



Impacts of Soil Pollution on Air Quality under Nigerian Setting

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Abstract

Soil pollution is majorly caused by human activities (viz: Agricultural practices, industrial activities and poor waste management) and natural effects such as flooding, acid rain, weathering processes. Soil pollution often cause soil barrenness, offensive odour etc. The resultant effect could impact on soil, air and water quality as well as human that reside or work close to the polluted area over a period of time depending on the physical nature of the pollutant as well as its concentration. This study reviews the impacts of soil pollution on air quality under Nigerian setting. The study found that soil pollutants from waste dumpsite could directly or indirectly cause emission of ammonia, methane, hydrogen sulphide, carbon monoxide, oxide of sulphur and nitrogen, and particulates matters into the atmosphere. Most of the aerosols have adverse effect on human health on exposure. The pollutant gases have been implicated as a major cause of respiratory related impairments. Some of the pollutant could also cause nose, eye, skin, throat irritation, cough, breathlessness, dizziness, weakness of the body and predisposed the body to certain organ dysfunctions. Soil pollutant could also aid in the transfer of pathogenic microbes that could predispose individuals residing close to soil polluted area such as dumpsite to diseases caused by microorganisms especially on immune compromised individuals. Some of the pollutant gases such as oxide of nitrogen and sulphur cause acid rain which have adverse impacts on infrastructure and biodiversity including humans than make use of the rainwater. Hence there is the need to adequately manage soil pollutants such as waste dumpsite.

Keywords

Biodiversity, Particulates, Pollutant gases, Public Health, Soil pollutants

Introduction

Environmental pollution is one of the major challenges facing humanity in the 21st century. Industrialization, urbanization and developmental projects are the major cause of environmental pollution which is associated to anthropogenic activities have increased with the last century globally [1-4]. The different components of the environment (mainly soil, water and air) are frequently impacted by anthropogenic activities and to lesser extent natural effects. Anthropogenic activities are human activities that are carried out on the earth surface encompassing the various environmental components.

Nearly all human activities are carried out on land. Izah, et al. reported that soil is a distinctive habitat for most living organisms [5]. Although some living organisms reside in aquatic ecosystem, some species of microbes are found in varying habitats such air, soil, water, reservoirs, storage tanks, inside and within the body of human and some other animals etc. But most of the resources that are widely utilized by humanity are found in the soil. Soil also plays several economic, social, ecological roles [5,6]. The human activities on soil have direct or indirect effect on soil quality. The impacts also extend to water and air quality. Some of the notable

activities that take place in the soil include construction works, erection of building structures, cultivation of vegetation, land transportation among others. As such, soil has been regarded as integral part of landscape probably due to its diverse and unique characteristics [5-7]. Soil is formed during weathering processes through the interaction of rock, geologic materials and microorganisms [8].

Soil is one of the major receipt of wastes (solid, liquid and air emission) generated from human activities. Several economic activities that lead to soil pollution are mainly from agricultural and industrial activities, and poor waste management from various processing outfit. In addition surface water are major receipt of wastes in many communities close

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to aquatic ecosystem [9-16]. Food processing such as cassava and oil palm processing wastes is predominantly dumped in soil and sometimes they block drainage systems and cause offensive odours [17]. Furthermore, Izah, et al. reported that oil palm processing affect soil and surface water quality receiving the effluents. The authors also reported that it could also impact on air quality [18].

Air pollution is a major global challenge and it's more intense in developing nations. Air pollution majorly occurs when the concentration of particulate matters (PM 1, PM 2.5, PM 4, PM7, PM 10 and total particulates), volatile organic compounds (isobutylene compounds), oxides of nitrogen, sulphur, carbon, hydrogen sulphide, methane, ammonia concentration among others exceed the limits required for human health over a period of time. In developing country like Nigeria, air quality study is still in infant stage and most of the emission standard for air quality is mainly meant to checkmate the activities of oil and gas, and some selected sectors [18-21].

Air pollution is caused by both natural and anthropogenic activities. The human activities causing air pollution include fossil fuel combustion, transportation activities, industrial processes, and non-industrial fugitive sources. Non industrial activities appear to be a major contributor of air pollution that often goes unnoticed. For instance, wastes are found in several unapproved places including markets, drainage channels, undeveloped land, streets, surface water [22,23]. Ohimain and Jenakumo, Angaye, et al. Ohimain is with opinion that inadequate and irregular evacuation practices by appropriate government agencies is a contributor factor of poor waste disposal methods [22-24]. These wastes are a major cause of soil pollution.

The major processes of discharging municipal solid wastes in Nigeria depend on the locality. For instance, in most communities aligning surface water in the Niger Delta especially Bayelsa state most of the wastes generated as deposited in water ways i.e. river, creeks, creeklets [25,26]. In the urban areas, most of the wastes are collected and deposited in open dumpsite where they are combusted during the dry season. Instances of using municipal solid wastes to fill burrow pits also exist. Other specific wastes resulting from industrial activities such as oil and gas are often treated accordingly before being discharged into the environment. The treatment strategy for these wastes depends on its toxicity level.

Air pollution have adverse effects on humans depending on the physical constituents of the aerosols, its concentration and dispersal level. Several diseases have been associated to aerosols especially respiratory based diseases. Therefore, this study focused on the impacts of soil pollution on air quality under Nigeria setting.

Causes of Soil Pollution

Soil pollution results from natural activities and to higher extent anthropogenic activities. The rate of pollution caused human activities has surpassed the level caused by natural effects in developing country like Nigeria. This section of the

paper focused on both natural and anthropogenic causes of soil pollution.

Anthropogenic causes of soil pollution

Several human activities that cause soil pollution include agricultural activities (use of pesticides-herbicides, chemical fertilizer), soil heavy metal enrichment resulting from mining activities, soil erosion after precipitation, poor management of animal wastes and general waste management, and food processing.

Use of pesticides: Pesticides are substances used in eradicating, mitigating, repelling and controlling pest in homes and agricultural field [27-37]. Pesticides have contributed a lot to pest management and agricultural enhancement in the world. The choice of pesticide depends on the type of pest to be eradicated. For instance, insecticides, miticides, larvicides, pediculicides are used to eradicate insects, herbicides are used for vegetation/herbs, acaricides is used to control ticks, molluscides is used to eradicate snails, other molluscs causing diseases, and rodenticides is used control rodents [27]. Most pesticides are produced from synthetic and semi-synthetic chemicals. In the past few decades, pesticides from botanicals have been research upon and several have proven to be effect to several pests especially insects and snails [38,39]. Synthetic based pesticides contain chemical constituent that could be toxic to non-target organisms found in the environment [27-36]. Pesticides applied in the agricultural field and/or household setting to eradicate other pesticides could end up in other habitats or location through aerosolization, careless discharge of cans or remains, or even through runoff after rainfall [37]. Some pesticides are known to alter soil native flora. Soil play essential role in soil formation and biogeochemical cycle [8]. Pesticides on aquatic organisms could results to contamination of the water column with regard to oxygen depletion, poisoning and mass mortality of aquatic organisms such as fisheries.

Chemical fertilizers: Fertilisers are used in agricultural practices. Typically, fertilizer is used to boost crop productivity or yield. Chemical based fertilizer are used for several plants such as maize, melon, yam and cassava etc in most rural communities whose source of livelihood is agriculture in many areas in Nigeria. Most chemical based fertilizer contains several constituents that could be toxic to some soil native flora. During its application runoff after precipitation could cause it to wash to an area it's not desired causing soil pollution.

Heavy metals: Typically, heavy metals which metals that a specific gravity of $\geq 5 \text{ cm}^3$ [40-42]. Heavy metals have been widely reported in several food materials including vegetables spices [43], fish [44-50], surface water [17,41], beverages [51], among others. Heavy metals have the tendency to persist in the environment because it's recalcitrant to degradation [47,51]. Heavy metals can bioaccumulate in tissues of plants and animals such as fish [42]. Most of the essential heavy metals such as chromium, zinc, copper, cobalt, iron etc are toxic to human body when their concentration exceeds the permissible level. Also, non-essential metals heavy metals such as cadmium, arsenic, lead, mercury are highly toxic

even at low concentration in the body. Heavy metal in the environment result from anthropogenic activities and to lesser extent natural effects. Human activity leading to heavy metals deposition includes mining, quarrying of elements from their ores, wastes streams containing heavy metals.

Erosion: Soil pollutants can be transported through erosion. Emission from industrial activities could aerosolize and transported through wind effects. It could also be transported through soil erosion to other places including soil and surface water that wastes were not originally dumped. Soil pollutants could also occur through leaching of contaminant [23]. The surface water are known as major sink of many environmental pollutants.

Animal wastes: Domestic animals such as goats, cattle, are reared in open area in some locations in Nigeria. The faeces and dumped in open places where it causes odour pollution in many areas in Nigeria. Furthermore, in abattoir and slaughter house, the wastes generated are also dumped in soil where it causes attendant odour pollution.

Poor waste managements: Wastes resulting from activities of man on the environment are a major source of environmental pollution especially in developing regions. Wastes are originated from home or household item and industrial materials that are no longer and in use [16]. Improper waste management is a challenge to many developing countries. Typically, Izah and Angaye reported that large chunks of wastes are generated in several sector of the economy [42]. Three major wastes generated include solid wastes (plastic, remains of food processing, agricultural residues), liquid (effluents from industries, food sector etc) and gaseous emissions (pollutant gases) [42]. Generally, improper management of municipal wastes is a major of pollution [52-54]. Several wastes stream are dumped close to surface water. For instance, Seiyaboh and Izah reported that market wastes close to Epie creek often end up in the aquatic ecosystem blocking the water ways and causing odour pollution [16]. The impacts and pollution level depends on its constituents/composition [16]. Typically, wastes such as plastics, glass, metals, batteries, fibres and rubber are some recalcitrant non degradable wastes. Furthermore, inorganic and organic solvents in dumpsite or landfill could be deleterious to the soil as well.

Food processing: Food are fundamental resources need for human existence [55-58]. During food processing several wastes are generated especially during raw material processing. Several wastes that poorly managed are generated in several sector including food processing such as oil palm [20,21,59-64], cassava [65-70]. Specifically, oil palm processing into palm oil and kernel oil generates palm oil mill effluents (liquid wastes), chaff, empty fruit bunch, palm press fiber (solid wastes) and gaseous emissions (pollutant gases) [18]. Furthermore, during cassava processing into cassava flake or high quality cassava flour (gari), sievates and cassava peels (solid wastes), cassava mill effluents (liquid wastes) and pollutant gases gaseous emissions are generated [2-6,51,65-70]. The wastes are underutilized in most high processing countries like Nigeria, where they cause attendant environmental impacts including odour pollution and alteration of soil quality parameters.

Natural cause

In the recent times, the severity and frequency of natural hazard have increased especially in developed nations. However in the Niger Delta region of Nigeria, the impacts of soil pollution resulting from natural effects appear to predominantly cause by acid rain and water flooding. The effects of the natural cause of soil pollution appear to be triggered by human effects.

Acid rain: Several oxides of sulphur, nitrogen combine with water to form acid rain. Soil is one of the direct recipients of acid rain. Acid rain has been widely reported to be toxic to infrastructures [71]. In soil, acid rain could alter the soil acidic content thereby causing soil pollution and impacting on non-acid tolerant soil fauna. These acid rain could have impact of plant yield and productivity, distribution of abundance of fauna especially insects and soil microbes.

Flooding: Flooding is one of the major natural disasters frequently encountered in Nigeria especially resident of the coastal areas. Furthermore, most part of some cities such as Yenagoa, Aba, Warri, Lagos etc gets flooded during wet season [72]. Furthermore, the intensity of the flooding is triggered by anthropogenic activities in the area. For instance, blockage of drainage canals, erection of building in water ways or drainage system are some of the factor affecting the severity of flooding.

Types of Soil Pollution

Soil pollution occurs in several forms including barrenness of soil, offensive odour, surface being occupied by other pollutants such as solid materials, pool of water and leachate.

Barrenness of land

The soil becomes barren when they are impact by human activities and to lesser extent by natural effects. When soil becomes barren due to anthropogenic activities the characteristics of the soil is impacted. For Instance, Izah, et al., Awotoye, et al., Okwute and Isu reported that soil receiving palm mill effluents is devoid of vegetation [18,73,74]. Furthermore, soil receiving cassava mill effluents do not allow the growth of vegetation like non contaminated soil. When soil becomes barren its ability to support the flora and fauna is affected. It could also hinder germination of seeds as well as its productivity.

Offensive odour

Soil pollutants have the tendency to cause odour. For instance, Izah, et al., Awotoye, et al., Okwute and Isu reported that soil receiving palm mill effluents is characterized by offensive odour [18,73,74]. In addition, cassava processing mill often emits offensive odour that could cause stomach upset [8]. Also, waste dumpsite releases offensive odour. The odour could be highly toxic to human depending on its composition.

Solid materials occupying the soil surface

Some of the soil pollutant is solid wastes. For instance, most plastics, metals, glass, paper among others have the

tendency to occupy space. This could hinder other useful activities that would have been carried out in the area.

Effects of Soil Pollution

Soil pollution have effects on the different major environmental components (viz: Soil, water and air quality) as well as human. This section of the paper focused on the effect of soil pollution.

Soil quality

Soil characteristics play essential role on its suitability for any activity. Several soil pollutants cause several impacts on the soil chemical parameters. Izah, et al., Awotoye, et al., Okwute and Isu reported that soil receiving palm mill effluents contain debris from processing mills, damp soil [18,73,74]. Studies have also indicated that cassava processing activities could alter the receiving soil characteristics [5,8,65]. Variation in soil characteristics could either be beneficial or detrimental to the flora and fauna in such place. For instance, Izah and Aigberua reported that cassava mill effluents decrease the population and diversity of microbes found in receiving soil [65]. This indicates that chemical composition of the pollutant could affect the fauna in soil. Also instance, of cassava mill effluents leading to reduction of plant productivity have also been reported in literatures [8]. Some of the soil pollutant could also enrich the soil with adequate nutrients leading to higher productivity.

Air quality

Soil pollution can impact on air quality. For instance, wastes dumpsite impact on air quality. Anagye, et al. reported that dumpsite emits carbon monoxide, oxide of sulphur, nitrogen and hydrogen sulphide [53]. Typically in dumpsite some of the common emission released includes carbon monoxide, oxide of sulphur and nitrogen, hydrogen sulphide, ammonia and methane (Table 1). The emission from waste dumpsite could also be as a result of decomposition of the various wastes through the interaction of the microbes found in the waste streams. The different microbial diversity found in the waste could play essential role in the type of emission generated. Furthermore, during dry season most dumpsite are frequently set ablaze and during the combustion processes different emission are released which depends on the moisture and chemical constituents of the waste [75].

Surface water

Water is one of the essential resources required for human existence. In Nigeria the potable water sources are mainly surface water (river and stream), ground water (borehole) and rain water [40,76,77]. In coastal region of Nigeria, most waste stream are deposited into the surface water including sewage [25,26,42] and other municipal wastes [9-12,25,26]. Most of the wastes from market end up in the surface water causing alteration in water and sediment quality.

Health

Soil is a platform through which vegetation are cultivated. Plants and animals have the tendency to bioaccumulate

Table 1: Seasonal distribution of air quality in some Municipal Solid Waste Dumpsites of Yenagoa Metropolis.

	Dry Season					Wet Season					
	CO (ppm)	SO _x (ppm)	NO _x (ppm)	H ₂ S (ppm)	NH ₄ (ppm)	CH ₄ (ppm)	CO (ppm)	SO _x (ppm)	NO _x (ppm)	H ₂ S (ppm)	
Eliozo/Eligbolo and Obigbo in Port Harcourt, River state	-	0.22-0.23	0-05 (for NO ₂) & 0.2-5.2 (for NO)	0.06-0.08	0.3-3	36 - 53	-	-	-	-	Ezekwe and Arokoyu [98]
Rumuolumeni, Port Harcourt, River state	-	0.026-1.677 mg/m ³ for SO ₂	0.1-0.39 mg/m ³ for NO ₂	0.084-0.404 mg/m ³	0-0.300 mg/m ³	0.007-0.138	-	-	-	-	Well and Adekunle [99]
Yenagoa metropolis	0.02 -1.18	0.01-0.81	0.01-0.82	0.20-6.95	-	-	0.01-0.54	0.01-0.81	0.01-0.33	0.07 -7.44	Angaye, et al. [53]
Control	0.02	0.01	0.01	0.01	-	-	0.01	0.01	0.01	0.01	
WHO Limits	30	0.07	0.12	0.07	-	-	30	0.07	0.12	0.07	
NAQS	10	0.01	0.04-0.06	-	-	-	10	0.01	0.04-0.06	-	

The season of Ezekwe and Arokoyu study was not mentioned [98]; Well and Adekunle Studies was carried out in December (dry season) [99].

toxicants such as heavy metals in their tissues. Hence the tendency of transferring soil contaminants to the food chain is high. Though food toxicant can enter the human body causing different form of diseases that could affect reproductive, respiratory, nervous, digestive system, and poisoning that could affects body organs such as liver, and kidney.

Impacts of Air Quality on Human Health

Airborne particles are mainly from natural and anthropogenic sources. Natural sources of airborne particles are from weathering processes and dust, while anthropogenic based air borne particles is from combustion, industrial processes, manufacturing/production settings, waste dump site. These air borne particles occurs on daily basis at varying concentration depending on the meteorological parameters such as wind speed, wind direction, atmospheric temperature, among others. Some of the industrial setting that release air emission include quarrying, metal smelting, steel manufacturing, and cement batching. Air quality is frequently measured by certain parameters including oxide of nitrogen, carbon, sulphur, sulphur dioxide, ammonia, isobutylene and particulates matters. Soil pollution tends to elicit the emission of these gases. Several factor affects air quality due to soil pollution. For instance, the physical, chemical etc concentration of the pollutants in the soil could affect air quality. Furthermore, natural conditions such as moisture content of the contaminated soil could affect air quality gradients. This section of the paper focused on impact of soil pollution on air quality parameters.

Particulates

Air particulates including PM₁, PM_{2.5}, PM₇, PM₁₀, and total suspended particulates have varying effect on human body. This is because the adsorption rate of the different particulate concentration differs. Several pathological effects are associated with air particulates especially when its concentration exceeds the recommended or desired limits. The impacts and severity of air particulates matter is due to the exposure duration, physical and chemical content of the particulates as well as concentration.

Authors have variously reported that particulate matters have increased respiratory and cardiovascular disease condition [20,78-80] including lung inflammation [81]. Authors have also reported that high rate of particulate matter causes respiratory diseases such as emphysema, pneumonia, bronchitis, asthma and respiratory tuberculosis [20,82,83]. Particulates have also been linked to increased hospital admissions associated with asthma-like conditions [20,80].

Over a long period of time, exposure to high concentration of particulates could damage eyes, teeth, bones, and increased decline in reproduction potentials among species residing in the area and susceptibility to other disease and related environmental hazards [20,84-87]. Ana, Ohimain, et al. also reported that particulate matter could lead to vascular dysfunction, and increased thrombosis [19,20].

Oxide of nitrogen

Most oxides of nitrogen are acidic in nature. For instance,

NO₂ which is an acidic gas is an important pollutant gases. It's emitted from several human activities especially on polluted dumpsites (Table 1). NO₂ have been linked to some environmental problems. Furthermore, NO₂ is also related to increased risk of respiratory and cardiovascular diseases, and it could cause liver and kidney diseases over prolong period of time [20,88]. Ezekwe, et al. reported that oxide of nitrogen could react with ammonia, moisture and other compounds to form small particulates which could easily penetrate into the lungs and cause respiratory discomfort including emphysema and bronchitis, and aggravate existing heart disease [89].

Oxide of carbon

Oxide of carbon is one of the major environmental pollutants that can cause several human diseases. Carbon dioxide has been linked to greenhouse gases. Several soil pollutants such as combustion of wastes and bush burning release carbon monoxide into the atmosphere [75]. In addition incomplete combustion of carbonaceous materials or fossil fuels-gas, oil, coal and wood also released carbon monoxide into the environment. Ohimain, et al. reported that when carbon monoxide is inhaled over the desired concentration it hinder the bloods ability to carry oxygen to vital organs such as the heart and brain [20]. Furthermore, high concentration of carbon monoxide in the body could lead to the formation of carboxyhaemoglobin [20,79].

Volatile organic compound

Volatile organic compounds are substances with low molecular weight and have short atmospheric life-time [20]. Furthermore, the severity of volatile organic compounds depends on the type of compound, level and duration of exposure. Authors have reported that short term exposure could lead to irritation of the sensory organs such as eyes, nose and throat [20,90]. Furthermore, exposure over a long period of time could predispose the person to liver and kidney problems and even cancer [20].

Hydrogen sulphide

Hydrogen sulphide is a colorless gas that is highly flammable and smells like rotten egg. It's known to cause irritation of the respiratory tracts which could lead to pulmonary edema at high concentration over a prolong period of time [91]. Acute or chronic toxicity is characterized by nausea, headaches, dizziness, vomiting, coughing, difficulty in breathing, convulsions, coma, death, and skin, nose, throat and eye irritation [91]. These symptoms depend on the exposure period and concentration.

Sulphur dioxide

Sulphur dioxide is one of the main oxides of sulphur that causes environmental degradation. Sulphur dioxide has a sharp smell, and it has the tendency to react with other compounds. For instance, it can easily react with water to form sulphuric acid. A significant amount of sulphur dioxide in the environmental emanates from anthropogenic sources such as coal, oil, gas combustion, extraction of sulphur containing compounds from its ore. It could also emanate from polluted soil. For instance, in dumpsite, due to anaerobic condition

of some part of the area, several noxious gases are emitted as odour. In addition, sulphur dioxide also contributes in corrosion of materials especially metallic objects. Instances of sulphur dioxide emission from wastes dumpsite have been reported (Table 1). On exposure, sulphur dioxide could lead to nose, throat irritation, cough, wheezing, breathlessness [92]. Again the effects of sulphur dioxide depend on the exposure duration and concentration gradients.

Ammonia

Ammonia is one of the noxious gases. High concentration of ammonia could lead to irritation of the skin, eye, nose, throat and respiratory tract. In the respiratory tract, it causes some level of discomfort and if not properly managed it could cause obstruction of the respiratory system [93]. Skin, ingestion and inhalation are the main route ammonia exposure route. The severity of the impacts depends on the exposure duration and concentration. Ezekwe, et al. reported ammonia in the atmosphere is of serious concern [89].

Methane

Methane is another important gas that can be produced from both natural and anthropogenic activities. Typically, methane is a colorless, odourless gas that highly flammable on exposure with oxygen. Burning fossil fuels (coal, natural gas and gasoline) is a major source of methane in the environment [94]. Methane is also produced from faeces of animals such as goat, cattle, sheep. This could be due to be presence of some species of methanogen. It could also be produced in decomposition of organic materials such as remains of food. Methane can also be produced during anaerobic treatment of some food processing waste water such as palm mill effluents [62,63,95] and cassava mill effluents [8]. Methane is a major greenhouse gas and it has been linked to climate change. Methane has been variously reported to be about 21 times more powerful than carbon dioxide [63]. On exposure, methane could lead to decline in oxygen content in the body thereby leading to loss of consciousness and coordination, dizziness and weakness of the body.

Effects of Air pollution

Air pollution typically causes several problems to both living and non-living things. For instance, dusts results from construction works often deposits on nearby by surfaces including infrastructures and vegetation covers. The extent of the effects depends on the physical constituents of the pollutants and dispersal mechanisms. On the living organisms perspectives, the microbes found in polluted soil such as dumpsite which are known to cause degradation of materials such as remain of food via aerobic and anaerobic techniques depending on the microbial isolates could be dispersed in the air and then cause disease condition to individuals that are exposed the soil pollutants. Studies have indicated that microorganisms are found in air around dumpsite vicinity. For instance, Igborgbor and Ogu reported the presence of *Staphylococcus*, *Streptococcus*, *Micrococcus*, *Bacillus*, *Pseudomonas*, *Escherichia coli*, *Klebsiella* species (bacteria), *Penicillium*, *Aspergillus*, *Alternaria*, *Mucor*, *Curvularia*, *Rhizopus*, *Cladosporium* species (fungi) as microbes found in

dumpsite and round its vicinity (between 100-500 m) is some part of Delta state [96]. Odeyemi reported the occurrence of *Escherichia coli* (37%), *Klebsiella* species (19%), *Pseudomonas* species (13%), *Serratia* species (15%), *Staphylococcus* species (8%), *Enterococcus* species (7%) and *Salmonella* species (1%) in air quality of dumpsite and around its vicinity (between 50-150 m) in some part of Ekiti state [97].

Air pollutants could affect plant reproduction and photosynthetic processes. This is because some pollutants could interfere with the cellular system of the plant causing mutation. This could lead to loss of several species. In addition, air pollutants such as oxide of sulphur and nitrogen have been implicated to cause acid rain. Due to the acidity content (low pH), it could degrade metallic surfaces and infrastructures made with concrete [71]. Acid rain have effect on humans and biodiversity resources. Seiyaboh and Izah have reported that consumption of acid rain water could predispose the individuals exposed to risk of lung related diseases [71]. The authors reported that it could affect vegetation and aquatic organisms such as fishes. On vegetation, it affects the germination potentials, productivity and yield.

Conclusion and the Way Forward

Air pollutants are known to be major risk factor of respiratory diseases such as asthma, chronic pulmonary disease, tuberculosis, lung diseases. The effects of the air pollutants could have effect on the nervous system causing dizziness, breathlessness and neurobehavioral disorders. It's also a major risk factor to cancer that could affect different body parts. In severe cases, it could lead to cardiovascular diseases and birth disorder among pregnant women. Based on the effects, several options can be used to prevent the effect of soil pollution that could release air borne particulates into the environment. This typically involves wastes segregation and treatment using most suitable method based on the chemical, physical and biological constituents of the wastes. This is because sorting of wastes into different class will provide suitable platform of management. There is the need for sensitization about the effect of soil pollution and the resultant effect through aerosols on humans through campaign, awareness and even extensive teaching in classrooms. There is the need for adequate planning methods on the use of some materials such as fertilizers, pesticides that cause soil pollution by checking the topography of the area whether its prone to flooding and runoff, and weather condition prior to use. Practices that encourage soil erosion need to be controlled and checkmated. This could be achieved through avoiding over tilling and encouraging afforestation. Overall disposal method of animal wastes need to be channeled through biotechnology such as anaerobic digestion. Soil pollutants leading to odour pollution could be controlled through anaerobic digestion.

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