

Soil Pollution & Its Solutions

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Abstract : *Soil pollution is caused by the presence of xenobiotic (human-made) chemicals or other alteration in the natural soil environment. Soil contamination can be termed as unfavourable alteration of soil by addition or removal of substances and factors which decrease soil productivity, quality of plants and ground water. Soil pollution is caused by (i) pesticides, herbicides, and fumigants (ii) chemical fertilizers and (iii) air pollutants washed down from atmosphere through rain. It reduces soil fertility, nitrogen fixation, Increases erodibility, Imbalance in soil fauna and flora, ecological imbalance, release of pollutant gases, increased salinity, clogging of drains, public health problems, pollution of drinking water sources etching addition, the pollutants will change the makeup of the soil and the types of microorganisms that will live in it. If certain organisms die off in the area, the larger predator animals will also have to move away or die because they've lost their food supply. Soil pollution can be cured by recycling, reforestation and solid waste management.*

Keywords: *Soil pollution, Pesticides, Ecological Imbalance, Reforestation, Recycling*

I. Introduction

The word pollution we hear has become a routine word in our mundane and day to day life. This word is tagged in our lives not only in schools or college but newspapers and magazines are also filled with the news of environmental pollution in abundance. So it becomes mandatory to know what exactly is it? Pollution occurs when pollutants from various sources contaminate our natural surroundings, thereby, affecting our normal lifestyles adversely due to the changes which these pollutants bring. So these pollutants are the key elements of pollution which are found as waste material of different forms. It is this pollution which brings imbalance in our surroundings and ecosystem which is our biggest life support system. The modernization and development which were earlier considered as boon to the modern society has turned into permanent ailment for the modern man. Along with development, pollution has also permanently settled into our lives, brought with it global warming and plethora of human illness. There are numerous ways in which pollution occurs in different forms. Some of these are - air, water, soil, radioactive, noise, heat/ thermal and light. Every form of pollution has two sources of occurrence; the point and the non point sources. It is easy to identify, monitor and control the point source, whereas, the non point sources are always hard to control. The present paper will deal with soil pollution extensively- its reasons, the ill effects it has and the solutions which could be adopted to prevent this.

II. Soil Pollution

Soil pollution as found by Wikipedia is caused by the presence of xenobiotic (human-made) chemicals or other alteration in the natural soil environment. Soil contamination, therefore, can be termed as unfavourable alteration of soil by addition or removal of substances and factors which decrease soil productivity, quality of plants and ground water. It is typically caused by various industrial activities, chemicals used in agricultural activities, or improper disposal of waste material. The most common and hazardous chemicals which are used are petroleum hydrocarbons, polynuclear aromatic hydrocarbons (such as naphthalene and benzo (a) (Pyrene), solvents, pesticides, lead, and Other heavy metals. Contamination is correlated with the degree to which industrialization takes place and the intensity to which chemicals are used. It is mainly of two main types; negative and positive.

Negative Soil Pollution

Negative soil pollution includes over usage of soil and erosion. Water and air are the two factors responsible for Erosion of soil. Water erosion takes place near the hills where high speed rivulets and flood removes and washes away the top soil. High speed winds also become a source of soil erosion also occurs by high speed winds which brings sand particles from dry desert. Fertile land is also being converted into barren areas by unplanned urbanization, building of road, houses or industrial complexes. Rubbish, empty cans, garbage, broken furniture, empty bottles, building material, sludge, ash, etc. are all dumped outside the towns on vacant lands which not only become barren but also make the nearby lands so. It is sometimes also called third pollution or landscape pollution.

Positive Soil Pollution

It is pollution caused by (i) pesticides, herbicides, and fumigants (ii) chemical fertilizers and (iii) Air pollutants washed down from atmosphere through rain.

Agricultural Practices

Modern agricultural practices pollute the soil to a large extent. With the advancing agro-technology, huge quantities of fertilizers, pesticides, herbicides and weedicides are added to increase the crop yield. Apart from these farm wastes, manure, slurry, debris, soil erosion containing mostly inorganic chemicals are reported to cause soil pollution. Some of these practices need to be dealt in detail.

Pesticides and Weedicides

A number of chemicals have been developed to kill insects (insecticides), fungi (fungicides), algal blooms (algacides), rodents (rodenticides), weeds (weedicides or herbicides) in

order to improve agriculture, forestry, horticulture and water reservoirs. The most widely used among them are insecticides. Most of these insecticides or pesticides are broad-spectrum and affect other animals, man and even plants. They are, hence, also called biocides.

(i) Chlorinated Hydrocarbons

They include DDT (dichloro-diphenyl-trichloroethane), DDE, Chlordane, Aldrin, Dieldrin, Endrin, Heptachlor, BHC (benzene hexa-chloride), etc. Chlorinated hydrocarbons are toxic. Dieldrin is 5 times more toxic than DDT when ingested and 40 times more poisonous when absorbed. Endrin is the most toxic amongst chlorinated hydrocarbons. Besides, being toxic these pesticides are both, persistent and mobile in the ecosystem (over dust particles- in air, over organic matter in water). The chlorinated hydrocarbons are fat soluble and, "therefore/ tend, to" accumulate inside living organisms. Their concentration per unit weight of the organisms also rises with rise in tropic level due to the phenomenon of biological amplification. DDT and other chlorinated hydrocarbons affects central nervous system, cause softening of brain, cerebral haemorrhage, Cirrhosis of liver, hypertension, cancer, thinning of egg shells in birds, malformation of sex hormones, etc. Ecological amplification of chlorohydrocarbons, therefore, proves, fatal to higher trophic level animals, especially fish and birds. Excessive spray of hard biocides sometimes causes an imbalance in prey-predator population. For example, in Australia the population of predator Lady Bird beetle (*Novius cardinalis*) declined while that of its prey, scale insect (*kerya purchasi*) increased due to DDT use (Rudd, 1971). The balance was restored only after DDT spraying was stopped. DDT also affects the photosynthetic activity of plant, especially phytoplankton.

(ii) **Organo-Pesticides** They include organo-phosphorus compounds (e.g., Malathion, parathion, diazinon, triothin, ethion, tetraethyl pyrophosphate or TEPP) and carbamates. Organo- pesticides are degradable but being poisonous they influence the workers handling them causing sweating, salivation, nausea, vomiting, diarrhoea and muscular tremors.

(iii) **Inorganic Pesticides** The pesticides usually contain arsenic and sulphur. Their continued use is poisonous to both plants and animal life since the pesticides are of persistent nature.

(iv) **Weedicides (Herbicides)** The chemicals are used in clearing area of forests for building new residential or industrial colonies, highways, rail-road, weed control in agriculture, horticulture and in forest management. The weedicides or herbicides are usually metabolic inhibitors which stop photosynthesis and other metabolic activities and hence kill the plants. Some weedicides cause death due to proliferation of phloem cells so as to block transport of organic food. Weeds of Aswan dam in Egypt were controlled by weedicides. It not only affected the agricultural fields irrigated by that water but also marine fish production in the sea where this water was discharged. The phenomenon of producing adverse ecological effects of substances or actions in later period is called ecological boomerang or backlash.

III. Urban Wastes

Urban wastes comprise of both commercial and domestic wastes consisting of dried sludge and sewage. All the urban solid wastes are commonly referred to as refuse. Constituents of urban refuse: This refuse consists of garbage and rubbish materials like plastics, glasses, metallic cans, fibres, paper, rubbers, street sweepings, fuel residues, leaves, containers, abandoned vehicles and other discarded manufactured products. Urban domestic wastes though disposed off separately from industrial wastes, can still be dangerous. This happens because they are not easily degraded.

IV. Industrial Wastes

Disposal of Industrial wastes is the major problem for soil pollution Sources: Industrial pollutants are mainly discharged from various origins such as pulp and paper mills, chemical fertilizers, oil refineries, sugar factories, tanneries, textiles, steel, distilleries, fertilizers, pesticides, coal and mineral mining industries, drugs, glass, cement, petroleum and engineering industries etc. Effect: These pollutants affect and alter the chemical and biological properties of soil. As a result, hazardous chemicals can enter into human food chain from the soil or water, disturb the biochemical process and finally lead to serious effects on living organisms.

V. Radioactive Pollutants

Radioactive substances resulting from explosions of nuclear testing laboratories and industries giving rise to nuclear dust radioactive wastes penetrate the soil and accumulate giving rise to land/soil pollution. Ex: Radio nuclides of Radium, Thorium, Uranium, isotopes of Potassium (K-40) and Carbon (C-14) are commonly found in soil, rock, water and air. Explosion of hydrogen weapons and cosmic radiations include neutron, proton reactions by which Nitrogen (N-15) produces C-14. This C-14 participates in Carbon metabolism of plants which is then into animals and human beings. Radioactive waste contains several radio nuclides such as Strontium90, Iodine-129, Cesium-137 and isotopes of Iron which are most injurious. Strontium get deposited in bones and tissues instead of calcium. Nuclear reactors produce waste containing Ruthenium-106, Iodine-131, Barium-140, Cesium-144 and Lanthanum-140 along with primary nuclides Sr-90 with a half life 28 years and Cs-137 with a half life 30 years. Rain water carries Sr-90 and Cs-137 to be deposited on the soil where they are held firmly with the soil particles by electrostatic forces. All the radio nuclides deposited on the soil emit gamma radiations.

VI. Biological Agents

Soil gets a large amount of human, animal and bird excreta which constitute a major source of land pollution by biological agents. Heavy application of manures and digested sludge can cause serious damage to plants within a few years.

VII. Fertilizers

Chemical fertilizers added to the soils enter the crop plants as well as leach down into water table to become part of underground water. Nitrogen fertilization produces toxic

concentration of nitrate or nitrite in the leaves and fruits, e.g., Spinach, Mustard, and Lettuce. Nitrate containing canned food causes corrosion of tin lining of the can, increases tin content of food and produces nitrous oxide (N₂O) gas. The toxicity increases if the drinking water also possesses sufficient nitrates. In the alimentary canal, the activity of bacteria changes nitrates into nitrites. The latter enter the blood and combine with haemoglobin to form methaemoglobin. As a result oxygen transport is reduced. It gives rise to disease known as methaemoglobinemia (presence of methaemoglobin in the circulating blood). In infants-it produces cyanosis, (blue babies due to bluish tint of skin). In adults it produces breathlessness. In infants nitrate poisoning can be fatal unless and until methylene blue is injected in time. Excessive use of chemical fertilizers causes soil deterioration through the decrease in natural bacterial population (nitrogen fixing, nitrifying, and sulphofying) and destruction of crumb structure. The Salt content of the soil is also bound to increase with continuous use of fertilizers.

VIII. Other Soil Pollutants

Air pollutants and many water pollutants become part of the soil. The soil also receives toxic chemicals during the weathering of certain rocks. A major part of lead given out in the automobile exhaust settles down on the roadside areas and becomes part of it. The same enters the food chain. Fluorides similarly pass both into pumped water and food chain. In plants fluorides combine chemically with Mg²⁺ of chlorophyll and hence inhibit photosynthesis, cause abscission of leaf and fruit, and hence destroy vegetation. Maize is a sensitive indicator in fluoride pollution. In human beings the typical symptoms of excess fluorine or fluorosis is the mottling of teeth. Later on bone fluorosis follows. The latter consists of weak bones, boat shaped posture and knocking of knees. Animals grazing over fluoride rich foliage show ill health, weak teeth, weak bones and swelling of knee bones.

IX. Salination Of Soil

Increase in the concentration of soluble salts in the soil is called salination. Origin or development of saline soil depends upon following factors

(i) Poor Drainage of Soil Salts dissolved in irrigation water accumulate on the soil surface due to inadequate drainage especially during flood.

(ii) Quality of Irrigation Water: The ground water of arid (dry, barren having not enough rainfall to support vegetation) regions is generally saline in nature. The irrigation water may be itself rich in soluble water and add to salinity of soils.

(iii) Capillary Action: Salts from the lower layers move up by capillary action during summer season and are deposited on the surface of the soil.

(vi) Excessive Use of Basic Fertilizers: Excessive use of alkaline fertilizers like sodium nitrate, basic slag, etc. may develop alkalinity in soil.

(v) Salts Blown by Wind: In arid regions near the sea, lot of salt is blown by wind and gets deposited on the lands.

(vi) Saline Nature of Parent Rock Materials: If soil develops from saline nature of parent rock materials, soil would be saline. India has about six million hectares of saline land. About 6,000-8,000 hectares of farm land becomes unfit for agriculture every year in Punjab alone.

X. Effects of Soil Pollution

Agricultural

- Reduced soil fertility
- Reduced nitrogen fixation
- Increased erodibility
- Larger loss of soil and nutrients
- Deposition of silt in tanks and reservoirs
- Reduced crop yield
- Imbalance in soil fauna and flora

Industrial

- Dangerous chemicals entering underground water
- Ecological imbalance
- Release of pollutant gases
- Release of radioactive rays causing health problems
- Increased salinity
- Reduced vegetation

Urban

- Clogging of drains
- Inundation of areas
- Public health problems
- Pollution of drinking water sources
- Foul smell and release of gases
- Waste management problems

XI. Environmental Long Term Effects Of Soil Pollution

When it comes to the environment itself, the toll of contaminated soil is even more dire. Soil that has been contaminated should no longer be used to grow food, because the chemicals can leech into the food and harm people who eat it.

If contaminated soil is used to grow food, the land will usually produce lower yields than it would if it were not contaminated. This, in turn, can cause even more harm because a lack of plants on the soil will cause more erosion, spreading the contaminants onto land that might not have been

tainted before. In addition, the pollutants will change the makeup of the soil and the types of microorganisms that will live in it. If certain organisms die off in the area, the larger predator animals will also have to move away or die because they've lost their food supply. Thus it's possible for soil pollution to change whole ecosystems

XII. Effects of Soil Pollution in Brief

- pollution runs off into rivers and kills the fish, plants and other aquatic life
- crops and fodder grown on polluted soil may pass the pollutants on to the consumers
- polluted soil may no longer grow crops and fodder
- Soil structure is damaged (clay ionic structure impaired)
- corrosion of foundations and pipelines
- impairs soil stability
- may release vapours and hydrocarbon into buildings and cellars
- may create toxic dusts
- may poison children playing in the area

XIII. Control of Soil Pollution

Reusing of materials

Materials such as glass containers, plastic bags, paper, cloth etc. can be reused at domestic levels rather than being disposed, reducing solid waste pollution.

Recycling and recovery of materials

This is a reasonable solution for reducing soil pollution. Materials such as paper, some kinds of plastics and glass can and are being recycled. This decreases the volume of refuse and helps in the conservation of natural resources. For example, recovery of one tonne of paper can save 17 trees.

Reforestation

Control of land loss and soil erosion can be attempted through restoring forest and grass cover to check wastelands, soil erosion and floods. Crop rotation or mixed cropping can improve the fertility of the land.

Proper methods should be adopted for management of solid waste disposal. Industrial wastes can be treated physically, chemically and biologically until they are less hazardous. Acidic and alkaline wastes should be first neutralized; the insoluble material if biodegradable should be allowed to degrade under controlled conditions before being disposed.

Improvement in mining techniques and transport of extracted materials should be done extensively, so that spread of mine dust should be minimised. The area should not be left barren and dry. Instead, afforestation should be carried out as soon as it becomes feasible. As a last resort, new areas for storage of hazardous waste should be investigated such as deep well injection and more secure landfills. Burying the waste in locations situated away from residential areas is the simplest and most widely used technique of solid waste management. Environmental and aesthetic considerations must be taken into consideration before selecting the dumping sites. Incineration of other wastes is expensive and leaves a huge residue and adds to air pollution. Pyrolysis is a process of combustion in absence of oxygen or the material burnt under controlled atmosphere of oxygen. It is an alternative to incineration. The gas and liquid thus obtained can be used as fuels. Pyrolysis of carbonaceous wastes like firewood, coconut, palm waste, corn cobs, cashew shell, rice husk paddy straw and saw dust, yields charcoal along with products like tar, methyl alcohol, acetic acid, acetone and a fuel gas.

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