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Towards UN SDG Goal 11 and 3: Analysing the Impact of 2021 Air Pollution Episodes On Human Health for Ghana and Nigeria

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ABSTRACT

Abstract—The mixture of solid particles and liquid droplets found in the air termed Particulate matter (PM) which described one form as PM2.5 is generated from many sources and can vary in chemical composition and physical characteristics[1]. Sulfates, nitrates, black carbon, and ammonium are typical chemical components of PM2.5. Internal combustion engines, power generating, industrial, agricultural, construction, and domestic wood and coal burning are some of the most prevalent human-made sources[1]. The most frequent wildfires, sandstorms, and dust storms are the main natural sources of PM2.5, degrading air quality. This research seeks to analyze the impact of air pollution episodes on air quality for Ghana and Nigeria by employing the services of the dataset from the NASA Giovanni System. We have used time series analysis of PM2.5 from the NASA Giovanni System that spans the years 2011 to 2021. The results obtained show that both Ghana and Nigeria recorded PM 2.5 which exceeds WHO guidelines above 4 to 5 times. In both cases PM 2.5 values are significantly lesser than 2020 and 2015 being the most polluted year compared with the past 10 years. This work recommends a regional and collaborative approach to air quality management via policy, monitoring, implementation and awareness to be able to reach the WHO and UN SDG goals 11 and 3.

Keywords: PM2.5, Air Pollution, SDG, Human Health, Satelite Technology

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1. INTRODUCTION

An estimated 4 million premature deaths are caused by exposure to outdoor air pollution every year, while an additional 3–4 million are caused by interior air pollution, accounting for around 1 in 9 fatalities globally[2][3]. Depletion of the ozone layer is caused by the degradation of atmospheric conditions. In addition to having a harmful impact on the environment, pollution is bad for human health, increasing the risk of conditions including lung cancer, heart disease, and stroke. The Environmental Protection Agency in Ghana periodically measures the amount of pollution concentration in the atmosphere from selected locations. The monitoring is done by using portable hand-held air quality monitoring devices which they carry with them to instantly monitor the levels at the short period of time when they are onsite. This short time measurement will not accurately reveal the actual pollution levels of across the country. There is the need for a continuous measurement to determine accurate pollution levels.

Satellite monitoring and ground based technologies are widely known to provide comprehensive coverage of data collection for monitoring of pollutions levels. Due to the limited number of ground based instruments in most part of the world which Africa is include, Satellite based monitoring is a cost effective means to provide continuous monitoring. Efficient use of satellite solutions will provide great insight to policy makers and researchers on the efforts towards reaching the UN SGD goals 3 and 11 as indicated. Therefore this study utilizes satellite data to provide an understanding of what happened in the year under consideration and how it compares to the past 10 years.

The majority of the pollution is from industry and the mining sector, bush fires etc. This research seeks to analyze the impact of pollution activities on the environment by considering two different countries ie. Ghana and Nigeria by employing time series analysis of PM2.5 derived from the NASA Giovanni System. An area average time series spanning the years 2011 up to 2021 was used to determine the pollution levels and the health issues involved.

Nigeria & Ghana

As the two largest economies in West Africa, the relationship between Nigeria and Ghana is a crucial one for the region. Trade ties are particularly important, and Nigeria's high levels of liquidity serve as an important source of capital for Ghana. However, a recent dispute between the two countries concerning the status of Nigerian traders in Ghana is a reminder of past bilateral tensions that have occasionally worsened political and economic relations, although the two countries have since moved to resolve the row and their governments have not heeded calls to sever ties. Nigeria and Ghana are the largest and second-largest economies in West Africa, respectively, and are also the two biggest oil producers in the region, although the difference in output between the two is immense. Nigeria was Ghana's third-most-important trade partner in 2010, accounting for almost 10% of total Ghanaian foreign trade. Ghana, in turn, was Nigeria's ninth-largest trade partner in that same year, accounting for some 1.3% of Nigerian trade (including 1.9% of exports). Nigeria has also been a very important source of investment in Ghana. In recent years, for example, several Nigerian banks have set up shop in Ghana, as has the Nigerian telecommunications company Globacom [16]

Global Burden Of Disease – Ghana And Nigeria

Figure 1a shows the geographical demarcation of Ghana, one of the countries under study. Figure 1b shows the Cause-Specific burden (Ghana, PM2.5, Deaths) from the Health Effects Institute. 2020[4]. The data source is the Global Burden of Disease Study 2019[5].

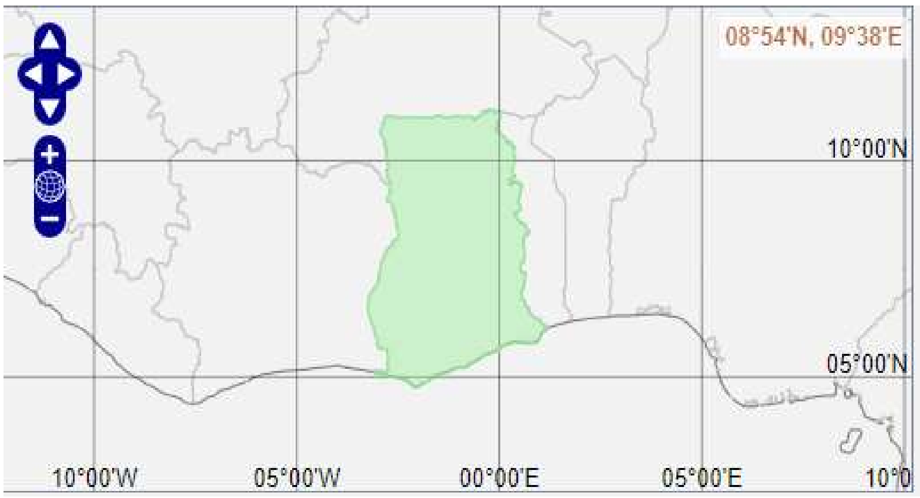


Figure 1a. The geographical demacation of Ghana

Figure 1b shows the percentage of deaths attributable to air pollution and non-air pollution for the year 2019. It must be noted that Chronic obstructive pulmonary disease (COPD) is the only disease for which health burden for ozone is estimated. Neonatal deaths and DALYs are estimated only for PM2.5, household air pollution, or the two combined (air pollution). Neonatal outcomes include complications from being born too small (low birth weight) or too early (pre-term) and lower respiratory infections. The percentages displayed by this graph on the cause-specific burden of air pollution (ambient air) in the 2019 year is very significant to elicit urgent attention and drastic measures if the selected SDG goals will be met.

The goal 3 ("Good Health and Well-being")-Target 3.9 seeks that “By 2030, substantially reduce the number of deaths and illnesses from hazardous chemicals and air, water and soil pollution and contamination”. The goal 11 ("sustainable cities and communities") Target 11.6 seeks that “By 2030, reduce the adverse per capita environmental impact of cities, including by paying special attention to air quality and municipal and other waste management.”[6] Indicator 11.6.2: Annual mean levels of fine particulate matter (e.g. PM2.5 and PM10) in cities (population weighted)[6].

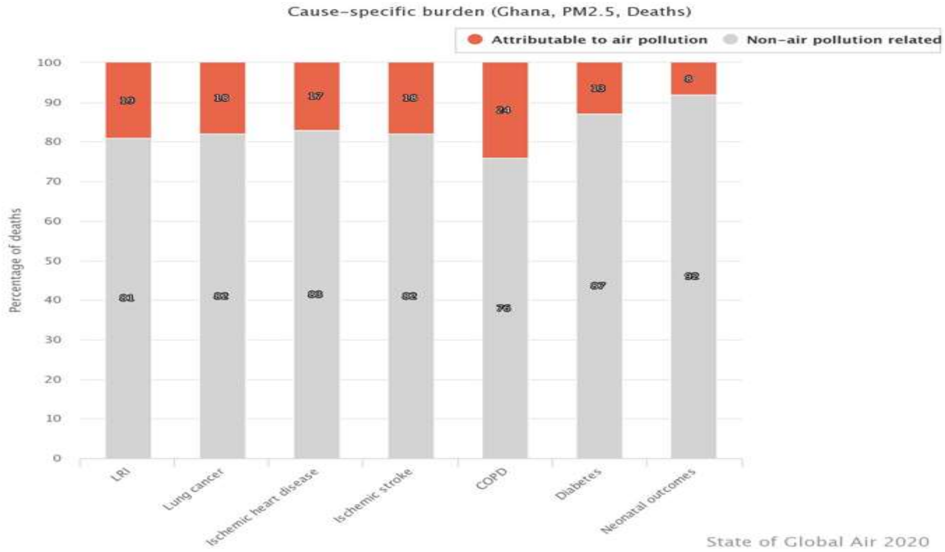


Figure 1b. Cause-Specific burden (Ghana, PM2.5, Deaths)

The geographical location of Nigeria is shown in Figure 1c and Figure 1d shows the Cause-Specific burden (Nigeria, PM2.5, Deaths). The rate of death attributable to air pullution for both countries in the year 2019 can not be grassed over. Figure 1e shows the relationship between the two countries.

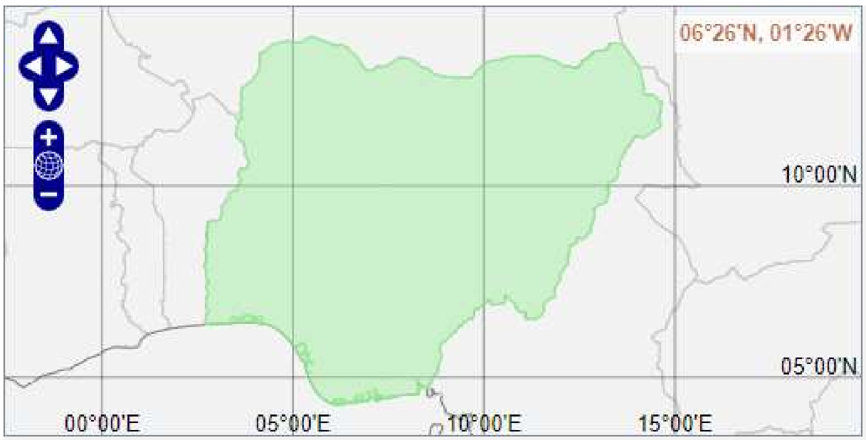


Figure 1c. The geographical demacation of Nigeria.

It worthy to note that in numerical terms Nigeria shows larger number of deaths but in percentages Ghana has a greater percentage of deaths attributable to air pollution than Nigeria. No data was available at the time of study for 2020 and 2021. But the case is made from the available data to show the need for working towards the specified SDG afore mentioned.

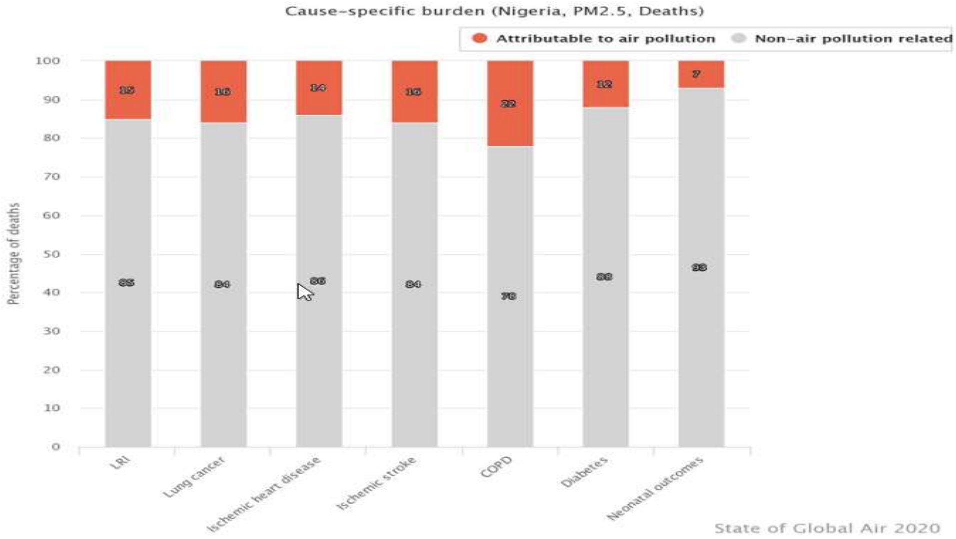


Figure 1d. Cause-Specific burden (Nigeria, PM2.5, Deaths)

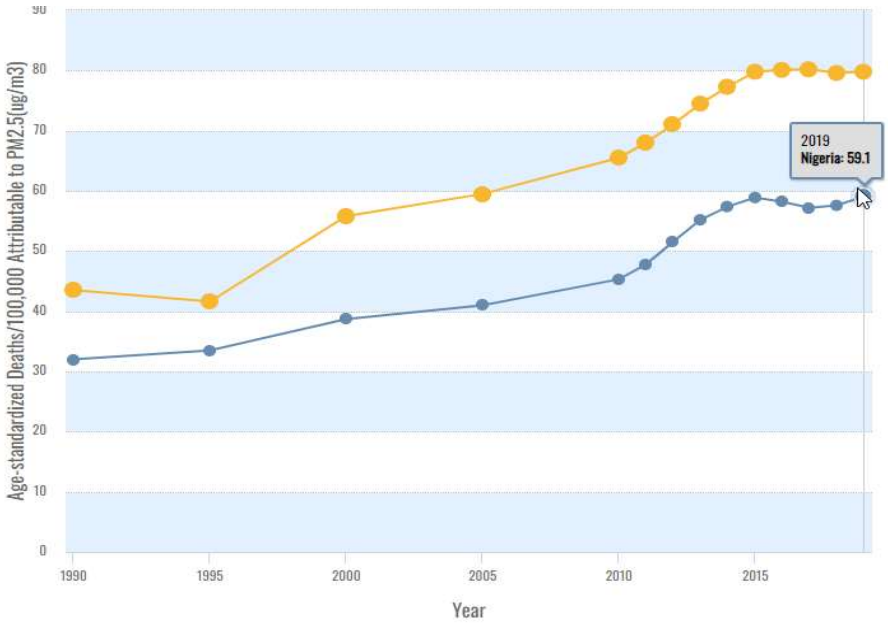


Figure 1e Comparing the cause specific burden for Ghana (yellow line) and Nigeria (blue line)

The State of Global Air 2020 estimates the cause specific burden of deaths attributable to air pollution for Ghana to be at a rate of 79.8 and that of Nigeria to be 59.1. in 2021. Using Age-standardized Daaths/100,000 as shown in Figure 1f(a) and 1f(b) for comparison among countries, the differences can be explained. It shows that the proportion of persons in Ghana's population in the corresponding age group is 79.8 whiles Nigeria is 59.1 in the case of death from cardiovascular diseases, estimated from similar age distribution. This means among the two countries Nigeria is better of, but advanced countries like Canada has better rate of 5.39 as at 2019, and that Ghana and Nigeria have more room for improvement as far as the SDGs in focus are concerned.

To draw attention to the need for effective and early realiziation of the SDG 3 and 11 this trend must be of concern to elicit urgent efforts in realizing the goal whiles reversing the trend.

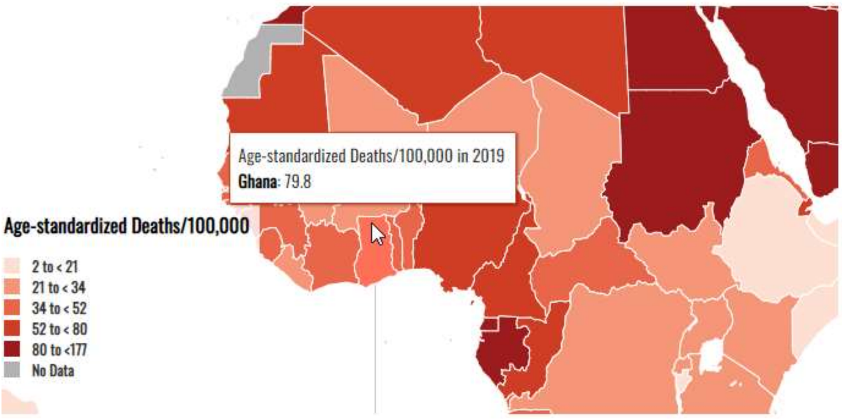


Figure 1f.(a) Age-standardized deaths/100,000 in 2019, Ghana

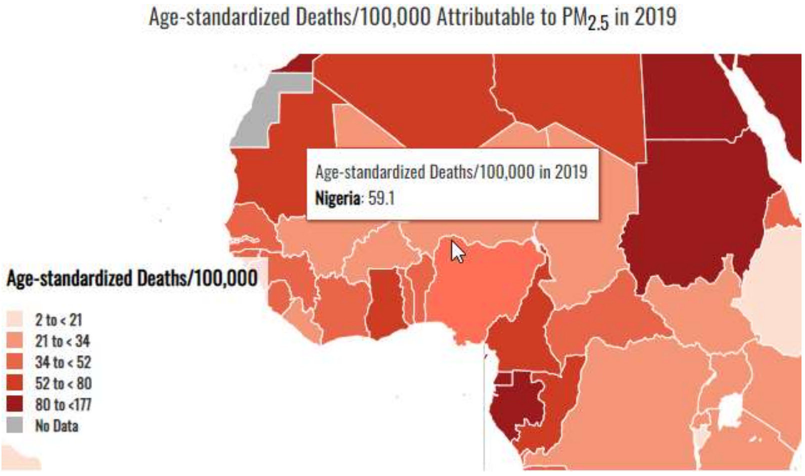


Figure 1f.(b) Age-standardized deaths/100,000 in 2019, Nigeria

2. LITERATURE REVIEW

PM2.5

PM2.5, or particulate matter, is one of six regularly measured criteria air pollutants and is widely regarded as the most dangerous to human health due to its widespread environmental presence and wide range of negative health effects. It is made up of fine aerosol particles with a diameter of 2.5 microns or less. PM2.5 is produced from a variety of sources and can have different chemical and physical properties. Sulfates, nitrates, black carbon, and ammonium are typical chemical components of PM2.5.

Internal combustion engines, power generating, industrial, agricultural, construction, and domestic wood and coal burning are some of the most prevalent human-made sources. The most frequent wildfires, sandstorms, and dust storms are the main natural sources of PM2.5. The African continent had only 13 out of 54 countries with sufficient public air quality monitoring data[7].

Seven million fatalities worldwide occur each year as a result of air pollution, which is currently thought to be the worst environmental health danger on the planet[6]. Numerous ailments, including heart disease, cancer, lung conditions, and asthma, are brought on by or made worse by air pollution. $8 billion (USD), or 3 to 4% of the global gross domestic product, has been calculated as the approximate daily economic cost of air pollution [8].

The World Health Organization (WHO) updated its global air quality recommendations in September 2021, 15 years after the previous revision, which was published in 2006.down to 5 μg/m3, with the ultimate goal of preventing millions of deaths[9]. Acknowledging the significant impact of air pollution on global health, the WHO cut the recommended annual PM2.5 concentration by half, from 10 μg/m3 down to 5 μg/m3, with the ultimate goal of preventing millions of deaths[9].

Progress Towards Adoption Of Key Actions That Can Significantly Improve Air Quality

[10] bemoans the evidence and the slow pace of action which indicate that air pollution in the Africa is likely to worsen in the near future as a result of rapid economic and population growth. He adds that it is anticipated that the implementation of the proposed African Continental Free Trade Area will significantly influence air quality policies and actions on the continent. Although the framework is anticipated to speed up economic activity that could raise air pollution emissions, it also carries the risk of accelerating air pollution in the area. And in this age of COVID-19, researchers have found that exposure to PM2.5 increases both the risk of contracting the virus and of suffering more severe symptoms when infected, including death [10][11].

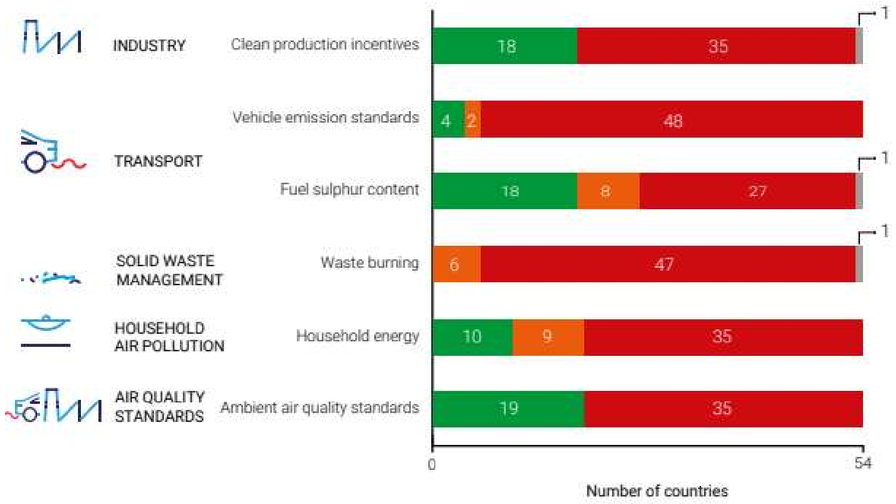


Figure 2: Progress towards adoption of key actions that can significantly improve air quality. Source p.3 of [6]

The chart in Figure 2 is used by [11] to show the efforts made by African countries as of 2019 in the indicated areas or sources of air pollution. The biggest gain in lowering emissions was seen in the road transportation sector. The Southern African Development Community economic group of 13 nations' commitment to embrace clean fuels and automobile pollution regulations served as a major impetus for this. The countries agreed to limit gasoline Sulphur content to 50 parts per million (ppm) or below and adopt a vehicle emission standard that is similar to Euro 4/IV in the agreement, which is set to go into effect by the end of 2022.

Since 2016, the transportation sector has significantly reduced emissions, and three more nations—Nigeria, South Africa, and Rwanda—have joined Morocco in adopting car emission norms that are higher than Euro 4/IV. As reported in 2016, 11 countries—Namibia, Benin, Zimbabwe, South Africa, Nigeria, Ghana, Lesotho, Eswatini, Malawi, Mozambique, and Zambia—began regulating diesel Sulphur content to 50 ppm and below, with the majority moving from the 51 to 500 ppm diesel Sulphur content category[11]. The sector also saw a significant improvement in fuel quality as a result. Ethiopia and Egypt likewise changed their classification from "above 500 ppm" to "51 to 500 ppm."[11] open burning of waste continues to be a major issue of concern and little action has been taken to reduce this practice; actions to minimize emissions in the transport sector are aimed at reducing tailpipe emissions of air pollutants and have focused on improving fuel quality and establishing vehicle emission standards;[11]

Although governments are concentrating on expanding access to clean cooking, progress has been slow and population increase frequently offsets gains made; slash-and-burn remains one of the region's primary causes of air pollution. However, a number of nations have recently seen a decline in the practice, which has significantly improved ambient air quality, particularly in rural areas during the dry season. It can be seen from Figure 2 from 2019, that there is minimal progress in the number of countries with policy and regulatory frameworks to support air quality management. In countries where these frameworks exist, they are not widely implemented[11].

Prioritizing air quality management in green recovery plans is crucial as the continent develops post-COVID-19 strategies to rebuild more effectively because doing so has numerous positive effects and advances several other Sustainable Development Goals (SDGs), such as improving access to clean and renewable energy (SDG 7), reducing poverty (SDG 1), improving health (SDG 3) and creating sustainable cities and communities (SDG 11)[11]. While nothing has been done to improve the region's air quality since the publication of the previous report in 2016, urgent action is required if Africa is to meet its goals for sustainable development as outlined in Agenda 2063 and the 2030 Agenda.

K. Ofosu-Amankwah, G.E.Q. Bessardon, E. Qauansh et. al.[12] presented fourteen years (2005-2018) assessment of aerosol optical depth (AOD) at 3 km resolution from MODIS Aqua and Terra satellites to ascertain the Spatio-temporal and seasonal distribution of aerosols over Ghana and its major cities. Utilizing the HYSPLIT model established that distant or transported aerosol sources to the city centres were of both marine and land generated origins. In addition, they surmise that moderate-high aerosol burden (AODs ~ 0.50) was observed over Ghana with a significant contribution from the premonsoon season. City centres of Takoradi and Kumasi showed higher aerosol loads (AODs ~ 0.80) than Accra and Tamale. They approached the pollution problem with a ground based instrument. Though greater accuracy of measurement is attributed to ground instrument, it lacks wider coverage greater space. The past 3 years are fallow and worth covering by further research.

The study by [13] sought to analyze the impact of mining activities on the environment by considering three different mining sites from Ghana, Kenya, and Tanzania by employing the services of the dataset from the NASA Giovanni System from 2005 to 2020. Their results showed that there was a significant increase in pollution level over time at all the mining sites, hence making mining one of the major contributors to air pollution in the places explored. Their focus on specific cities and on mining leaves room for engaging with the datasets to show what is happening around the region with SDG in mind. E Emetere et al 2017 [9] proposed that the effect of aerosol retention also affects the fluctuation of the surface temperature through their study on the Effect of aerosols loading and retention on surface temperature in the DJF(December, January, February) months in Enugu, Nigeria. This paper seeks to leverage on the sound literature discussed above and utilizes NASA Satellite data to investigate air pollution impact on Ghana and Nigeria with the aim of discovering how air pollution episodes of 2021 impacted air quality and to establish its relationship with the past 10 years history through a time series analysis.

3. METHODOLOGY

This essay examines a few effects of mining discussed in a few academic journals. The following section retrieves the data for PM2.5, or the amount of emitted particulate matter the many mining sites, releasing pollutants into the environment NASA's GIOVANNI method for seasonal and monthly area-averaged time series of the bulk of the dust column density- for several years prior to and following the PM2.5 mining locations were established. NASA's GIOVANNI Interactive Online Visualization for the GES-DISC and evaluation A web interface to the infrastructure system obtain earth scientific data from satellites. This gateway access to the NASA earth observation satellite information that has been gathered over time.

MERRA-2

The Modern-Era Retrospective analysis for Research and Applications, Version 2 (MERRA-2) provides data beginning in 1980 and runs a few weeks behind real time. Alongside the meteorological data assimilation using a modern satellite database, MERRA-2 includes an interactive analysis of aerosols that feed back into the circulation, uses NASA's observations of stratospheric ozone and temperature (when available), and takes steps towards representing cryogenic processes.

PM2.5

Micrograms per cubic meter (g/m3) was used as the reference metric for this report's PM2.5 values. PM2.5, or particulate matter, is one of six regularly measured criteria air pollutants and is widely regarded as the most dangerous to human health due to its widespread environmental presence and wide range of negative health effects. It is made up of fine aerosol particles with a diameter of 2.5 microns or less. PM2.5 is produced from numerous sources and has a wide range of chemical and physical properties. Sulfates, nitrates, black carbon, and ammonium are typical chemical components of PM2.5. Internal combustion engines, power generating, industrial, agricultural, construction, and domestic wood and coal burning are some of the most prevalent human-made sources. Dust storms, sandstorms, and wildfires are the most frequent natural causes of PM2.5.

4. RESULTS AND DISCUSSION

PM2.5 emanating from different areas in the study area with time. This section focuses on the level of PM2.5 produced from different countries in Africa. The countries are Ghana and Nigeria. According to the WHO air quality guidelines (WHO 2005), the annual mean of PM2.5 is 10 ug/m2 and the monthly mean is 25/m2. Figure 3(a) represents the Time Series Area-Averaged of Total Surface Mass Concentration –PM2.5 [MERRA-2 Model M2TMNXAER v5.12.4] kg m-3 form January 2021-December- 2021-Dec, over Ghana. The two highest Time Averaged PM2.5 were recorded in February 2021 as 0.00000095kgm-3(43.0913ug) and December, 2021 as 0.0000001kg m-3 which translates into 45.3592ug . The lowest PM2.5 was recorded in August, 2021 was 0.00000001 kgm-3(4.5359ug)

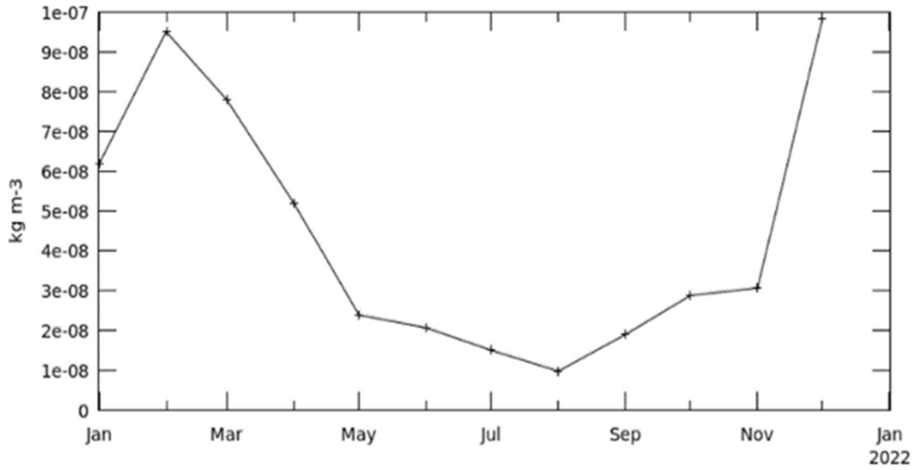


Figure 3(a) Time Series, Area-Averaged of Total Surface Mass Concentration - PM 2.5 monthly 0.5 x 0.625 deg. [MERRA-2 Model M2TMNXAER v5.12.4] kg m-3 from 2021-Jan - 2021-Dec, Shape Ghana

Figure 3(b) represents the Time Series Area-Averaged of Total Surface Mass Concentration – PM2.5 [MERRA-2 Model M2TMNXAER v5.12.4] kg m-3 form January 2021-December- 2021-Dec, over Nigeria. The two highest Time Averaged PM2.5 were recorded in February 2021 as 0.00000014kg/m-3(63.5029ug) and December, 2021 as 0.000000155kg/m-3 which translates into 70.3068ug . The lowest PM2.5 was recorded in August, 2021 was 0.00000002 kgm-3(9.0718ug).

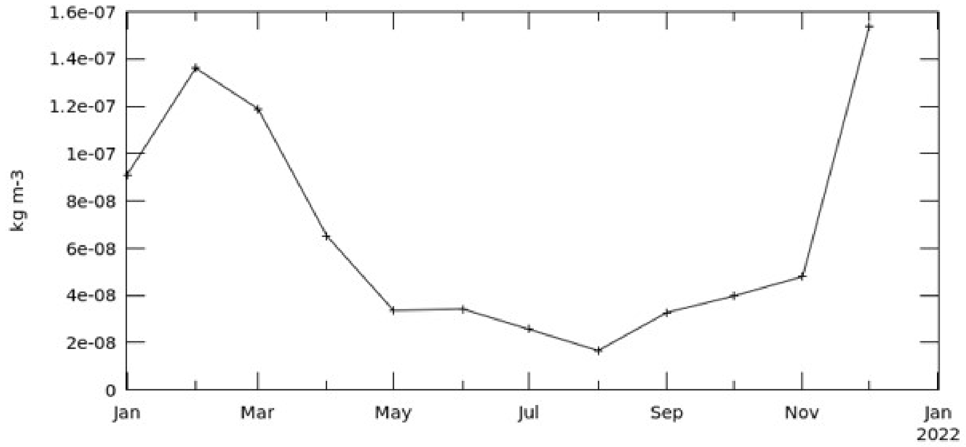
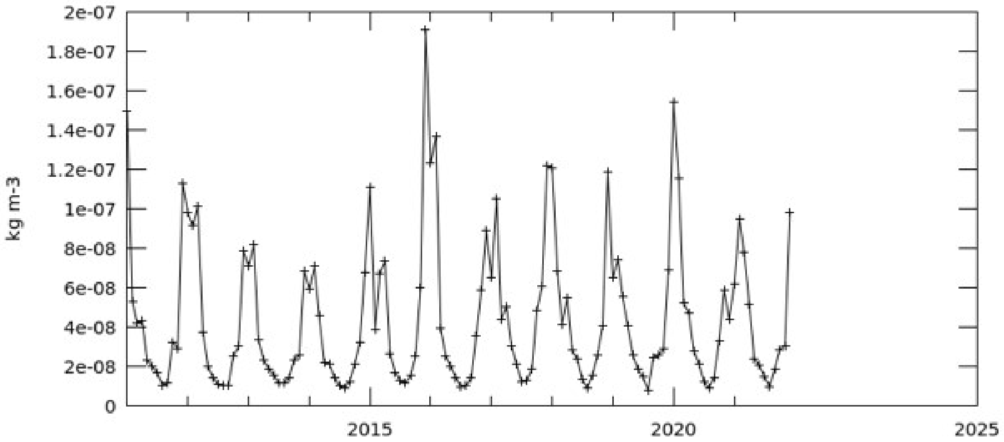


Figure 3(b). Time Series, Area-Averaged of Total Surface Mass Concentration - PM 2.5 monthly 0.5 x 0.625 deg. [MERRA-2 Model M2TMNXAER v5.12.4] kg m-3 over 2021-Jan - 2021-Dec, Shape Nigeria

Figure 4(a) shows the Time Series, Area-Averaged of Total Surface Mass Concentration - PM 2.5 monthly 0.5 x 0.625 deg. [MERRA-2 Model M2TMNXAER v5.12.4] kg m-3 over 2011-Jan - 2021-Dec, Shape Ghana for comparison of 2021 with the previous year. To answer how different the pollution episodes of 2021 was from the previous year, it can be observed that the highest pollution year in the past 10 years was 2016 at 0.00000018kgm3(81.6466ug) for Ghana with PM2.5.

The next highest pollution year was 2020 with PM2.5 of 0.00000015kgm3 (68.0389ug). It can be stated that the PM2.5 values of 2021 place the year average within the 6th polluted year compared to the past ten year averages with recorded annual average of 0.0000001kg3 (45.3592ug).



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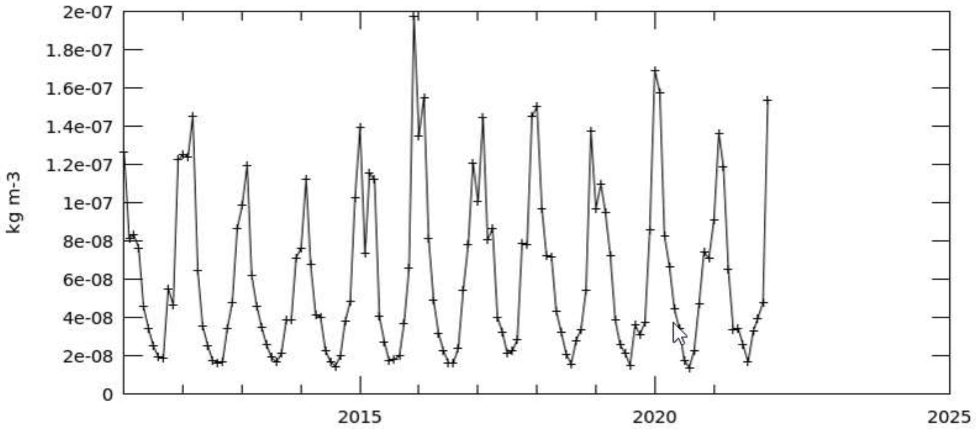
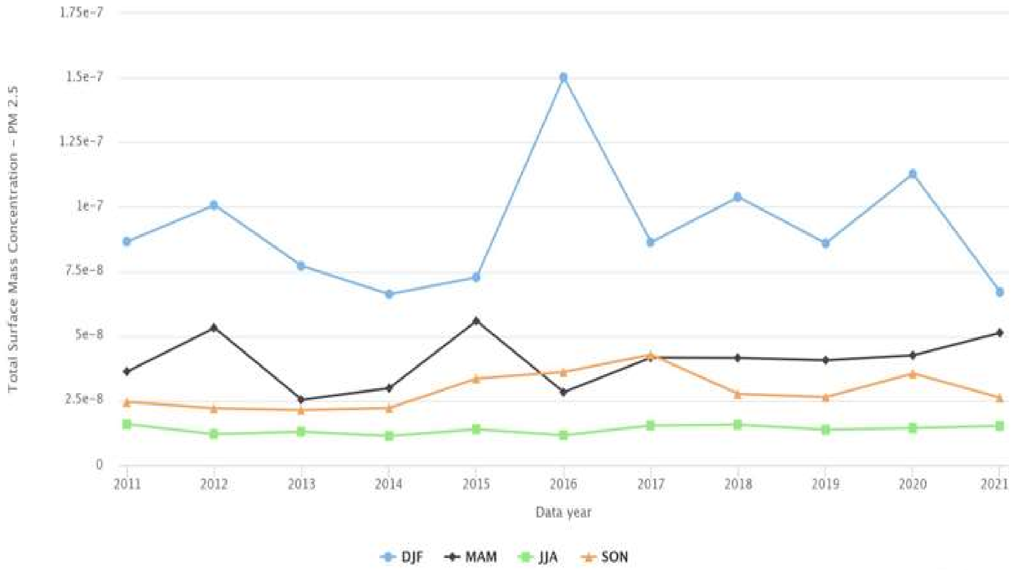


Figure 4(b Time Series, Area-Averaged of Total Surface Mass Concentration - PM 2.5 monthly 0.5 x 0.625 deg. [MERRA-2 Model M2TMNXAER v5.12.4] kg m-3 over 2011-Jan - 2021-Dec, Shape Nigeria

Figure 5(a) shows the Inter annual Time Series, Area-Averaged of Total Surface Mass Concentration - PM 2.5 monthly 0.5 x 0.625 deg. [MERRA-2 Model M2TMNXAER v5.12.4] kg m-3 over 2011-Jan - 2021-Dec, Shape Ghana. The graph divides the year into 4 periods: DJF as December-January-February, MAM as March-April-May, JJA as June-July-August, and SON as September-October-November.This covers the 10 year period from 2011 to 2021. It can be seen that DJF which is the annual dry season of the year recorded higher PM2.5 averages than the other seasons as expected. JJA which is the raining season is noted to have the lowest recorded PM2.5 averages for the past 10 years. There appears to be a change in season pattern for MAM and SON since 2017, where MAM PM2.5 averages exceed that of SON for the past 5 years.

Another observation is that the MAM PM2.5 averages for 2021 shows a rise in trend as compared to previous year 2020. It can also be added that these MAM values shows to be the 3rd highest of the season for the past 10 years. Just as captured in the time serieas average that 2016 recorded the highest PM 2.5 averages making it the most polluted year in the past 10 years, the DJF PM 2.5 average for 2016 shows the highest of the four season for the past 10 years with an average of 0.00000015kgm-3(68.0389ug). 2021 DJF averages was 0.000000075kgm-3(34.0194ug). making the season one of the 4th lowest in the season for the past 10 years.



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It can also be added that these MAM values shows to be the 3rd highest of the season for the past 10 years. Just as captured in the time serieas average that 2016 recorded the highest PM 2.5 averages making it the most polluted year in the past 10 years, the DJF PM 2.5 average for 2016 shows the highest of the four season for the past 10 years with an average of 0.00000016kgm-3(72.5748ug). 2021 DJF averages was 0.0000001kgm-3 (45.35924ug). making the season one of the 5th lowest in the season for the past 10 years.

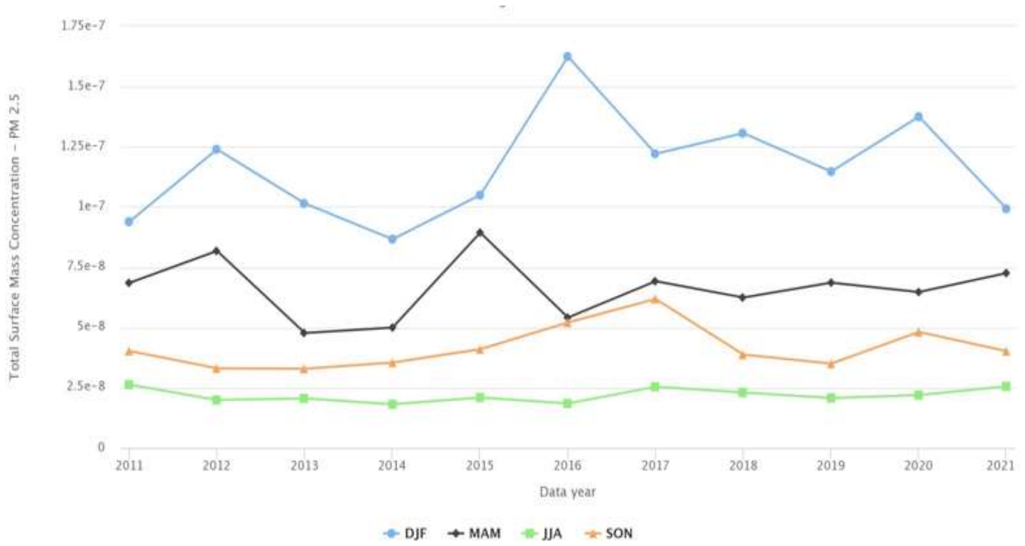
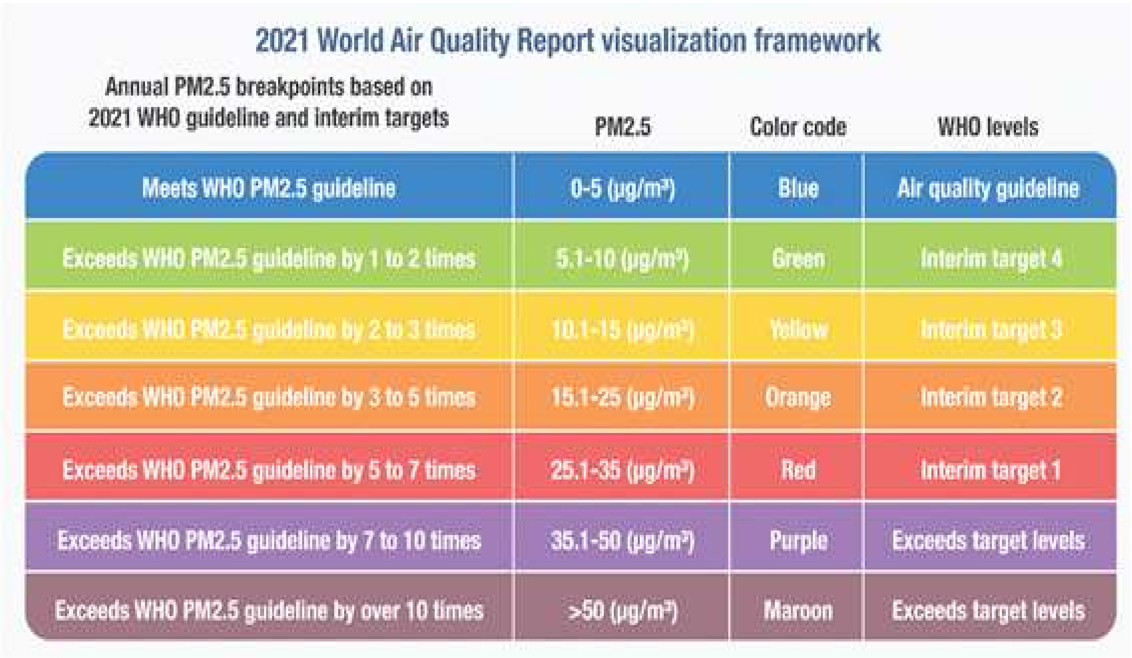


Figure 5(b). Inter annual Time Series, Area-Averaged of Total Surface Mass Concentration - PM 2.5 monthly 0.5 x 0.625 deg. [MERRA-2 Model M2TMNXAER v5.12.4] kg m-3 over 2011-Jan - 2021-Dec, Shape Nigeria



2021 World Air Quality Report visualization framework

Annual PM2.5 breakpoints based on 2021 WHO guideline and interim targets	PM2.5	Color code	WHO levels
Meets WHO PM2.5 guideline	0-5 (μg/m³)	Blue	Air quality guideline
Exceeds WHO PM2.5 guideline by 1 to 2 times	5.1-10 (μg/m³)	Green	Interim target 4
Exceeds WHO PM2.5 guideline by 2 to 3 times	10.1-15 (μg/m³)	Yellow	Interim target 3
Exceeds WHO PM2.5 guideline by 3 to 5 times	15.1-25 (μg/m³)	Orange	Interim target 2
Exceeds WHO PM2.5 guideline by 5 to 7 times	25.1-35 (μg/m³)	Red	Interim target 1
Exceeds WHO PM2.5 guideline by 7 to 10 times	35.1-50 (μg/m³)	Purple	Exceeds target levels
Exceeds WHO PM2.5 guideline by over 10 times	>50 (μg/m³)	Maroon	Exceeds target levels

Figure 6 2021 World Air Quality visualization Framework[14]

Figure 6. Shows the WHO World Air Quality visualization framework. It must be noted that Satellite measurements are known to vary somewhat from ground measurements. However, the patterns observed will not necessarily differ. In light of this, this paper uses the Figure 6, above to illustrate how the observed measurements of PM values impact human health with reference to UN global guidelines on PM2.5 and the SDGs.

Considering Figure 1a for Ghana, the two highest Time Averaged PM2.5 were recorded in February 2021 as 0.00000095kgm-3(43.0913ug) and December, 2021 as 0.0000001kg m-3 which translates into 45.3592ug exceeds WHO PM2.5 guideline by 7 to 10 times, exceeding target levels. The lowest PM2.5 recorded in August, 2021 was 0.00000001 kgm-3(4.5359ug) is noted to meet WHO PM2.5 guideline. It can also be noted that January, February, March April, November, and December PM 2.5 values significantly exceed the WHO PM2.5 guideline.

Considering Figure 5(b) for Nigeria, the two highest Time Averaged PM2.5 recorded in February 2021 as 0.00000014kg/m-3(63.5029ug) and December, 2021 as 0.000000155kg/m-3 which translates into 70.3068ug exceeds WHO PM2.5 guideline by over 10 times, exceeding target levels. The lowest PM2.5 was recorded in August, 2021 was 0.00000002 kgm-3(9.0718ug) is noted to exceed the WHO PM2.5 guideline by 1 to 2 times. It can also be noted that January, February, March April, November, and December PM 2.5 values significantly exceed the WHO PM2.5 guideline.

5. RECOMMENDATION

Considering 6 years gone after SDG goals and 9 more years, both countries will have to put in greater and aggressive but collaboratively to meet WHO levels target 2, 3, 4 and the ultimate of annual PM2.5 levels less than 5ug. To realize the targets within the limited time remaining, collaboration among neighboring countries at the regional level (ECOWAS) to create policies for mitigation, monitoring and implementation strategies towards the SDG goals 3 and 11 is recommended. This is due to the traveling nature of aerosols which make up this harmful PM2.5.

6. CONCLUSION

The study presents a 2021 spatio-temporal and seasonal aerosol distribution assessment over Ghana and Nigeria by utilizing MERRA-2 Model M2TMNXAER v5.12.4 at 3 km resolution. A ten year comparison was done with 2021 for the two countries. The study shows that both countries experience significant PM2.5 annual averages far exceeds the WHO guidelines for 2021 and the previous years. It was noted that the recorded PM2.5 averages for 2021 is not the highest for the past 10 years but be placed in the 4th highest for Ghana and 5th highest for Nigeria respectively.The impact such exposure to PM2.5 have on human health is very critical especially for people with cardiovascular conditions. This underscores the need for continuous monitoring and policy implementations to minimize the adverse effects on lives in reaching the SDG targets 3 and 11 for these countries.

The observations so far explains why the 2021 World Air Quality (using cheaper, private ground monitoring data) ranks Ghana in the least 30th and Nigeria 18th country out of 117 countries in world air quality. Ghana is placed better than Nigeria in the rankings with an annual PM2.5 average of 25.9 and 34.0 respectively with both countries exceeding WHO PM2.5 guideline by 5 to 7 times but meeting interim target 1 of WHO levels. Deposition of sea salt spray due to a bubble bursting from the ocean and emissions from oil and gas industries can be considered to be the contributing source to the observed PM2.5 for Ghana.

The highest PM2.5 averages by the time series analysis of 2021 will show both countries far exceed the WHO guidelines by over 10 times from the satellite data used. Whereas the sea contributes significantly, the greater industrial activities in Nigeria can be attributed to be one of the reasons for higher PM2.5 values observed. The higher PM2.5 loadings observed in the pre-monsoon season (DJF) could be attributed to land preparation activities by local farmers awaiting the onset of rains in the monsoon. These activities are characterized by intense biomass burning and soil tillage with the possible release of large amounts of aerosols or PMs into the atmosphere[12]. The least seasonal mean PM2.5 observed in the post-monsoon season (JJA). This observation could be a result of excess scavenging due to intermittent rains in the post-monsoon seasons.

This paper agrees with[12] that extreme PM2.5 loading disparity observed between the two contrasting seasons, dry/harmattan and monsoon season, attributable to the changes. In the dry season, dust transport from the Sahara is dominant in the atmosphere compared to the monsoon season, where high emissions of biogenic aerosols and particles with more remarkable hygroscopic growth may be observed.In conclusion, both Ghana and Nigeria are moderately polluted and to routinely monitor air quality in our cities and the country as a whole, the PM2.5 product at 3 km resolution from the satellite on MERRA-2 Earth Observing System (EOS) can be utilized as they work to achieve the SDG targets in goal 3 and 11. However, in order to describe locally produced aerosols over the country, it is advised that additional research be done to determine the contribution of aerosol emissions from the various regions of Ghanaian and Nigerian cities.

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