CAUSES AND CONSEQUENCES OF AIR POLLUTION IN NIGERIA

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INTRODUCTION

Air pollution is a significant cause of morbidity and mortality. The greatest health impacts from air pollution worldwide occur among the poorest and most vulnerable populations. The amount of exposure in terms of the number of people, exposure intensity and time spent exposed is far greater in the developing world (Smith, 1993); approximately 76% of all global particulate matter air pollution occurs indoors in the developing world

WHAT IS AIR POLLUTION?

The World Health Organisation defines air pollution as 'the disequilibrium of air caused due to the introduction of foreign elements to humans' natural and manmade sources to the air so that it becomes injurious to biological communities'. It has also been defined as the contamination of air by discharge of harmful substances, which can cause health problems including burning eyes and nose, itchy irritated throat and breathing problems (USEPA 1994).

Air pollution is also the introduction of chemicals, particulate matter, or biological materials that cause harm or discomfort to humans or other living organisms, or damages the natural environment, into the atmosphere. It is also defined as the presence of chemicals in the atmosphere in quantities and duration that are harmful to human health and the environment. It can be defined as the presence in the outdoor or indoor atmosphere of one or more gaseous or particulate contaminants in quantities, characteristics and of duration such as to be injurious to human, plant or animal life or to property, or which unreasonably interferes with the comfortable enjoyment of life and property (Odigure, 1998)

Pollution of the environment is one of the most horrible ecological crises the world is subjected today. The environment (air, land or soil and water) was in the past pure, virgin, undistributed, uncontaminated and basically most hospitable for living organisms but the situation is just the reverse today. Today, the environment has become foul, contaminated, undesirable and therefore, harmful for the health of living organisms, including man.

WHAT ARE AIR POLLUTANTS?

These are harmful solid, liquid or gaseous substances that are present in such concentrations in the environment which tend to be injurious to living organisms.
They are also known as substances in the air that can cause harm to humans and the environment. Pollutants can be in the form of solid particles, liquid droplets, or gases.

CLASSIFICATION OF POLLUTANTS

There is no singular view by which pollutants can be classified.

POLLUTANTS CAN BE CLASSIFIED AS EITHER PRIMARY OR SECONDARY

This classification is based on the manner they reach the atmosphere. Usually, primary pollutants are substances directly emitted from a process, such as ash from a volcanic eruption, the carbon monoxide gas from a motor vehicle exhaust or sulphur dioxide released from factories.

Secondary pollutants are not emitted directly. Rather, they form in the air when primary pollutants react or interact. An important example of a secondary pollutant is ground level ozone- one of the many secondary pollutants that make up photochemical smog.
Note that some pollutants may be both primary and secondary: that is, they are both emitted directly and formed from other primary pollutants.

POLLUTANTS MAY ALSO BE CLASSIFIED AS NATURAL OR MAN MADE

Natural pollutants include dusts or particulate matters, and the man made pollutants include all chemicals that are produced by man. It must however be noted that a pollutant is not yet a pollutant until it has caused a significant alteration in the normal gaseous composition of the atmosphere. It can therefore be said that all chemicals or natural matters whose introduction is greater than the maximum that the earth can take or absorb are pollutants. Meanwhile, it is also useful to note that all chemicals (before they become pollutants) are useful.

POLLUTANTS MAY BE CLASSIFIED BASED ON CHEMICAL COMPOSITION

Their names have been given according to the prominent chemical compounds they contain:

i. Sulphur-containing compounds

ii. Nitrogen – containing compounds

iii. Carbon-containing compounds

iv. Halogen-containing compounds

v. Toxic substances

vi. Radioactive compounds

POLLUTANTS MAY BE CLASSIFIED ACCORDING TO PHYSICAL STATE

Pollutants are classified as

i. Gaseous

ii. Liquid (aqueous)

iii. Solid

POLLUTANTS MAY BE CLASSIFIED ACCORDING TO THE SPACE SCALES OF THEIR EFFECTS

i. Local (or indoor)

ii. Regional

iii. Global

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MAJOR PRIMARY POLLUTANTS PRODUCED BY HUMAN ACTIVITY INCLUDE:

SULPHUR OXIDES (SO): the most common sulphur pollutant is sulphur dioxide, a chemical compound with the formula SO_2. SO_2 is produced by volcanoes and in various industrial processes. Since coal and petroleum often contain sulphur compounds, their combustion generates sulphur dioxide, therefore a typical source of SO_2 is the exhaust of vehicles that use leaded automobiles. Further oxidation of SO_2, usually in the presence of a catalyst such as NO_2,

forms H_2SO_4 and thus acid rain (Anderson, 2005). This is one of the causes for concern over the environmental impact of the use of these fuels as power sources.

NITROGEN OXIDES (NO): the most common is nitrogen dioxide and it is emitted from high temperature combustion. It can be seen as the brown haze dome above or plume downwind of cities. Nitrogen dioxide is a chemical compound with the formula NO_2. It is one of the several nitrogen oxides. This reddish-brown toxic gas has a characteristic sharp, biting odour. NO_2 is one of the most prominent air pollutants and is introduced into the air mainly through automobile exhaust, gas stoves and heaters, wood-burning stoves, kerosene space heaters

CARBON MONOXIDE: It is a colourless, odourless, non-irritating but very poisonous gas. It is a product of incomplete combustion of fuel such as natural gas, coal or wood. Vehicular exhaust is a major source of carbon monoxide.

CARBON DIOXIDE (CO_2): It is a colourless, odourless, non-toxic greenhouse gas associated with ocean acidification, emitted from sources such as combustion, cement production and respiration

VOLATILE ORGANIC COMPOUNDS: VOCs are an important outdoor air pollutant. They are often divided into the separate categories of methane (CH_4) and non methane (NMVOCs). Methane is an extremely efficient greenhouse gas which contributes to enhance global warming. Other hydrocarbon VOCs are also significant greenhouse gases via their role in creating ozone and in prolonging the life of methane in the atmosphere, although the effect varies depending on local air quality. Within the NMVOCs, the aromatic compounds benzene, toluene and xylene are suspected carcinogens and may lead to leukaemia through prolonged exposure. 1, 3-butadiene is another dangerous compound which is often associated with industrial uses.

PARTICULATE MATTER: Particulates, alternatively referred to as Particulate Matter (PM) or fine particles, are tiny particles of solid or liquid suspended in a gas. In contrast, aerosol refers to particles and the gas together. 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 articles 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). Toxic metals, such as lead, cadmium and copper.

CHLOROFLUOROCARBONS (CFCS): It is harmful to the ozone layer emitted from products currently banned from use.

AMMONIA (NH_3): It is emitted from agricultural processes. Ammonia is a compound with the formula NH_3. It is normally encountered as a gas with a characteristic pungent odour. Ammonia contributes significantly to the nutritional needs of terrestrial organisms by serving as a precursor to foodstuffs and fertilizers. Ammonia, either directly or indirectly, is also a building block for

the synthesis of many pharmaceuticals. Although in wide use, ammonia is both caustic and hazardous.

ODOURS: Such as from garbage, sewage and industrial processes

RADIOACTIVE POLLUTANTS: Produced by nuclear explosions, war explosives and natural processes such as the radioactive decay of radon.

SECONDARY POLLUTANTS INCLUDE: Particulate matter formed from gaseous primary pollutants and compounds in photochemical smog. Smog is a kind of air pollution; the word "smog" is a portmanteau of smoke and fog. Classic smog results from large amounts of coal burning in an area caused by a mixture of smoke and sulphur dioxide. Modern smog does not usually come from coal but from vehicular and industrial emissions that are acted on in the atmosphere by ultraviolet light from the sun to form secondary pollutants that also combine with the primary emissions to form photochemical smog.

GROUND LEVEL OZONE (O_3): It is formed from NO and VOCs. Ozone (O_3) is a key constituent of the troposphere. It is also an important constituent of certain regions of the stratosphere commonly known as the Ozone layer. Photochemical and chemical reactions involving it drive many of the chemical processes that occur in the atmosphere by day and by night. At abnormally high concentrations brought about by human activities (largely the combustion of fossil fuel), it is a pollutant and a constituent of smog.

PEROXYACETYL NITRATE (PAN): Similarly formed from NO and VOCs.

MINOR AIR POLLUTANTS INCLUDE: A large number of minor hazardous air pollutants. Some of these are regulated in USA under the Clean Air Act and in Europe under the Air Framework Directive. A variety of persistent organic pollutants attached to particulate matter.

PERSISTENT ORGANIC POLLUTANTS (POPS) are organic compounds that are resistant to environmental degradation through chemical, biological and photolytic processes. Because of this, they have been observed to persist in the environment, to be capable of long-range transport, bioaccumulation in human and animal tissue, biomagnified in food chains and to have potential significant impacts on human health and the environment.

FATE OF AIR POLLUTANTS

The pollutants of the atmosphere are simple gases, hydrocarbons and particulate material which can be disposed of easily by biotic agencies. However the biosphere occurs only of earth's surface while most of these pollutants escape high up in the atmosphere. These biotic processes, which involve water vapours, the constituents of particulate material, are responsible for causing their chemical transformations. In the atmosphere carbon monoxide is oxidized to carbon dioxide. Most of the hydrocarbons are also oxidized to yield carbon dioxide and water. Similarly, nitrous and nitric oxides are changed to nitrogen dioxide (Marland *et al*., 2005**).**

These oxides dissolve in minute droplets of water or fine film of water on aerosol surface to yield the corresponding acids. If ammonia is present in the atmosphere, it is also dissolved in water to form ammonium hydroxide. A variety of chemical reactions occur on aerosol surface in the atmosphere between these reactants. Aerosols containing other constituents such as chlorides, carbonates and other salts also take part in the atmospheric reactions (Fuggle, 2004).

Depending on the quantities of various constituents present in the atmosphere and the extent of the atmospheric reactions, aerosols bearing various acids such as carbonic, nitric and sulphuric acids and their salts such as carbonates, nitrates and sulphates are formed. These are brought down in bulk as rains, dews or snow. Gases present in amounts larger than those needed to saturate the carrying medium (Water) are left in the atmosphere (Milton, 2005).

In Nigeria, from the release of large concentration of oxides of nitrogen and sulphur in the Niger delta environment it is glaring that some cases of acidified rain occur in the region. Although literature is deplete in this area it is obvious that such phenomenon is experienced.

Olobaniyi and Efe (2007) also show elevated levels of lead (0.56 mg/L) and low pH values ranging from 5.10-6.35 in rain water collected in Warri and environs. Akpoborie *et al*. (2000) also report low pH values from water obtained from shallow hand dug wells in Ughelli, Warri and Okurekpo all in Delta State. Most combustion processes lead to the release of oxides of nitrogen and lower fractions of hydrocarbons and in the presence of UV radiation the resultant smog could lead to decrease in visibility. Although not readily reported this is a common phenomenon in a region like the Niger delta that has large hydrocarbon deposits and various episodes of combustion processes.

Some 45.8 billion Kw of heat are discharged into the atmosphere of the Niger-Delta from 1.8 billion ft3 of gas everyday (Aaron, 2006). Ogbuigwe (1998), reports that temperatures produced at flare sites could be as high as 1,600°C. Temperature as high as 400°C at an average distance of 43.8 m from flare sites in Isoko, Delta State have been recorded. Studies by Alakpodia (1989, 1995) showed that flares have negative effects on vegetation growth, animal life and ecological equilibrium in the Niger Delta area. Heat Production kills vegetation around the heat area. It suppresses the growth of flowering plants and reduces agricultural productivity and wild life biodiversity.

The presence of acidified rain water in the environment increases the corrosion rate of roofing sheets, monuments and other economic structures. In the Niger delta area there is glaring evidence of the impacts of corrosion on several building structures.

AIR POLLUTION IN NIGERIA

Atmospheric pollution is gradually becoming a serious menace in Nigerian cities. Especially in the metropolitan areas, inefficient energy combustion in the transportation system generates high levels of localized air pollution. The recent increase in the importation of second-hand cars and

the widespread adoption of the single-engine, "okada" motor-cycles for ferrying passengers all over most Nigeria cities have accentuated the general level of air pollution.

Indeed, motor vehicles produce more air pollution than any other single human activity (World Resources Institute 1992). Nearly 50 percent of global carbon monoxide, hydrocarbon, and nitrogen oxide emissions from fossil fuel combustion come from gasoline – and diesel powered engines. In city centres like Lagos and Abuja, especially on highly congested streets, traffic can be responsible for as much as 90 to 95% of the ambient carbon monoxide levels, 80 to 90% of the nitrogen oxides and hydrocarbons, and a large portion of the particulates, posing a significant threat to human health and natural resources (Savile 1993).

Heavy reliance on biomass materials as the main energy source for domestic needs, especially by the poor in Nigeria has also been identified, among other things, as partly responsible for a variety of health problems particularly among women.

Industrial energy use contributes to the overall level of air pollution. In this regard, the gas flaring in the oil-producing regions of the country represent perhaps the most pernicious of atmosphere pollution in the country. In particular, they have heightened the level of airborne emissions of such pollutants as sulphur dioxide, carbon monoxide and nitrogen oxides, all of which pose serious health hazards in urban areas.
It is claimed that Nigeria's carbon dioxide emissions from industrial processes, estimated at 96513 million metric tons in 1992, was the highest in sub-Saharan Africa, excluding the Republic of South Africa. The emission from flared gas alone accounted for more than one half of this figure.

Ever since the discovery of oil in Nigeria in the 1950's, the country has been suffering the negative environmental consequences of oil development. The growth of the country's oil industry, combined with a population explosion and a lack of environmental regulation, led to substantial damage to Nigeria's environment especially in the Niger Delta region, the centre of the country's oil industry (Oyekunle, 1999).

The country also faces environmental challenges from air pollution and desertification, with the encroachment of the Sahara desert in north and severe air pollution in over crowded cities such as Kaduna, Lagos and Abuja (Ifeanyichukwu, 2002). The Niger Delta's main environmental challenges result from oil spillage, gas flaring and deforestation. Gas flaring is the one the hottest environmental issues in Nigeria. Flaring is the controlled burning of the waste natural gas associated with oil production (Bassal, 1981)

COMMON CAUSES OF AIR POLLUTION IN NIGERIA

BIOMASS COMBUSTION: In Nigeria, biomass in form of firewood, coal, bamboo trunks and dead leaves are commonly used sources of cooking fuel especially in the rural areas. Of all these the most frequently used is firewood. This fuel woods are usually logged from nearby bushes and forests or are collected as dead branches within the residential vicinities by the women and

sometimes children and are used to generate energy for cooking. The combustion of firewood releases gaseous pollutants and particulate matter. From literature the gaseous pollutants from cooking emissions are carbon monoxide

CO, carbon dioxide CO_2, sulphur dioxide SO_2, nitrogen dioxide NO_2, volatile organic compounds VOCs and particulate matter. The particulate matter generated is in the form of carbon black, sooth and fly ash which are major components of smoke and are most often within the 10μm size range.

REFUSE BURNING: Refuse disposal is a major environmental problem in Nigeria particularly in the urban areas. The refuse is usually from multiple sources including domestic, municipal, agricultural and industrial sources. One of the environmentally unfriendly methods of managing the waste is by open burning either on nearby lands or open dumps within the residential vicinities. The composition of the refuse, age of the dump and intensity of the flame usually determines the nature of the air pollutants. Often times the air within refuse burning sites is inundated with VOCs, CO, SO, NO, Total Hydrocarbons (THCs), as well as various classes of toxic and hazardous compounds via Polycyclic Aromatic Hydrocarbons (PAHs), dioxins, PCBs (Polychloro Biphenyls) and heavy metals such as lead, nickel and mercury. Refuse burning is the most common refuse disposable method in Nigeria and it constitutes a major cause of air pollution.

TRAFFIC EMISSIONS: Over 600 million people globally are exposed to hazardous level of traffic-generated pollutants United Nation (1998). Human exposure to these air pollutants is believed to have posed severe health problems especially in urban areas where pollution levels are on the increase. Pollution due to traffic constitute up to 90- 95% of the ambient CO levels, 80-90% of NO, hydrocarbon and particulate matter in the world, posing a serious threat to human health (Savile, 1993). In Nigeria much attention is focused on general industrial pollution and pollution from the oil industries, with little attention on the effects of air pollution from mobile transportation sources (Faboya,1997; Iyoha, 2009).

Increased pollution from mobile sources is on the increase with per capita increase in vehicle ownership. The consequence of this is the congestion of most Nigeria city roads and a corresponding increase in the burden of air pollutants and their associated effects. Studies conducted by Akpan and Ndoke, (1999) in Northern Nigeria show higher values of CO_2 concentration (1780-1840 ppm) in heavily congested areas in Kaduna and (1160-1530 ppm) in Abuja. A study of the impacts of urban road transportation on the ambient air was conducted by Koku and Osuntogun (1999) in three cities in south western Nigeria. Air quality indicators namely CO, SO_2, NO_2 and Total Suspended Particulates (TSP) were determined. The highest levels obtained for the air pollution indicators were CO-233 ppm, SO_2-2.9 ppm, NO_2-1.5 ppm and total particulates 852 ppm in Lagos.

In Ibadan the highest levels obtained were CO-271 ppm, SO_2-1.44 ppm and NO_2-1.0 ppm. In Ado-Ekiti the highest levels obtained were CO-317 ppm, NO_2-0.6 ppm and SO_2-0.8 ppm. These results were found to be higher than FEPA limits for CO-10 ppm, SO_2-0.01 ppm, and NO2-0.04-0.06 ppm. A comparative study of emission levels in Lagos and the Niger Delta area was

reported by Jerome (2000). Two major cities, Port-Harcourt and Warri were considered for the NDA. The results obtained showed that the concentrations of TSP, NO, SO_2 and CO in Lagos and the Niger Delta communities were above the FEPA recommended limits. The CO levels for Lagos 10-250ppm were higher than the levels 5.0-61.0 and 1.0-52ppm recorded in the two selected communities in the Niger Delta. The TSP concentrations were also high for both locations when compared to WHO standard.

At the National level, available data on the total number of vehicles registered in Nigeria shows an increase from 38,000 to 1.6 million between 1950 and 1992 (Enemari, 2001). Data from the Federal Road Safety Commission (FRSC) of Nigeria however, indicates that between 1999 and 2004 about six million vehicles (6,000,000) were registered in Nigeria of which 70% of the registered vehicles were cars and 30% busses and trucks. The reason for the large increase of registered vehicles in 1999 was due to the deadline given for the registration of all vehicles in the country by FRSC. The subsequent years indicate vehicles coming in for the first time into the country.

The increase recorded in 2002 was the climax due to favourable government policies on importation of fairly used vehicles at the inception of democratic rule in Nigeria. Although there was a decline in 2004, it is obvious that the number of vehicles plying Nigerian roads had continued to increase. In Lagos alone about 223,764 vehicles were registered in 2008 compared to 160,134 vehicles registered in 2007. Also in the first quarter of 2009 more than 58,000 vehicles were registered and a total of 27,587 motorcycles were also registered between July 2006 and July 2009 (http//alafrica.com/stories). From the above data it is apparent that the average emission concentration from motor vehicles and motorcycles in the country is in the increase.

BUSH BURNING: Bush burning is a common phenomenon in Nigeria. Most times the burning of bush is done prior to land cultivation as one of the initial steps of land preparation. This constitutes part of the pre planting preparation. The process of bush burning leads to the release of various types of gaseous pollutants and particulate matter. Very often the gas stream is inundated with volatile organics and oxides of carbon (CO), sulphur (SO) and nitrogen (NO) depending on the fuel composition and intensity of the flame. Particulate matter usually within the 10μm size range is also produced in the course of the combustion process.

INDUSTRIAL EMISSIONS: Apart from Lagos which was the former political capital but still regarded as Nigeria's economic capital, the next most industrialized part of the country is the Niger Delta Area. The region boasts of oil and non oil related industries including refinery, petrochemical, liquefied natural gas, chemical fertilizer, aluminium smelter, paper, cement, flour, wood, battery and textile industries etc., which emit various kinds of air pollutants. The pollution from these industries adds to the burden of gaseous and particulate pollutants in the air. In the era of textile industries in Kaduna, there was a high level of air pollution in areas around the industries.

CHEMICAL FERTILIZER INDUSTRY: The chemical fertilizer industry in Nigeria is still in its infant stage. It utilizes a variety of raw materials such as natural or synthetic gas

(methane), atmospheric nitrogen, steam and sand as filler material in the production of various formulations.

REFINERY AND PETROCHEMICAL COMPLEX: Nigeria is a land richly blessed with oil. In the late nineties, there were three functional refineries when the crude oil was refined. The refineries were a major cause of air pollution in Nigeria. It is especially so as they are located within residential areas.

GAS FLARING: According to Cedigaz (2000), Nigeria holds the highest record (19.79%) of natural gas flaring globally and is responsible for about 46% of Africa's total gas flared per tonne of oil produced. Until present there are not less than 123 flaring sites in the region making Nigeria one of the highest emitter of green house gases in Africa (Uyigue and Agho, 2007). Similarly, analytical assessment of the statistical bulletin of the Central Bank of Nigeria (2004) showed that the average rate of gas flaring in Nigeria during the period 1970-1979 stood at 97%, while 97 and 95% were flared between 1980, 1989 and 1990 to 1999, respectively. Between 2000 and 2004, 51% was flared. In the same vein, between 1970 and 2004 Nigeria has flared an average of 76% of the total gas produced. Much of the natural gas extracted in oil wells in the Niger Delta is immediately flared into the environment at a rate that approximates 70 million/m3/day. This is equivalent to 40% of African natural gas consumption and forms the single largest source of greenhouse gas emissions on the planet (Wikipedia, 2007; Moffat and Linden, 1995). The largest proportion of these flare
Sites and pollutant concentrations are located in the Niger Delta.

PIPELINE EXPLOSION: The explosion of pipelines occurs either accidentally or by sabotage. In the Niger Delta area of Nigeria, much of the pipeline explosions are a product of the later and they are usually accompanied most times with fire outbreak. The burning flame and smoke from the oil pipelines releases large concentrations of gaseous substances and particulate matter. The substances in most cases include CO, NO, VOCs, THCs, carbon black, soot and some heavy metal residues.

CONSEQUENCES OF AIR POLLUTION IN NIGERIA

Air pollution has impacted negatively in the lives of Nigerians and the Nigeria environment.

EFFECTS ON WEATHER, CLIMATE AND ATMOSPHERIC PROCESSES

In general, air pollution is responsible for 2 main global problems:

i. Contamination of the upper atmosphere

ii. Alteration of weather and climate

Air pollution has affected the local weather condition in Nigeria. This is apparent in the change in the duration and intensity of rainy, harmattan and dry seasons. Recently, the heat emissions of the sun are becoming rather scorching and experts believe it is due to the depletion of the protective ozone layer. The warming effect that results from this phenomenon could affect, significantly, the comfort and the liveability of the urban people.

Also, the distribution and abundance of particulate matters is responsible for local rainfall patterns and hence there is a significance increase in precipitation in and around cities, and is due to air pollution. Air pollution causes weather to change on a continental or global basis. Many gaseous pollutants and fine aerosols reach the upper atmosphere, where they have on the penetration and absorption of sunlight. According to modern environmentalists, increasing particulate matter pollution may reduce the amount of sunlight reaching the surface of the earth thereby lowering solar radiation energy at the earth's surface.

EFFECT ON HUMANS' HEALTH

RESPIRATORY SYSTEM AND DISEASES

The first target organs attacked by air pollutants are respiratory system. Considering the respiratory system of humans, from the nasal cavity to near the bronchi, which constitute the passage of air, mucus covers the mucous epithelium.

The airway of trachea and the bronchi are provided with cilia to eliminate foreign substances. Also, there are alveolar macrophages of phagocyte in the alveolar of the lungs exchanging carbonic dioxide for oxygen.

MAN'S RESPIRATORY SYSTEM AS IT IS AFFECTED BY AIR POLLUTION

Of the air pollutants inhaled, the larger particulate matters are caught in the nasal cavity. However, so-called suspended particulate matters, measuring 10μm or less in diameter pass through the nasal cavity to reach the trachea and/or the alveolar.

Of the gaseous substances, sulphur dioxide, which is soluble in water, is absorbed mainly in the upper airway, causing chronic bronchitis or asthma. On the other hand, ozone, nitrogen oxides and other insoluble gaseous substances advance deep in the lungs, causing asthma or chronic bronchitis or possibly pulmonary emphysema. Also, when carbon monoxide comes in contact with haemoglobin contained in the blood in alveolar, it disturbs transportation of oxygen by the blood because the substance combines with haemoglobin more easily than oxygen.

In many cases, however, air pollution causes chronic respiratory diseases especially asthma, chronic bronchitis and lung emphysema. These respiratory diseases are known generally as chronic obstructive pulmonary diseases (COPD).

Another disease that can be caused by air pollution is lung cancer. It should however be known that the causes of these diseases are not limited to air pollution. Due to lack of data, the diseases accruing to air pollution and the number of people affected is not readily known however, other air pollution effects on health include: Low birth weight and nutritional deficiency in children; interstitial lung disease, chronic obstructive lung disease, tuberculosis, cardiovascular disease and cataract among others in adults.

EFFECT ON VEGETATION

In terms of the damage to plants caused by air pollution, forests could be damaged and agricultural area recording poor growth and yield. This could be caused by the sulphur dioxide (SO2) and hydrogen fluoride (HF) from stationary sources. Plant damage could also result from mobile sources including automobiles.

EFFECTS ON MATERIAL AND CULTURAL PROPERTIES

The effects of air pollution is not only on people's health and living things such as plants, but also extend to man-made items such as materials like metals and cultural properties. To recognize and investigate the effects of air pollution on materials and cultural properties is to evaluate the economic loss from the air pollution and at the same time improve the safe maintenance of public assets

VISIBILITY DEGRADATION

The light from the sun deteriorates as its being absorbed and scattered by aerosols; absorption by air pollutants and water vapour; scattering by airborne particles, among others. The main cause of visibility degradation due to air pollution are aerosol and gases in the atmosphere, but the visibility conditions can differ greatly due to atmospheric condition such as humidity; the optical characteristics of the target; and the strength and distribution of the light at the time in question. When air pollution is severe, the atmosphere appears to be coloured. But the colour can vary depending on the type of pollution. Air pollution appears black when it is due to soot from the burning of fossil fuels, but has a whitish hue when it is due to photochemical pollution.

ROLE OF NIGERIAN GOVERNMENT IN ENVIRONMENTAL PROTECTION

Historical examination of laws on Nigerian environment before 1969 reveals a startling absence of any form of statutory regulations aimed at protecting the environment from industrial pollution. However, following the dumping of toxic waste in Koko, a seaport in Delta State, in 1988, the government swung into action to deal effectively with the problems of environmental degradation. Since then efforts have been geared towards sustaining the environment.

One of the first steps taken was to promulgate the Harmful Waste (Special Criminal Provisions, etc), Decree 42 in November 1988. The decree prohibits the purchase, sale, importation, transmit, transportation, and storage of harmful wastes in the country. This legal sanction was followed a month later by Decree No. 58 of 30th December, 1988 which established a body known as the Federal Environmental

PROTECTION AGENCY (FEPA).

The Decree also provides for the national environmental standards on water quality, efficient limitations, air quality and atmospheric protection, noise control, discharge of hazardous substances and released offences. Within the context of the Decree, FEPA is expected to cooperate with the Ministry of Petroleum Resources (Petroleum Resources Department) for the removal of oil related pollutants' discharged into the Nigerian environment. The Decree also empowered FEPA to inspect, search, seize and arrest offenders. The Decree also provides for general penalties for individuals as well as for companies and firms found liable. Whereas an individual on conviction is liable to a fine not exceeding N20, 000.00 or to imprisonment for a term not exceeding 2 years (or both), a corporate body found liable would pay a fine of not exceeding N500, 000.00 and compensation commensurate with the breach thereof and restoration of the polluted area to an acceptable level as approved by the agency.

The Ministry of Petroleum Resources, through various Petroleum Acts and subsidiary legislation ensures that the petroleum industry carried out its activities safely and in an environmentally sound manner.

The government have more work to do however in implementing the decrees. There is an increasing rise of air pollution in Nigeria basically from the petrol run generator sets that almost every household possess. This is so because the electricity generated in the country is not enough to ensure steady supply of light.

Also, there are no incinerators and the waste vans don't cover every area of the country. Preference is given to the high brow areas leaving others to take care of their waste themselves. The result is a dumping on, in most cases, the major roads heap of waste and it constitutes a high cause of air pollution in the country. Efforts should also be made to recycle waste.

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