources of outdoor air pollution are known to be beyond the control of individuals and demands concerted action by local, national and regional level policy-makers working in sectors like transport, energy, waste management, urban planning, and agriculture. Therefore, striving to enforce these policies by the World Health Organization will help to reduce air pollution [7]. These policies are derived from the following:

Industry: clean technologies that reduce industrial smokestack emissions; improved management of urban and agricultural waste, including capture of methane gas emitted from waste sites as an alternative to incineration for use as biogas.

*Energy***:** ensuring access to affordable clean household energy for cooking, heating and lighting.

Transport: prioritizing rapid urban transit, walking and cycling networks in cities as well as rail interurban freight and passenger travel; shifting to cleaner heavy-duty diesel vehicles and low-emissions vehicles and fuels, including fuels with reduced sulfur content.

Urban planning: improving the energy efficiency of buildings and making cities more green and compact and thus energy efficient

*Power generation***:** shifting to clean modes of power generation. Increased use of low-emission fuels and renewable combustion-free power sources such as solar, wind or hydropower, co-generation of heat and power and distributed energy generation such as mini-grids and rooftop solar power generation.

Municipal and agricultural waste management: strategies for waste reduction, waste separation, recycling and reuse or waste reprocessing as well as improved methods of biological waste management such as anaerobic waste digestion to produce biogas are feasible and low cost alternatives to the open incineration of solid waste. Where incineration is unavoidable, then combustion technologies with strict emission controls are critical.

VII. CONCLUSION

The threat of climate change and air pollution on the health of people is very obvious. This poses a great danger to the economy of the state resulting from people migrating to other places. It is very important to establish and enforce policies regarding air pollution. Thus, illegal refining of crude oil should be abated and the government should proactively engage in massive tree planting that will help sanitize the environment. There is a need for regular and strict monitoring of atmospheric pollutants in Port Harcourt region to ensure it does not exceed the accepted level so as to avert its health challenges. Finally, crude burning of hazardous factory wastes should be discouraged and vehicular emissions should be regulated. A healthy city is a product of healthy environment and atmospheric processes.

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