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# Soil Pollution and its Adverse Effects

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***Abstract - When harmful compounds (also known as pollutants or contaminants) are present in soil in sufficient amounts to pose a threat to human health and/or the environment, this is referred to as soil pollution. Whether the soil is highly polluted or relatively pristine, it will always contain a wide variety of pollutants. These contaminants include metals, inorganic ions and salts, and a wide variety of organic compounds. Soil microbes and decomposed organic matter are mostly responsible for the production of these chemicals. Water from precipitation is only one example of an atmospheric chemical that can make its way into the soil, but there are many others. These chemicals can also penetrate the soil by wind erosion or other forms of soil disturbance, as well as via surface water bodies and shallow groundwater that move through the soil. Soil pollution occurs when the quantity of contaminants in the soil rises over the levels normally present in the environment.***

***Keywords - Soil Pollution, Health, Adverse Effects, Environment.***

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## 1. INTRODUCTION

The introduction of foreign organisms, or xenobiotics, into the soil, or some other disruption of the soil's natural ecosystem, are the primary causes of soil pollution and, by extension, land degradation. Common culprits include manufacturing processes, agricultural pesticides, and poor garbage disposal. Hydrocarbons from petroleum, polycyclic aromatic hydrocarbons, solvents, insecticides, lead, and other heavy metals are the most often encountered compounds in this context. The concentration of harmful chemicals and the extent of industrialisation both increase the likelihood of pollution. Health concerns from inhaling contaminated soil vapours or coming into touch with contaminated soil itself are the primary sources of worry with soil pollution. Geology, hydrology, chemistry, computer modelling abilities, GIS in Environmental Contamination, and an understanding of the evolution of industrial chemistry are all essential for the mapping of contaminated soil sites and the subsequent cleanups, which may be both time-consuming and costly. Many nations in Western Europe and North America have established legislative frameworks to detect and address the environmental issue of polluted soil. [1]

Some developing nations have developed tremendous industrialisation yet are less controlled than others. Remember that every soil has substances that are poisonous to humans and other species. But in unpolluted soil, the concentration of such compounds is so low that they do not threaten the local environment. Soil contamination occurs when the concentration of one or more such harmful compounds is high enough to harm living creatures.[2]

## 2. POLLUTANTS

Xenobiotics, which are not present in nature but may be created by humans, are among the most dangerous soil contaminants. The words 'xenos' (foreigner) and 'Bios' (life) in the Greek language provide the basis for the English word 'xenobiotic (life). It's been established that a number of xenobiotics cause cancer. In Fig. 1, we can see a breakdown of the most common soil contaminants. [3]

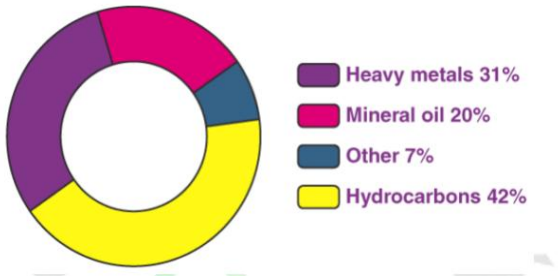


**Figure 1: Pollutants in polluted soil**

### i. Heavy Metals

Soils contaminated with heavy metals pose serious health risks to humans. Asbestos (As), mercury (Hg), lead (Pb), antimony (Sb), zinc (Zn), nickel (Ni), cadmium (Cd), selenium (Se), beryllium (Be), thallium (Tl), chromium (Cr), and copper are all metals that might be considered soil contaminants (Cu).

### ii. Polycyclic Aromatic

Hydrocarbons Organic compounds that meet both of the following criteria are known as polycyclic aromatic hydrocarbons (PAHs): 1) They are composed entirely of carbon and hydrogen; and 2) Their molecular structures contain more than one aromatic ring. Some studies have found an association between PAH exposure and an increased risk of developing cancer. Some of these chemical substances have been linked to cardiovascular disease in humans. Coke (coal) processing, automobile emissions, cigarette smoke, and shale oil extraction are all potential sources of PAHs, which contribute to soil contamination. [4]

**iii. Industrial Waste**

Soil contamination may be caused when industrial waste is dumped on the ground. Soil pollution is a serious problem, and industrial waste is a typical cause:

- Chlorinated solvents in manufacturing.
- The dioxins created in the process of making insecticides and in the process of burning trash.
- Plasticizers/dispersants.
- These chemicals are called polychlorinated biphenyls.

Petroleum hydrocarbon waste products, including benzene and methylbenzene, are known to be carcinogenic, and are produced by the petroleum industry.

**iv. Pesticides**

The term "pesticide" refers to any compound or combination of substances used to eliminate or control unwanted pests. A few examples of common pesticides in farming are: First, the chemicals (triazines, carbamates, amides, henoxyalkyl acids, and aliphatic acids) that are used to eradicate weeds and other plants that aren't wanted. Fungicides (mercury-containing compounds, thiocarbamates, and copper sulphate) are used to kill or limit the growth of parasitic fungus, whereas insecticides (organophosphates, chlorinated hydrocarbons, arsenic-containing compounds, and pyrethrum) are used to kill insects. There are several ways in which these substances can harm human beings. Pesticides have been linked to a wide range of health problems, including damage to the central nervous system, immune system, cancer, and birth abnormalities. [5]

**3. PROCESSES**

There are two main types of soil contamination: [6]

i. Naturally soil pollution, and

ii. Anthropogenic soil pollution

**i. Natural Soil Pollution**

Pollutants can be accumulated in soils naturally through exceedingly unusual methods. Differential soil deposition by the atmosphere can cause this. Soil contamination can also develop when contaminants in the soil are washed away by rainwater and carried to other areas. An buildup of compounds containing the perchlorate anion (ClO4 -) is an example of natural soil pollution that occurs in some desert habitats. Some pollutants can be created naturally in soil as a result of the influence of particular environmental circumstances, and this must be taken into account. Perchlorates, for instance, can occur in chlorine- and metal-rich soils after a thunderstorm. [7]

**ii. Anthropogenic Soil Pollution**

Human activity is responsible for virtually all instances of soil contamination. The soil can become contaminated due to many different human activities. The following, however, are some of the reasons why soils get polluted.

- Industrial Mishaps and Unintentional Releases.
- Weapons-grade Chemicals.
- Damage to Subterranean Tanks Due to Corrosion.
- Waste Water Discharge.
- Waste Management and Dumping Problems.

**4. HEALTH EFFECTS**

Human health can be adversely affected by contact with contaminated soil or by breathing in vaporised soil contaminants; however, a potentially greater threat is posed by the infiltration of soil contamination into groundwater aquifers used for human consumption, sometimes in areas seemingly far removed from any apparent source of above ground contamination. In most cases, this leads to the onset of illnesses that are directly linked to environmental contamination. The effects of soil pollution on human health can range widely, depending on the nature of the pollutant, the route of exposure, and the susceptibility of the population at risk. Chromium, lead, and other metals, petroleum, solvents, and numerous pesticide and herbicide formulations have all been linked to cancer, birth defects, and other long-term health problems when exposed to them over time. Health risks in soil and groundwater have also been linked to industrial or man-made concentrations of naturally occurring chemicals like nitrate and ammonia associated with livestock manure from agricultural activities. Higher rates of leukaemia have been linked to long-term exposure to benzene at high enough concentrations. Increased kidney damage and other chronic illnesses have been linked to mercury and cyclodienes. Liver toxicity has been associated with PCBs and cyclodienes. The use of carbonates and organophosphates can set off a cascade of reactions that paralyses the

muscles. The liver and kidneys are particularly vulnerable to the effects of several chlorinated solvents, which also depress the neurological system. [8]

## 5. TYPES OF SOIL POLLUTION

Pollutants in the soil might be any substances that are harmful to living things. Erosion and a decline in the soil's quality are two further negative effects of pollution's disruption of the soil's natural makeup. Soil contamination can be categorised according to the contaminant's origin and the harm it causes to the environment. Contaminants in the soil can come from farms, factories, and cities. [9]

### i. Agricultural Pollution

- Fertilizers improve agricultural yields but can contribute to soil contamination, which has negative effects on soil quality.
- The contamination of soil by pesticides is equally harmful to plant and animal life.
- Those pollutants permeate the soil and end up in our drinking water.
- Water systems and other areas are harmed when these chemicals are washed away by rain or irrigation and end up in the local runoff.[10]

### ii. Industrial Waste

- Most industrial byproducts contribute to oil pollution, over 90%.
- Harmful chemicals are leached into the earth from improperly discarded garbage.
- Animal and plant life, as well as municipal water sources, are harmed by these contaminants.
- The soil profile can be damaged by the toxic vapours that escape from controlled landfills and eventually fall back to earth as acid rain. [11]

### iii. Urban Activities

- Soil contamination can be caused both directly and indirectly by human activity.
- The neighbouring land or streams get contaminated due to improper drainage and increased run-off.
- Trash that isn't disposed of properly decomposes into the ground and deposits a variety of toxic chemicals and contaminants. These may once again leak into groundwater or be carried away by the local water system.
- In the process of decomposition, bacteria release methane gas, which contributes to climate change and poor air quality. And it stinks, which can lower people's quality of life. [12]

## 6. EFFECTS OF SOIL POLLUTION

Anthropogenic activities are the primary cause of soil pollution. Soil contamination is a result of the use of these waste products, which contain compounds that aren't present in nature. Common sources of soil contamination include manufacturing processes, agricultural chemical usage, and inappropriate garbage disposal. Both direct and indirect exposure to polluted soil poses health hazards. When soil is contaminated, it throws the ecosphere out of whack and puts living things at risk. Soil degradation has far-reaching consequences for the planet's ecosystems and the wellbeing of its inhabitants. Plants typically do not do well in soil that has been contaminated by pollution. Some crops may be able to flourish despite the presence of harmful substances in the soil, and if eaten, might pose major health risks. Soil contamination can manifest itself in several ways, one of which is a rise in soil salinity. When this happens, plants can't grow in the soil, and it eventually becomes worthless and barren. Many soil creatures (such earthworms) may perish if the soil structure were to be altered by soil pollution. Larger predators (such as birds) may be affected and forced to relocate in search of food if the soil's ability to sustain life is further degraded. Nearby residents are more likely to experience health problems such headaches, nausea, exhaustion, skin ailments, and even miscarriages. Cancer, leukaemia, reproductive abnormalities, kidney and liver damage, and central nervous system failure are only some of the chronic illnesses that can result from soil contamination over time. [13]

### i. Long term effects of soil pollution

Soil pollution has far-reaching consequences that, depending on the source of the contamination, might be challenging to address. It is important to treat soil with care since it is essentially its own ecosystem and may be easily disrupted by the introduction of non-native substances. That's great if we want to improve the soil's health by introducing additions like fertiliser and compost, but it's not so great if soil contamination is a concern.

### ii. Effects on soil micro-organism

Pesticides and their impact on soil There may be long-term repercussions from microorganisms. In order to maintain a fertile soil environment, micro-organisms are required. Your plants won't bloom into their full beauty without them. Microorganisms, often known as "microscopic organisms," are those that are too tiny to be seen with the naked eye. The top soil is where they make their home. Soil is home to an abundance of microbial life, some of which include: [14]

- Bacteria
- Fungi
- Algae

- Protozoa

**iii. Effects on humans**

- Pollution of soil can have serious effects on human health. Foods cultivated on dirty soil pose health risks to humans. This may shed light on the cause of minor and fatal diseases.
- Exposure to contaminated soil over a long period of time can alter a person's genetic makeup, perhaps resulting in congenital abnormalities and persistent health problems.
- Long-term contact with carcinogenic substances such heavy metals, gasoline, solvents, and agricultural compounds.
- Long-term exposure to benzene is linked to an increased risk of developing leukaemia. Kidney impairment is a more common side effect of mercury exposure. Liver toxicity has been associated with cyclodienes. [15]

**iv. On plant growth**

- Due to soil pollution, the biological system's delicate equilibrium has been disrupted.
- It takes a long time for plants to adjust to a shift in soil chemistry.
- When soil microorganisms die off, erosion becomes much more of an issue.
- Soil contamination reduces the soil's fertility, rendering it unfit for agriculture and the survival of local flora and fauna.
- A polluted environment is toxic to most kinds of life.[16]

## 7. CONCLUSION

Soil pollution is the accumulation of naturally occurring materials or the occurrence of new synthetic materials that alter the surface layer of the earth's crust by changing its physical, chemical, biological, or radiological properties. These changes disrupt the soil's composition, impact the ecological system's natural balance, and prevent the soil from purifying itself (self-cleaning). Both new synthetic materials and a high number of naturally existing materials can contribute to soil contamination. Soil's composition, structure, and chemical and physical qualities all have a role in how contaminated it is, in addition to the types, quantities, and methods involved in disposing of harmful materials.

## 8. REFERENCES


1. Agarwala, A. and Liu, Y. (2015): Remediation technologies for oil-contaminated sediments. Marine Pollution Bulletin; 101(2): 483-490.
2. Peters, W.A. and Howard, J.B. (2016): Thermodynamic driving forces for PAH isomerization and growth during thermal treatment of polluted soils. Journal of Hazardous Materials; 79(1-2): 189-208.
3. Fayiga, A.O. and Saha, U.K. (2016): Soil pollution at outdoor shooting ranges: Health effects, bioavailability and best management practices. Environmental Pollution; 216: 135-145.
4. Cela, R. and Rodríguez, I. (2020): Multiresidue procedure to assess the occurrence and dissipation of fungicides and insecticides in vineyard soils from Northwest Spain. Chemosphere; 261: 127696.
5. Zhao, Q., Cui, B. and Liu, X. (2015): Polycyclic aromatic hydrocarbons (PAHs) in wetland soils under different land uses in a coastal estuary: Toxic levels, sources and relationships with soil organic matter and water-stable aggregates. Chemosphere; 110: 8-16
6. Khademi, H. and Flühler, H. (2017): Continuous soil pollution mapping using long-term irrigation of wastewater discharged from domestic sewage treatment plants. Pedosphere; 21(5): 621-627.
7. Salam, M. and Varma, A. (2019): Bacterial community structure in soils contaminated with electronic waste pollutants from Delhi NCR, India. Electronic Journal of Biotechnology; 41: 72-80.
8. Leenaers, H. and Zegwaard, J. (2018): The grey areas in soil pollution risk mapping: The distinction between cases of soil pollution and increased background levels. Journal of Hazardous Materials; 61(1-3): 249-255.
9. Appiah-Adjei, E.K. and Adjei, K.A. (2019): Potential heavy metal pollution of soil and water resources from artisanal mining in Kokoteasua, Ghana. Groundwater for Sustainable Development; 8: 450-456.
10. Zhang, H. and Fu, Z. (2021): An improved weighted index for the assessment of heavy metal pollution in soils in Zhejiang, China. Environmental Research; 192: 110246.
11. Roychoudhury, A.N. and Klump, J.V. (2018): Major and trace element geochemistry in Zeekoevlei, South Africa: A lacustrine record of present and past processes. Applied Geochemistry; 23: 2496-2511.
12. Ma, S. and Ni, W. (2017): Heavy metal pollution of soils in the site of a retired paint and ink factory. Energy Procedia; 16(A): 21-26.
13. Liu, M., Song, Y. and Lei, L. (2018): Microplastics in soils: Analytical methods, pollution characteristics and ecological risks. TrAC Trends in Analytical Chemistry; 109: 163-172.
14. Zhang, Y., Wang, X. and Ji, H. (2020): Stabilization process and potential of agro-industrial waste on Pb-Contaminated soil around Pb-Zn mining. Environmental Pollution; 260: 114069.
15. Hudak, P.F., Wachal, D.J. and Hunter, B.A. (2016): Managing subsurface property

hazards: Reactive soils and underground storage tanks. Urban Water; 1(3): 237-241.

16. Gong, H., Wu, C. and Yin, G. (2021): Multiple classes of chemical contaminants in soil from an e-waste disposal site in China: Occurrence and spatial distribution. Science of The Total Environment; 752: 141924.

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