

dumping of waste materials, mining, smelting of metals and also dumping of domestic refuse and solids, untreated sewage and industrial wastes.

Types of Soil Pollution

Soil pollution may be any chemicals or contaminants that harm living organisms. Pollutants decrease soil quality and also disturb the soil's natural composition and also lead to erosion of soil. Types of soil pollution can be distinguished by the source of the contaminant and its effects of the ecosystem. Types of soil pollution may be agricultural pollution, Industrial wastes and urban activities.

Agricultural Pollution

- Agricultural processes contribute to soil pollution.
- Fertilizers increase crop yield and also cause pollution that impacts soil quality.
- Pesticides also harm plants and animals by contaminating the soil.
- These chemicals get deep inside the soil and poison the ground water system.
- Runoff of these chemicals by rain and irrigation also contaminate the local water system and is deposited at other locations.

Industrial Waste

- About 90% of oil pollution is caused by industrial waste products.
- Improper disposal of waste contaminates the soil with harmful chemicals.
- These pollutants affect plant and animal species and local water supplies and drinking water.
- Toxic fumes from the regulated landfills contain chemicals that can fall back to the earth in the form of acid rain and can damage the soil profile.

Urban Activities

- Human activities can lead to soil pollution directly and indirectly.
- Improper drainage and increase run-off contaminates the nearby land areas or streams.
- Improper disposal of trash breaks down into the soil and it deposits in a number of chemical and pollutants into the soil. These may again seep into groundwater or wash away in local water system.
- Excess waste deposition increases the presence of bacteria in the soil.
- Decomposition by bacteria generates methane gas contributing to global warming and poor air quality. It also creates foul odors and can impact quality of life.

Causes of Soil Pollution

Soil Pollution is a result of many activities by mankind which contaminate the soil. Soil pollution is often associated with indiscriminate use of farming chemicals, such as pesticides, fertilizers, etc. Pesticides applied to plants can also leak into the ground, leaving long-lasting effects. Read about the dangers of pesticides. In turn, some of the harmful chemicals found in the fertilizers (e.g. cadmium) may accumulate above their toxic levels, ironically leading to the poisoning of crops. Heavy metals can enter the soil through the use of polluted water in watering crops, or through the use of mineral fertilizers. Faulty landfills, bursting of underground bins and seepage from faulty sewage systems could cause the leakage of toxins into the surrounding soil. Acid rains caused by industrial fumes mixing in rain falls on the land, and could dissolve away some of the important nutrients found in soil, as such change the

structure of the soil. Industrial wastes are one of the biggest soil-pollution factors. Iron, steel, power and chemical manufacturing plants which irresponsibly use the Earth as a dumping ground often leave behind lasting effects for years to come. Fuel leakages from automobiles, which get washed by rain, can seep into the nearby soil, polluting it. Deforestation is a major cause for soil erosion, where soil particles are dislodged and carried away by water or wind. As a result, the soil loses its structure as well as important nutrients found in the soil. Some of the causes of soil pollution can be as follows:

- Industrial effluents like harmful gases and chemicals.
- Use of chemicals in agriculture like pesticides, fertilizers and insecticides.
- Improper or ineffective soil management system.
- Unfavorable irrigation practices.
- Improper management and maintenance of septic system.
- Sanitary waste leakage.
- Toxic fumes from industries get mixed with rains causing acid rains.
- Leakages of fuel from automobiles are washed off due to rains and are deposited in the nearby soil.
- Unhealthy waste management techniques release sewage into dumping grounds and nearby water bodies.
- Use of pesticides in agriculture retains chemicals in the environment for a long time. These chemicals also affect beneficial organisms like earthworm in the soil and lead to poor soil quality.
- Absence of proper garbage disposal system leads to scattered garbage in

the soil. These contaminants can block passage of water into the soil and affect its water holding capacity.

- Unscientific disposal of nuclear waste contaminates soil and can cause mutations.
- Night soil contamination due to improper sanitary system in villages can cause harmful diseases.

Effects of soil pollution

The main reason for soil contamination is due to the presence of anthropogenic activities. These waste products are made of chemicals that are not originally found in nature and hence lead to soil pollution. Soil pollution is typically caused by industrial activity, chemicals used in agriculture and improper disposal of waste. Soil contamination leads to health risks due to direct and indirect contact with contaminated soil. Soil pollution causes huge disturbances in the ecological balance and the health of the organisms is under risk. The effects of pollution on soil are quite disturbing and can result in huge disturbances in the ecological balance and health of living beings on earth. Normally crops cannot grow and flourish in a polluted soil. However if some crops manage to grow, then these crops might have absorbed the toxic chemicals in the soil and might cause serious health problems in people consuming them. Sometimes the soil pollution is in the form of increased salinity of the soil. In such a case, the soil becomes unhealthy for vegetation, and often becomes useless and barren. When soil pollution modifies the soil structure, deaths of many beneficial soil organisms (e.g. earthworms) in the soil could take place. Other than further reducing the ability of the soil to support life, this occurrence could also have an effect on the larger predators (e.g. birds)

and force them to move to other places, in the search of food. People living near polluted land tend to have higher incidences of migraines, nausea, fatigue, skin disorders and even miscarriages. Depending on the pollutants present in the soil, some of the longer-term effects of soil pollution include cancer, leukemia, reproductive disorders, kidney and liver damage, and central nervous system failure. These health problems could be a result of direct poisoning by the polluted land (e.g. children playing on land filled with toxic waste) or indirect poisoning (e.g. eating crops grown on polluted land, drinking water polluted by the leaching of chemicals from the polluted land to the water supply, etc).

Long term effects of soil pollution

The long term effects of soil pollution are many and can be difficult to deal with, depending on the nature of the contamination.

How Soil Gets Polluted

Soil is a sort of ecosystem unto itself, and it is relatively sensitive to foreign matter being applied to it. That's good for us in the case of wanting to add soil amendments, fertilizer and compost to make the soil healthier, but not so good when it comes to soil pollution.

There are many different ways that soil can become polluted, such as:

- Seepage from a landfill
- Discharge of industrial waste into the soil
- Percolation of contaminated water into the soil
- Rupture of underground storage tanks
- Excess application of pesticides, herbicides or fertilizer
- Solid waste seepage

• The most common chemicals involved in causing soil pollution are:

- Petroleum hydrocarbons
- Heavy metals
- Pesticides
- Solvents

Soil pollution happens when these chemicals adhere to the soil, either from being directly spilled onto the soil or through contact with soil that has already been contaminated.

As the world becomes more industrialized, the long term effects of soil pollution are becoming more of a problem all over the world. It is thought that a full 150 million miles of China's farmland is contaminated. Even when soil is not being used for food, the matter of its contamination can be a health concern. This is especially so when that soil is found in parks, neighborhoods or other places where people spend time.

Health effects will be different depending on what kind of pollutant is in the soil. It can range from developmental problems, such as in children exposed to lead, to cancer from chromium and some chemicals found in fertilizer, whether those chemicals are still used or have been banned but are still found in the soil.

Some soil contaminants increase the risk of leukemia, while others can lead to kidney damage, liver problems and changes in the central nervous system.

Those are just the long term effects of soil pollution. In the short term, exposure to chemicals in the soil can lead to headaches, nausea, fatigue and skin rashes at the site of exposure.

When it comes to the environment itself, the toll of contaminated soil is even direr. 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. There are some ways to get soil back to its pristine condition or to remove the spoiled soil so the land can be used for agriculture again. Tainted soil can be transported to a site where humans won't be exposed to the chemicals, or the soil can be aerated to remove some of the chemicals (which can add the problem of air pollution if the chemicals can be released into the air).

Other options include what's known as bioremediation, where microorganisms are used to consume the pollution-causing compounds as well as electromechanical systems for extracting chemicals, and containment of chemicals by paving over the tainted area.

None of these are an ideal solution. Preventing contamination in the first place is the best way to go. It won't eliminate all potential pollution problems, but choosing to farm organically is a good way to protect the soil (and yourself) from chemicals found in pesticides and other common garden chemicals.

Effects on soil micro-organism



The effects of pesticides on soil microorganisms can cause a ripple effect that can last for years. Microorganisms are essential to healthy soil. Without them, your plants will not reach their true potential.

Microorganisms are organisms that are too small to be seen with the human eye. They live on the top-most layer of soil. There are many microorganisms which live in the soil including:

- Bacteria
- Fungi
- Algae
- Protozoa

Microorganisms are responsible for the decomposition and recycling of organic materials in the soil. They aid in the plant's absorption of essential nutrients. An example of this is the nitrogen fixing bacteria, *Bradyrhizobium*, which lives in a nodule on the soybean plant. It provides nitrogen to the plant and boosts growth.

Biopesticides are microorganisms that can help a plant defend it against pests. These microorganisms include antimicrobial metabolites, antibiotics and extracellular enzymes. The potential of these biopesticides has not been fully examined by scientists. It is hopeful that science will be able to re-produce the effects of the biopesticides, which will help to

eventually eliminate the need for harmful chemical pesticides.

Pesticides are designed to kill bugs that are harmful to plants. Pesticides kill specific pests on plants such as slugs, beetles and flying insects. The chemicals used in most pesticides can kill more than just garden pests; they can kill the helpful organisms that live in the soil. Some of these chemicals can remain in the soil for years, effectively keeping necessary micro-organisms from working the soil.

Common chemical pesticides that are used in gardens and by large-scale crop producers include the following:

- Basic Copper Sulfate
- Silica Gel
- Sodium Fluoride
- Carbon Disulfide
- Hydrogen Cyanide
- Methylchloroform
- Fenthion
- Boric Acid

There are literally hundreds of pesticides that have been manufactured and applied to soil in the past. We are beginning to understand the ramifications of using these toxic chemicals on the soil. In places where the chemicals are used extensively, plants will no longer grow at all, or will fail to thrive.

Unfortunately, many pesticides can kill more than just their intended targets, namely the necessary micro-organisms in the soil. When chemicals are used for a period of time on plants in an area, they will eventually leach into the soil. Once in the soil they can kill the micro-organisms living in the soil that break down organic material and aid in plant growth. It can take years before micro-organisms can once again live in soil that has had toxic chemicals applied to it.

Alternatives to Harmful Chemical Pesticides

For the average gardener, the use of organic pesticides can keep a healthy balance in the soil. Many organic pesticides are made of minerals or other plant materials that will keep pests at bay and break down quickly in the soil. Examples of some common organic pesticides include the following:

- Cayenne pepper spray--Can be sprayed on the leaves of plants to deter harmful insects.
- Soap spray--Also sprayed on plants to get rid of aphids.
- Tobacco powder--A spray can be made from the finely ground tobacco leaves and water. It is used to kill sucking insects on plants such as aphids, thrips and spider mites.
- Pyrethrin--Made from the chrysanthemum plant. This organic pesticide is used to knock out flying insects and ground pests such as grubs.
- Neem--Derived from the neem tree. Used to control Gypsy moths, leaf miners, mealy bugs, whiteflies and caterpillars.
- Sabadilla--Derived from the sabadilla lily. Used to control caterpillars, leaf hoppers, stink bugs and squash bugs.

Soil pollution causes huge disturbances in the ecological balance and health of living organisms at an alarming rate. Some the effects of soil pollution are:

- Disturbance in the balance of flora and fauna inhabiting in the soil.
- Contaminated soil decreases soil fertility and hence there is decrease in the soil yield.
- Reduced soil fertility hence decrease in soil yield.
- Loss of natural nutrients in soil.

- Reduced nitrogen fixation.
- Loss of soil and nutrients.
- Increased soil erosion.
- Imbalance in the flora and fauna of the soil.
- Increase in soil salinity, makes it unfit for cultivation.
- Creation of toxic dust.
- Foul odor due to industrial chemicals and gases.
- Alteration in soil structure can lead to death of organisms in it.
- Reduction in soil fertility.
- Loss of the natural nutrients of the soil.
- Imbalance is the flora and fauna of the soil.
- Salinity increases in the soil making it unfit for cultivation.
- Crops grown on polluted soil cause health problems on consumption,
- Soil pollution creates toxic dust.
- Foul odor due to chemicals and gases can lead to problems like headaches, nausea, etc.
- Pollutants in soil cause alteration in soil structure, causing death of many soil organisms. This can affect the food chain.

Effects on humans

- Soil pollution has major consequences on human health. Consumption of crops and plants grown on polluted soil cause health hazards. This could explain small and terminal illness.
- Long term exposure to polluted soil affects the genetic make-up of the body and may congenital illnesses and chronic health diseases.
- Chronic exposure to heavy metals, petroleum, solvents and agricultural chemicals can be carcinogenic.

- Exposure to benzene for a long term is associated with higher incidence of leukemia. Mercury causes higher incidences of kidney damage. Cyclodienes are linked to liver toxicity.
- Organophosphates can lead to chain of responses leading to neuromuscular blockage.
- Chlorinated solvents induce damages to liver, kidney, depression of the central nervous system.

On plant growth

- The balance of ecological system is affected due to contamination of the soil.
- Plants are mostly unable to adapt to the change in the chemistry of the soil in short time period.
- The microorganisms found in the soil decline and create additional problems of soil erosion.
- Fertility of the soil decreases due to soil pollution, making it unsuitable for agriculture and local vegetation to survive.
- Soil pollution is hazardous to health.
- Polluted lands cannot support most forms of life.

On soil fertility

- The chemicals present in the soil due to pollution are toxic and can decrease the fertility of the soil, thereby decreasing the soil yield.
- Agriculture on contaminated soil produces fruits and vegetable that lack quality nutrients.
- Consumption of these may be poisonous and cause serious health problems to people consuming them.

Toxic dust

- Emissions of toxic gases and foul odor from the landfills pollute the

environment and causes serious health effects on some people.

- The foul odor causes inconvenience to people.

On soil structure

- Soil pollution can lead to death of many soil organisms like the earthworms which can lead to alteration in the soil structure.
- This can force other predators to move to other places in search of food.

Control of soil pollution

A number of ways have been suggested to curb the pollution rate. Attempts to clean up the environment require plenty of time and resources. Some the steps to reduce soil pollution are:

- Ban on use of plastic bags below 20 microns thickness.
- Recycling of plastic wastes.
- Ban on deforestation.
- Encouraging plantation programmes.
- Encouraging social and agro forestry programmes.
- Undertaking awareness programmes.
- Reducing the use of chemical fertilizer and pesticides.
- Recycling paper, plastics and other materials.
- Ban on use of plastic bags, which are a major cause of pollution.
- Reusing materials.
- Avoiding deforestation and promoting forestation.
- Suitable and safe disposal of wastes including nuclear wastes.
- Chemical fertilizers and pesticides should be replaced by organic fertilizers and pesticides.
- Encouraging social and agro forestry programs.
- Undertaking many pollution awareness programs.

Prevention of soil pollution

Toxic chemical compounds, salts, radioactive agents, toxins and other waste contribute to soil pollution. These have adverse effect on plant and animal health. Soil contains both organic as well as inorganic material. The organic material is



A tilled field with rich soil.

(Photo Credit Digital Vision./ Photodisc/ Getty Images)
formed due to decaying of plant and animal matter. This often makes up the upper most layer of soil. The organic soil such as rocks, has taken over thousands of years to be formed. The top layer is made up of organic soil, while the layers below are inorganic soil. Pollution has gradually reached the inorganic layers as well. There are different types of soil pollution, namely agricultural soil pollution, industrial waste causing soil pollution, urbanization causing soil pollution. These different types of pollution cause the fertility of the soil to reduce and mineral content in the soil to be destroyed. Therefore, measures have to be taken for preventing soil pollution.

To increase agricultural yield, most farmers took to using chemical fertilizers. No doubt that the yield did indeed increase, but at the cost of the soil losing its fertility. To restore the fertility of the soil to what it was, will take a very long time, however, one has to start at some point of time. Drastic measures are required for the same. Farmers should be

encouraged to start using bio fertilizers. The microorganisms in these fertilizers will help in increasing the fertility of the soil.

To avoid soil pollution, it is important, that along with fertilizers, farmers should shift to bio pesticides and fungicides, also known as herbicides. These products will take a little longer to react, but they do not have adverse effect on the soil. It is best to use manure both as a fertilizer as well as pesticide, as it has far less side effects as opposed to its chemical counterpart.

If one has to look at the soil pollution facts, it will be seen that toxic waste has a big role to play in soil pollution. Hence, industrial toxic waste should be treated to reduce its toxicity before it is disposed off. At the same time, responsible methods should be used for disposing off the waste. The best, however, is to avoid the use of harmful chemicals unless they are of extreme importance.

Although a lot of propaganda has been carried out about recycling waste, not many measures have been taken about the same. If each family has to take it upon themselves to recycle waste, the land pollution caused due to landfills will be reduced considerably. The land so saved can be used constructively for a number of better tasks.

After plastic was invented, people thought it was convenient to opt for plastic containers, bags, etc., which could be disposed off after use. However, plastic is one of the main causes of soil pollution, as it takes a very long time to disintegrate. Therefore, people should consider shifting to reusable containers like glass, cotton bags, etc. Although paper does disintegrate faster, a lot of trees are cut for producing paper bags. Therefore, it is best to opt for cloth bags. Similarly, instead of using

tissue papers in the kitchen, etc., one should opt using cloth napkins, handkerchief, etc. This will go a long way in reducing landfills.

There is no doubt that the organic products are costly as opposed to the chemically grown products. But choosing the organic products will encourage more organic production. This will help in preventing soil pollution.

To prevent soil pollution, deforestation measures have to be undertaken at rapid pace. Soil erosion is caused, when there are no trees to prevent the top layer of the soil from being transported by different agents of nature like water and air. At the same time, measures should be taken to avoid over cropping and over grazing, as it leads to flood and soil erosion and further deterioration of the soil layer.

Various chemicals such as pesticides, insecticides and fungicides play important roles in plant growth; however the overuse of these chemicals is considered to be one of the prime factors leading to soil pollution. Reducing or even avoiding the use of such chemicals is one of the most elementary and important preventive measures. Manures and bio-fertilization can be used as alternatives to chemicals. Manures are often recommended by environmentalists and agriculturists because, as compared to pesticides, manures have minimal adverse effect on the environment. Bio-fertilization is a process in which certain microorganisms such as rhizobium are used to increase the soil fertility in place of chemicals.

Another common measure used to minimize soil pollution is controlling the growth of weeds. Weeds are unwanted plants that grow alongside the main plant and often result in the accumulation of various minerals into the soil layer. One of

the common methods to control weed growth is covering the soil with layers of newspapers or plastic sheets just before cultivation.



Other common methods of preventing soil pollution include reforestation and recycling of waste materials. Deforestation or the cutting down of trees often leads to erosion of the soil, which leads to soil pollution due to the loss of fertility of the soil. Thus, reforestation is an effective method of preventing soil pollution.

In addition, reducing the volume of refuse or waste in landfills by recycling materials such as plastics, papers and various other materials is another effective and common method of preventing the phenomenon of soil pollution.

- Strong regulatory programs to minimize soil contamination need to be introduced.
- Reuse and recycle unwanted items. Or even better, reduce consumption and reduce your trash. The less rubbish we create the less chance the waste will end up in our soil.
- There is a need to educate the public about the harms done when they litter.
- For gardens, make use of organic fertilizers and organic pesticides, because they are usually made of natural substances, are bio-degradable and do little harm to the natural balance in the soil.

- Insist on buying natural and organic food, because chemical pesticides and fertilizers are not used in their growing process. Not only are organic foods healthier for the environment, they are also healthier for you and your family. Read about the benefits of organic food.
- Cut down usage of paper. Or use recycled paper. In this way, fewer trees need to be cut down and there would be reduced deforestation. Read about the benefits of recycling to the environment.

For decades people have believed that harmful chemical pesticides were the only true way to rid gardens and crop fields from pests. Soil pollution has occurred from the use of pesticides and it takes years and sometimes decades for some of these chemicals to break down. Luckily there are many organic chemicals that are just as effective. The effects of pesticides on soil micro-organisms are less invasive when organic pesticides are used. People need to break the habit of using harmful pesticides and switch to using organic ones that break down quickly in the sunlight and in the soil. The faster a chemical breaks down, the sooner the soil can return to a healthy state. Most organic pesticides are also safe to use around people and pets. They can easily be washed from fruits and vegetables making them healthier for you and your family to eat.

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