Air quality index of Asa-dam industrial area, Ilorin, Kwara State

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Abstract: **In this study, assessment of air quality indices and its possible health impacts in Asa-Dam industrial area, Ilorin, Kwara State, Nigeria was carried out. The ambient air quality measurement was done with respect to Particulate Matter (PM2.5 and PM10), and carbon mono-oxide. Sample collections were limited to air quality. Air quality sources were randomly selected within the vicinity of the study area, but at different distances. Also, the samples were collected at different locations sixty (60) points. The monitoring exercises were taken in the daytime, the air pollution measurements were carried out using direct reading, automatic in-situ gas monitors; Smart AS8900 Multi-Gas Monitor was used in measuring carbon monoxide (CO), BR-SMART-126 Portable 4-in-1 Air Quality Monitor was used to detect PM2.5, PM10, Garmin Dakota 20 GPS was used to collect Coordinates of sampling points.**

The result shows the mean concentration of $PM_{2.5}$ (46.3217), PM_{10} (56.1544) were found to be higher than WHO standards but LEL (9.72667), CO (0.12056) were found to be below the international (WHO) permissible standard. Also in Table 4.3, the combined Air Quality index for Asa-Dam industrial area according to the USEPA scale used show that $PM_{2.5}$ with AQI of 128 is unhealthy especially for sensitive group of people and can predispose them to Increasing likelihood of respiratory symptoms in sensitive individuals, aggravation of heart and lung disease and premature mortality in persons with cardiopulmonary diseases and the elderly. This high level can be as a result of Human activities, such as the burning of fossil fuels in vehicles, power plants and various industrial processes also generate significant amounts of aerosols. Therefore, those in this group; people with respiratory or heart diseases, the elderly and children should avoid/limit staying for a long time outdoors.

PM_{10} with AQI 51 shows its moderate, although people with respiratory diseases are at most risk in this group. Unusually sensitive people should consider reducing prolonged or heavy exertion. The AQI (1) For carbon monoxide (CO), is good and does not pose any treat to health.

Comprehensive air quality monitoring and adequate measures should be implemented. There is also a need for the continuous monitoring and auditing of PM2.5 and PM10 in the community to safeguard the health of the public and the environment.

Keywords: **Air pollution, particulates, Air quality index.**

I.INTRODUCTION

Nigeria is Africa's most populous country (170 million people as of 2012). Between 1990 and 2008 its population grew by 60% and is projected to reach 0.5e1 billion people by 2100 (UN, 2013). Nigeria's 2012 GDP growth rate of 7% per year, forecast to continue (PwC, 2013), is amongst the highest in the world. The economy of Nigerian recently surpassed South Africa as the largest on the continent (Magnowski, 2014). This rapid growth in Nigeria elicits a range of environmental concerns including air quality and Pollution (Hopkins et al., 2009; Osuji *et al*., 2009; Assamoi *et al.,* 2010).

Air pollution can be defined as the presence of pollutants, such as sulphur dioxide (SO2), particle substances (PM), nitrogen oxides (NOx) and ozone (O3) in the air that we inhale at levels which can create some negative effects on the environment and human health (Turk and Kavraz, 2011). It can be classified into natural air pollution which includes wind-blown dust, volcanic ash, and gases, smoke and trace gases from forest fires, and anthropogenic air pollution which includes products of combustion such as nitrogen oxides (NOx), carbon oxides (COx), sulphur dioxide (SO2) (Oyekanmi *et al*., 2010).

At all levels, air pollution is becoming a topic of intense researches because of the increased level of anthropogenic activities and climatic changes. (Komolafe *et al.,* 2014).

Though, air pollution could be due to natural sources, a major anthropogenic source of air pollution is due to man's quest for better standard of living and the utilization of natural resources for rapid industrialization, urbanization and consequently causing excessive air pollution (Arslan *et al*., 2010)

Air pollution in the urban centers has increased rapidly as a result of high population density, increased numbers of motor vehicles, use of fuels with poor environmental performance, poorly maintained transportation systems and above all, environmental regulations and policies that are ineffective (Komolafe *et al.,* 2014).

Poor air quality is detrimental to human health, with a number of studies finding short-term and long-term pulmonary and cardiovascular health effects of PM10 and PM2.5 (Rückerl, Schneider, Breitner, Cyrys, & Peters, 2011).

According to Prüss-Üstun et al., (2016) Air pollution is one of the great killers in our age. In the absence of aggressive control, ambient air pollution is projected by 2060 to cause between 6 million and 9 million deaths per year (Organisation for Economic Co-operation and Development, 2016). Non-communicable diseases account for 70% of air pollution deaths, and air pollution is a major, insufficiently appreciated cause of non-communicable diseases (Prüss-Üstun et al., 2016).

Contamination of air arising from anthropogenic inputs has been a global concern as a result of the health effects associated with it. High levels of gases (such as SO2, NO2, CO, and hydrocarbons) and particulates tend to pollute the atmosphere as they cause harmful effects to environment and human health (Tawari & Abowel 2012 and Othman 2010).

United Nations records on the impact of air pollution in Africa have been scary (UNEP, accessed 14th January 2020). In 2015, the World Bank reported 94 percent of Nigerians were exposed to air pollution levels that exceeded World Health Organization (WHO) guidelines. Furthermore, it was believed that polluted air killed more people worldwide than AIDS, malaria, breast cancer, or tuberculosis (UNEP, Accessed January 14, 2020.)

Industrial pollution can also impact air quality, and it can enter the soil, causing widespread environmental problems. Industrial pollution hurts the environment in a range of ways, and has a negative impact on human lives and health. Pollutants can kill animals and plants, cause imbalance in ecosystems, degrade air quality radically, damage buildings and generally degrade quality of life. Although, pollution is an expensive, undesirable and necessary part of human life, even in primitive cultures, accumulated human excretory products and smoke from cooking fires causes pollution (Chaloulakou, 2007, Ahmed 2018).

The World Health Organization (WHO) estimates that outdoor air pollution alone accounts for around 2% of all heart and lung diseases, about 5% of all lung cancers, and about 1% of all chest infections.

Most of the pollution on the planet can be traced back to industries of some kind (Heredia, 2014) and industrial emissions are the second largest pollutants of the atmosphere after automotive exhausts (Gull et al, 2013). Air pollution in the urban centre has increased rapidly due to high population density, increased numbers of motor vehicles, use of fuels with poor environmental performance, poorly maintained transportation systems and above all, ineffective environmental regulations and policies (Komolafe et al., 2014).

Particulate matter (PM) has received considerable attention in the last few years because of its association with death and morbidity. (Samet et al 2000, Pope et al 2000) Particulates are a heterogeneous group of pollutants that come from a variety of sources and are divided into 3 categories: ultrafine, fine, and coarse. Ultrafine particulates are less than 0.1 ɥm in diameter, pass easily into the lower respiratory tract (below the larynx), and have been associated with increased mortality rates.10 Fine particulates (less than 2.5 ɥm in diameter, or PM2.5) have been of increasing interest because, of all the particulates, they appear to penetrate deepest into the human lung and are most strongly linked with death and other adverse health effects (Stieb 2002). PM2.5 are the byproducts of combustion and constitute the bulk of total particulate matter in most urban areas. Twenty-five percent to 55% of PM2.5 are composed of sulfates (EPA 2004). Coarse particulates (particulates with diameters between 2.5 and 10 ɥm) are a component of PM10 (particle diameter less than 10 ɥm). In 1997, the EPA moved to establish PM2.5 as a separate pollutant, subject to independent regulation. Implementation was blocked by the United States Court of Appeals in 1999 (Pope et al 2001) but was ultimately permitted by the United States Supreme Court in 2001. At this time, areas designated as nonattainment areas must submit plans to meet set standards by February 2008 and must be in compliance by 2010.

According to World Health Organization 1999, exposure to elevated levels of CO is also associated with headaches, visual impairment, reduced cognitive functioning and ability, and reduced ability to perform complex tasks. Very high levels can result in unconsciousness and eventually death (Medline Plus, 2016).

Poor air quality is detrimental to human health, with a number of studies finding short-term and long-term pulmonary and cardiovascular health effects of PM10 and PM2.5 (Rückerl, Schneider, Breitner, Cyrys, & Peters, 2011).

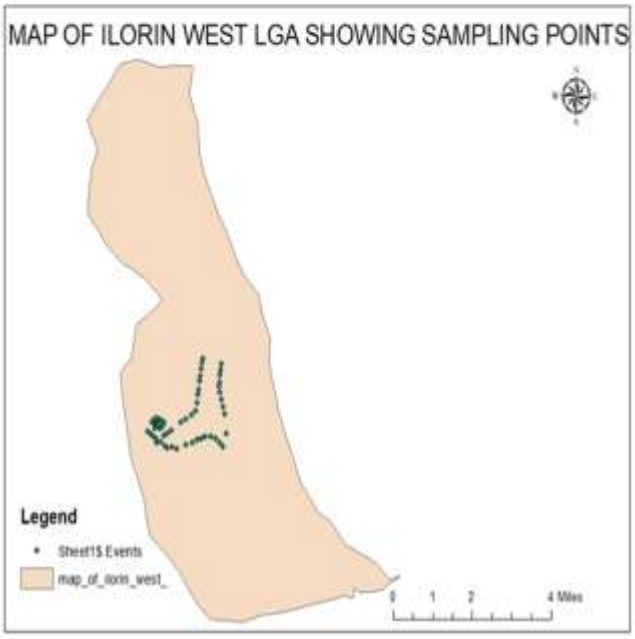
The objective of this study is to find out the air quality index in the Asa-dam industrial area in Ilorin, Kwara State.

II. METHODS

Description of the Study Area

Ilorin located on latitude 8º30’ and 8º50’N and longitude 4º20’ and 4º35’E of the equator.

Asa-dam industrial area which is the main focus of the study is an area within the Ilorin metropolises under Ilorin West Local government area. The Asa-dam industrial area is consisting mainly of industries and some residential communities at close proximity.



Source: developed by author (field work) 2019

Figure1: Map of Kwara State and Ilorin west LGA showing the sampling points.

III. SAMPLING PROCEDURES, COLLECTION, PREPARATION AND ANALYSIS.

Ambient air monitoring of pollutants in the study area was conducted for five weeks. The field survey was carried out to assess the concentration levels of Particulate matter (2.5, 10), Carbon monoxide (CO), in the study area. Real time in-situ measurement of air pollutants was carried out.

Sample collections were limited to air quality. Factorial/ Purposive sampling techniques also known as (judgment, selective or subjective sampling techniques) was adopted for this study.

Air quality sampling points were randomly selected within the vicinity of the study area, but at different distances from each other. Also, the samples were collected at different locations.

The monitoring exercises were taken during the daytime, between the hours of 6 am and 6 pm. Night samples were not collected.

Smart AS8900 Multi-Gas Monitor was used in measuring carbon monoxide (CO), BR-SMART-126 Portable 4-in-1 Air Quality Monitor was used to detect $PM_{2.5}$, PM_{10}, Garmin Dakota 20 GPS was used to collect Coordinates of sampling points.

IV. RESULT

Table 1; Descriptive Statistics summary

	N	Minimum	Maximum	Mean	Std. Deviation	Variance	WHO Guidelines
CO (ppm)	60	0.0000	1.0667	0.12056	0.2206	0.049	50
PM2.5 (ug/m3)	60	38.1333	63.9000	46.3217	5.8888	34.678	25
PM10 (ug/m3)	60	46.4667	75.2000	56.1544	6.4919	42.145	50
Valid N (listwise)	60						

The mean concentration of Carbon dioxide (CO) were 0.12ppm This value is far lower than WHO permissible limits of 50ppm and therefore may pose no immediate hazard to the expose population.

Mean concentration of $PM_{2.5}$ measured is 46.32 is higher compared to the permissible standard given by WHO (25ppm). Also the concentration of PM10 of 56.15 is higher than WHO standard of 50ppm. Theses has adverse health effect.

Table 2: Air quality index (AQI) for the study area according to USEPA

PARTICULATES	MEAN	AQI	AQI CATEGORY	SENSITIVE GROUP	HEALTH EFFECT
$Pm_{2.5}$	46.322	128	Unhealthy for sensitive groups	People with respiratory or health diseases, the elderly and children are the groups most risk.	Increasing likelihood of respiratory symptoms in sensitive individuals, aggravation of heart and lung disease and premature mortality in persons with cardiopulmonary diseases and the elderly
Pm_{10}	56.154	51	Moderate	People with respiratory disease are the groups most risked	Unusually sensitive people should consider reducing prolonged or heavy exertion
Co	0.121	1	Good	People with heart diseases	None

AQI rating by USEPA

Good (0 -50)

Moderate (51 -100)

Unhealthy for sensitive group (101 –150)

Unhealthy (150 –200)

Very Unhealthy (201-300)

Hazardous (301-500)

The combined Air Quality index for Asa-Dam industrial area according to the USEPA scale used show that $PM_{2.5}$ with AQI of 128 is unhealthy especially for sensitive group of people and pose a health risk

PM_{10} with AQI 51 shows its moderate, although people with respiratory diseases are at most risk in this group. Unusually sensitive people should consider reducing prolonged or heavy exertion.

For carbon monoxide (CO), the AQI (1) is good and does not pose any treat to health.

V. DISCUSSION

The result shows in Table 1 the mean concentration of $PM_{2.5}$ (46.3217), PM_{10} (56.1544) were found to be higher than the standards given by WHO of 25ppm and 50ppm respectively.

Sources of particulate matter can be manmade or natural. Some particulates occur naturally, originating from volcanoes, dust storms, forest and grassland fires, living vegetation and sea spray. Human activities, such as the burning of fossil fuels in vehicles, power plants and various industrial processes also generate significant amounts of aerosols. Averaged over the globe, anthropogenic aerosols those made by human activities currently account for about 10% of the total amount of aerosols in our atmosphere. Increased levels of fine particles in the air are linked to health hazards such as heart disease (Molles, 2005) altered lung function and lung cancer. Persistent free radicals connected to airborne fine particles could cause cardiopulmonary disease (Bronwen, 1999).

High level of particulates in the area can be associated with to the industrial activities going on in the area.

In Table 2, the combined Air Quality index for Asa-Dam industrial area according to the USEPA scale used show that $PM_{2.5}$ with Air Quality Index of 128 is unhealthy especially for sensitive group of people and can predispose them to Increasing likelihood of respiratory symptoms in sensitive individuals, aggravation of heart and lung disease and premature mortality in persons with cardiopulmonary diseases and the elderly. This high level can be as a result of Human activities, such as the burning of fossil fuels in vehicles, power plants and various industrial processes also generate significant amounts of aerosols. Therefore, those in this group; people with respiratory or heart diseases, the elderly and children should avoid/limit staying for a long time outdoors.

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VI. CONCLUSTION

From the results it can be concluded that the air quality of Asa-Dam industrial area is slightly polluted. Efforts must be made to reduce the air pollution. Reducing air pollution saves and improves the quality of lives. It can help to reduce the incidence of acute and chronic respiratory infections such as pneumonia and asthma among children. Reducing air pollution would reduce complications during pregnancy and childbirth for the resident of the communities.

Comprehensive air quality monitoring and adequate measures should be implemented; Regular environmental audit/inspection by regualtors is adviced.

WHAT THIS STUDY ADDS

Kwara State Ministry of Environment's Report of 2010 acknowledges this lack of air pollution data for Ilorin and its environs. These study has made attempt to provide novel Air quality/air pollution assessment data on carbon mono-oxide and particulates at levels 2.5 and 10.

DISCLOSURE STATEMENT

No potential conflict of interest was reported by the authors.

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