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EMERGING ISSUE IN ENVIRONMENTAL AIR QUALITY IN NIGERIA: A BRIEF REVIEW

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ABSTRACT

Nigeria faces a significant environmental challenge concerning air quality, driven by increasing industrialization, urbanization, and insufficient waste management. Pollutants such as particulate matter, nitrogen oxides, sulfur oxides, carbon monoxide, polycyclic aromatic hydrocarbons, and volatile organic compounds deteriorate air quality. These pollutants are released from vehicle exhaust, generator emissions, industrial diesel plants, waste burning, and dust. They pose serious health risks, including respiratory and cardiovascular diseases. Addressing the challenges of emerging contaminants requires persistent policy implementation, public awareness, and sustainable practices to improve air quality and safeguard public health in Nigeria, as well as its environmental integrity.

Keywords: Air-quality, Contaminants, Emerging, Environment, Pollutants.

INTRODUCTION

The quality of outdoor air is crucial to human health and the environment. Outdoor good air quality brings a healthy and quality environmental integrity. Poor air quality is a significant challenge in Nigeria (Akpan & Akpan, 2019), as it contributes to atmospheric contamination. This reduces the quality of air in the environment, resulting in significant impacts on public health.

According to Ogbuewu & Nnaji (2023), numerous researchers have conducted extensive studies on water quality assessment in both urban and rural areas in Nigeria. However, there is a need to extend this approach to environmental air quality, ensuring the environment is free from toxic contamination. Poor air quality can be disastrous as it can lead to contamination of the air by harmful substances like oxides of

sulphur, oxides of nitrogen, carbon monoxide (CO), polycyclic aromatic hydrocarbons (PAHs), and volatile organic compounds (VOCs) from exhaust fumes which poses health risks to humans, animals and the environment. Environmental air quality refers to the conditions of outdoor air and its impact on humans, animals, other living organisms, and their infrastructure. Poor air quality (air pollution) can emanate from various sources, including exhaust emissions from generators and vehicles, industrial activities, the burning of waste materials or incineration, and dust. These lead to respiratory and cardiovascular disease, premature death, and other health challenges. In Nigeria, the poor air quality is exacerbated by rapid industrialization, urbanization, inadequate waste management, and limited enforcement of environmental regulations. According to Ogbuewu & Nnaji (2023), an air quality monitoring network does not exist in Nigeria. It has been recorded that poor air quality causes more premature deaths per year than unsafe drinking water or malnutrition (Roy, 2016). According to the World Health Organization (WHO), poor air quality was responsible for 11.6% of global deaths in 2012, resulting in approximately 6.5 million deaths annually, with 3 million attributed to outdoor pollution. The majority (88%) of these deaths occurred in low and middle-income countries (WHO, 2016). Furthermore, the Organization for Economic Cooperation and Development (OECD) estimated that over 700,000 premature deaths in Africa were linked to poor air quality (Roy, 2016), highlighting the urgent need for environmental sanitization and mitigation of air pollution. Numerous studies have investigated air pollution in major cities worldwide, including those in Europe, Asia, and North America, highlighting the necessary actions to reduce emissions. According to Kampa & Castanas (2008), anthropogenic activities are primary sources of air pollutants. However, air pollution research is limited in Africa, particularly in West Africa, underscoring a significant knowledge gap in the region (Norman *et al.*, 2007). Air quality is primarily hindered by air pollution, which causes harmful effects and results in adverse environmental impacts. Air pollution, on the other hand, is the presence of substances in the air that are harmful to humans, other living organisms, and the environment. The pollutants could be gases like sulphur dioxide, nitrogen oxides, ozone, and soot, which affect both outdoor and indoor air quality.

SOURCES OF AIR POLLUTION

The various sources of air pollution that contribute to poor air quality in the environment include both natural and anthropogenic sources. The natural sources include wildfires, dust storms, and volcanic eruptions. In contrast, anthropogenic sources include indoor air pollution from industrial processes, the burning of fossil fuels for electricity generation, transportation, waste management, and agriculture. The major source of air pollution stems from the daily activities of humans, including the burning of fossil fuels, construction, and transportation (Perera, 2017). Warfare, nuclear weapons, and rocketry can also contribute to air pollution (Hafemeister, 2016).

Industrial and Construction

The burning of fossil fuels to generate electricity, as well as construction, renovation, and demolition, generates dust and other pollutants that can cause air pollution (Lauvaux *et al*., 2022; Azarmi & Kumar, 2016). Old buildings constructed with asbestos, although banned in some countries, pose a risk of lung disease upon exposure during demolition (Caceres & Venkata, 2023). Carpet and plywood emit formaldehyde (HCHO) gas, which also contributes to air pollution and is detrimental to humans upon exposure.

Household Sources

As of 2003, over 2.3 billion people in developing countries heavily rely on burning biomass fuels, such as wood, coal, and kerosene, for cooking, which causes indoor air pollution (WHO, 2016). The effect is particularly pronounced among women who are likely to be responsible for cooking and caring for younger children (WHO, 2016). The gas stove also contributes to air pollution by emitting NO_2, benzene, and carbon monoxide (Niranjan, 2024).

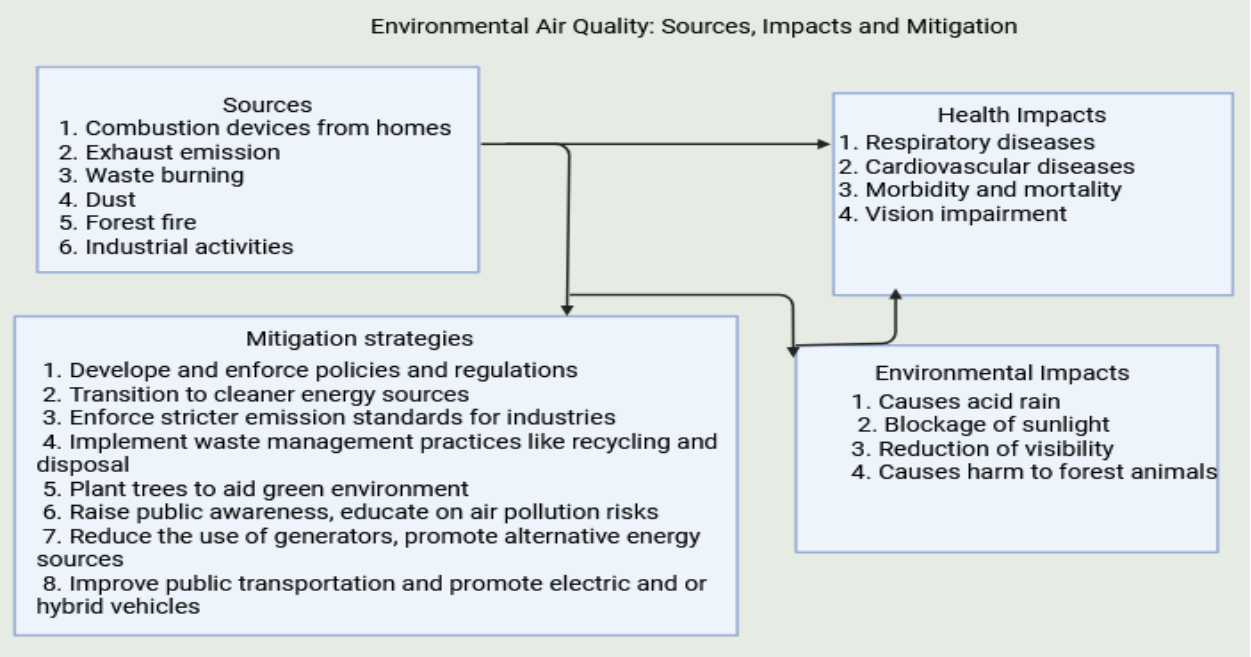

Figure 1: Environmental air quality; sources, impacts, and mitigations

OTHER POLLUTANTS RESPONSIBLE FOR AIR QUALITY REDUCTION

Aerosol

Air pollutants can also take the form of aerosols. These are solid particulates or liquid droplets dispersed and carried out by gas (Hidy, 2012). This encompasses fog, mist, smog, smoke, and spray, and can be either natural or man-made, impacting air quality, climate, and human health.

Another major driver of climate change is emissions from vehicles, which release particulate matter and other pollutants into the atmosphere (Wang *et al*., 2019; Aggarwal & Jain, 2015). Diesel trains, ships, and planes also contribute significantly to air pollution. Fertilizer, on the other hand, serves as a source of manure for agricultural purposes and also contributes to nitrogen oxides. In low-income countries like Nigeria, the open dumping of waste is a major source of air pollution. The waste materials may be intentionally burned or ignite on their own, releasing soot, methane, and other pollutants (United Nations Environmental Programme (UNEP), 2021).

CLASSIFICATION OF POLLUTANTS

Carbon dioxide (CO_2)

The primary source of CO_2 is the burning of fossil fuels. It is potentially lethal at high concentration, that is, when the concentration is above the atmospheric level. However, WHO recognizes CO_2 as a climate pollutant and does not include the gas in its air quality

guidelines or set a recommendation target for it (WHO, 2006). CO_2 is called an air pollutant because it is the major greenhouse gas responsible for climate change (Vallero, 2014).

Carbon monoxide (CO)

CO is a colourless, odourless, and highly toxic gas. It is the product of the incomplete combustion of fuel such as natural gas, coal, or wood. Vehicular emissions were the major sources of CO in the past; however, modern vehicles do not emit much CO. Wildfires and bonfires are the major sources of outdoor CO emissions presently (Pearson & Derwent, 2022). Indoor CO is a major problem and primarily originates from cooking, heating, and generator exhaust.

Nitrogen oxides

Nitrous oxide (N_2O) is mainly emitted by the burning of fossil fuels and lightning in lesser amounts. NO_2, on the other hand, is produced from the reaction of NO with other atmospheric gases (Ogbuewu & Nnaji, 2023; Perez-Invernon *et al*., 2022). NO and NO_2 can cause acid rain. NO_2 is a reddish-brown toxic gas with a strong odour, while NO is odourless and does not have a colour.

Oxide of sulfur

Sulfur oxides can react with some compounds in the atmosphere to form other particles and contribute to particulate matter pollution. At high concentrations, gaseous sulfur oxides can damage plants by decreasing their growth. SO_2 is a corrosive, acidic gas formed by burning crude oil and coal. Fossil fuel also contains sulfur compounds, and their combustion generates SO_2.

Ground-level ozone (O_3)

This is mostly found when nitrogen oxides and volatile organic compounds (VOCs) are mixed in the presence of sunlight. It can also be obtained from CO or CH_4. Ozone (O_3) can react with other compounds to form photochemical smog. When ground-level ozone is produced, it can stay in the air for a long period and therefore can be transported far from where it was first formed.

Volatile Organic Compounds (VOCs)

VOCs are both indoor and outdoor pollutants. VOCs are a group of compounds that can contribute to photochemical smog and aerosols, thereby impacting climate change. VOCs include CH_4, CO, acetone, toluene, etc. Some of these compounds, such as butadiene and benzene, can cause cancer (Lewis, 2018). Methane is a highly efficient greenhouse gas that contributes significantly to global warming.

EFFECTS OF POOR AIR QUALITY ON HUMANS AND THE ENVIRONMENT

Polluted air has been discovered to cause health risks and environmental challenges. Some of the health problems associated with poor air quality are stated herein.

Cardiovascular disease: There is strong evidence that air pollution increases the risk of cardiovascular disease, including stroke, high blood pressure, and ischemic heart disease (de Bont *et al.*, 2022). According to the Global Burden of Disease Study (GBDS), air pollution is responsible for 27 % of deaths from strokes worldwide and 28 % of ischemic heart disease (de Bont *et al.*, 2022). The risk is higher in regions with higher air pollution for elderly and overweight individuals (de Bont *et al.,* 2022).

Lung Disease: polluted air has been associated with increased hospitalization and mortality, as well as chronic obstructive pulmonary disease (COPD) (Holtjer *et al.,* 2023). COPD is a common disease that causes breathing difficulties, and it is the fourth largest cause of death globally (Holtjer *et al.*, 2023). Almost half of COPD deaths are due to poor quality of air inhalation. Particulate matter (PM) and NO_2 were also associated with an increased risk of developing COPD (Holtjer *et al.*, 2023). Polluted air is also associated with an increase in asthma cases (Holtjer *et al.*, 2023).

Cancer: Over 265,000 lung cancer deaths were attributed globally in 2019 to exposure to fine particulate matter, suspended in the air (Berg, 2023). Exposure to indoor air pollution, including radon, causes another 170,000 lung cancer deaths (Berg, 2023). Lung cancer is common among people exposed to NO_2 and black carbon (Karimi & Samadi, 2024).

Teratogenic effects: Congenital disabilities, miscarriages, and stillbirths are likely when the mother is exposed to air pollution during pregnancy. Exposure to air pollution is associated with low birth weight. This may be as a result of the pollutants impacting the placenta or fetus directly or indirectly via the mother's health (UNICEF, 2024). Polluted air in children resulted in the death of over 700,000 children in 2021, where709 000 were less than 5 years of age and 16,600 were aged 5 to 14 years (UNICEF, 2024). Children in low-income countries are exposed to PM at higher rates than those in higher-income countries. Other health effects of air pollution in children include asthma, pneumonia, and lower respiratory tract infections. There is also a possible link between exposure to air pollution during pregnancy and after birth and autism in children (Dutheil *et al.*, 2021; Kang *et al.*, 2024).

MITIGATION STRATEGIES TO AIR POLLUTION

Transition to Cleaner Energy

Transitioning from fossil fuels to cleaner energy sources, such as solar, wind, and electric power, can significantly reduce air pollution. This transition can be achieved by investing in renewable energy infrastructure, promoting energy-efficient technologies, and encouraging sustainable practices (Qiu *et al.*, 2016).

Improve Public Transportation

Enhancing public transportation can decrease reliance on personal vehicles, reducing emissions and air pollution. This can be achieved by developing efficient public transit systems, such as buses and trains, through government investment in electric or hybrid vehicles, as well as encouraging cycling and walking (Rojas-Rueda *et al*., 2016).

Enforcement of Emission Standards

Strict enforcement of emission standards can hold polluters accountable and drive change. Authorities should implement and enforce regulations on industrial emissions, conduct regular vehicle emissions testing, and impose penalties for non-compliance with these regulations. Authorities should also support the introduction of new technologies for air quality monitoring (Mishra *et al*., 2015). With these measures in place, environmental air quality in Nigeria can improve significantly.

CONCLUSION

Nigeria, as a nation, faces significant environmental air quality challenges due to Rapid urbanization and industrialization, which contribute significantly to air pollution. Sources include industrial activities, vehicular emissions, generator use, waste burning, and incineration, among others. This situation leads to severe health issues, such as respiratory diseases, cancer, asthma, and cardiovascular problems. Most deaths from air pollution occur in low- and middle-income countries like Nigeria. To mitigate air pollution, several strategies should be employed, including transitioning to cleaner energy sources, enhancing public transportation, and enforcing stricter emission standards. Additionally, raising public awareness and implementing effective policies can help address this emerging issue. Nigeria needs to prioritize environmental sanitation and sustainable practices to protect public health and well-being. Effective action is necessary to mitigate the effects of air pollution.

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