



**Biotica
Research
Today**
Vol 4:4
2022

224
227

Soil Pollution: Causes, Effect and Remediation

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 Open Access

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Keywords

Fertilizers, Irrigation, Pesticides, Water

Article History

Received on: 29th March 2022

Revised on: 03rd April 2022

Accepted on: 04th April 2022

E-mail: bioticapublications@gmail.com

How to cite this article?

Sunil *et al.*, 2022. Soil Pollution: Causes, Effect and Remediation. *Biotica Research Today* 4(4): 224-227.

Abstract

The soil pollution has occupied the attention of a large number of researchers because of its continuity and effect on humans, animals and plants alike. Soil pollution occurs as a result of the entry of elements that change the composition and organism of the soil, and reduce its fertility, making it more vulnerable to drought, and unsuitable for agriculture. The most important soil pollutants before radioactive uranium pollution, pollution by industrial and household waste, volcanic eruptions, forest fires, and others. Most of the agricultural lands are irrigated by rivers polluted with factory wastewater. Also, the most important sources of pollution represented by pesticides and chemical fertilizers that contain toxic substances and seep into the soil to remain for a long time, and contribute to eliminate soil fertility.

Introduction

It is no exaggeration to say that modern-civilized, lifestyle, which is quintessentially western in origin and has deeply permeated practically all societies everywhere, has been extracting an increasingly high price in terms of relentless environmental degradation which it has been causing in all three compartments of nature- air, water and soil. In fact, conversion of the remainder of the world population to this particular lifestyle using a variety of ploys, including colonial subjugation, has been so effective and thorough that communities everywhere have been gleefully abandoning their ancient cultural values that taught them to live in harmony with nature and adopting western values that are based on gross abuse and exploitation of nature's bountiful benediction without which life on earth cannot exist (Nath, 2003).

Man has wiped out a third of the natural world in the last thirty years and soon will have to start looking for a new planet to live on. The scale of devastation is so great that man will have used up all the Earth's natural resources by 2075. If every human alive today continues to consume resources and produce carbon dioxide at the same rate as the average Briton, we will need to colonize at least two Earths to survive. Our current rate of consumption is eroding the very fabric of our planet and will ultimately threaten our long-term survival (Nathanail *et al.*, 2005).

It is sobering to consider the logical implication of the above. If we fail to colonize at least two earths by around 2075 and we have yet to find even one in the unimaginable vastness of the Cosmos let alone colonize it the earth will become so polluted and denuded of vital life-support systems that it would no longer be fit for human habitation.

The study of soil pollution is very important to a large number of researchers and those interested in the environment, due

to the great impact that the pollution of agricultural lands has on the lives of humans and animals alike. The chemical and physical changes in soil composition are caused by the entry of foreign bodies. Also, the use of pesticides and chemical fertilizers in large quantities, the fall of acid rain, as well as the dumping of solid and liquid waste from factories and others, contribute to the loss of soil fertility and organic materials. It also sheds light on the most important soil pollutants, such as radioactive contamination. Radioactive pollution is one of the most important global pollutants due to the negative effects of radioactive materials on soil, plants, humans and animals. The research focuses on industrial and household waste pollution. Most of the factories are located near residential areas and rivers. Also, volcanoes, fires and mining contribute significantly to soil pollution and losing its organic matter and fertility. Pesticides, fungicides and chemical fertilizers affect soil and agricultural crops. The use of untreated wastewater to irrigate agricultural lands causes soil pollution through the growth of harmful insects and plants. Environmental pollution is all the undesirable changes that occur in the environment, whether partial or total, due to the whole types of human activities. It is also known as the atmosphere that results from changes in the ecological environment created by humans; Environmental pollution can be considered as the cause of inconvenience, damage, disease, or death (Jamal, 2019). Soil pollution can be defined as the entry of foreign bodies into the soil that leads to a change in the chemical and physical composition. This often results from the use of pesticides and fertilizers, and acid rain that changes the pH of the soil, throwing off radioactive unions and others (Badran, 1988). Also, it can be defined as the destruction that affects the soil layers causing a change in the natural characteristics of the main environmental elements due to the leakage of complex chemical compounds or artificial radioactive materials that raise the radioactive level in the soil, and impede its analysis. Pollution of agricultural land is defined as the corruption that affects agricultural land, and changes its natural, chemical or biological characteristics and properties. It makes it negatively affect, directly or indirectly, on the person, animal or plant living on its surface. Agricultural soil pollutants include agricultural residues such as plant residues and their weeds, roots left over from burning the ground, vegetable residues, crop stems, tree leaves, and fallen fruits before they ripen (Yasiri, 2019). The problem of soil pollution differs from other pollution because it is a long-term problem. It can be completely eradicated and eliminated by reducing the causes of the disease before identifying the treatment. Despite the importance of soil to humans, there is no legislation in the European Union that targets soil protection specifically. Various policies have addressed water, waste, chemicals and industrial pollution. In this regard, the European Commission adopted an objective strategy to protect the soil, which has become widespread in Europe.

Causes of Soil Contamination

A wide variety of mainly anthropogenic pollution sources are responsible for contaminating soil (Jamal, 2019), and these sources are mainly and sometimes exclusively meant for, or concerned with, producing goods for macroeconomic development through industrialization and/or services for human welfare in industrialized and industrializing societies. Some of these sources are described below.

Industrial Activity

Industrial activity has been the biggest contributor to the problem in the last century, especially since the amount of mining and manufacturing has increased. Most industries are dependent on extracting minerals from the Earth. Whether it is iron ore or coal, the by-products are contaminated, and they are not disposed of in a manner that cannot be considered safe. As a result, the industrial waste lingers in the soil surface for a long time and makes it unsuitable for use.

Pesticides

Before World War II, the chemical nicotine chemical present in the tobacco plants was used as the pest controlling substance in agricultural practices. However, DDT was found to be extremely useful for malaria control and as pest control of many insects during World War II. Therefore, it was used for controlling many diseases. Hence, post-war, people started using it as pest control in agriculture for killing rodents, weeds, insects, etc. and avoiding the damages due to these pests. However, everyone gradually the adverse effects of this chemical which led to the ban of this chemical in many parts of the world including India. Moreover, pests became resistance to DDT due to the chemicals regular use. Hence this led to the introduction of other harmful chemicals such as Aldrin and Dieldrin. Pesticides are synthetic toxic chemicals that definitely kill different types of pests and insects causing damage to agriculture but it has many ecological repercussions. They are generally insoluble in water and non-biodegradable. Therefore, these chemicals will not gradually decompose and keep on accumulating in the soil. Therefore, the concentration of these chemicals will increase when the transfer of these chemicals take place from lower to higher trophic level via the food chain. Hence, it will cause many metabolic and physiological disorders in humans.

Chlorinated Organic Toxins

The harmful effect of DDT and other chemicals led to the introduction of less persistent organic and more biodegradable substance such as carbamates and organophosphates. However, these chemicals act as harmful toxins for nerves, hence they are more dangerous to humans. It led to pesticides related to the death of field workers in some agricultural fields.

Herbicides

Slowly, the industries began production of herbicides like sodium arsenite (Na_3AsO_3), sodium chlorate (NaClO_3), etc. Herbicides can decompose in a span of few months. However, even they affect the environment and are not environmental friendly. Even though they are not as harmful as organo-chlorides but most of the herbicides are toxic. They are known to cause birth defects. Furthermore, research suggests that spraying herbicides causes more insect attack and diseases of plants in comparison to manual weeding. One thing to note here is all the above factors occupy just a small portion of the causes. Majority of the causes is related to manufacturing activities in chemical and industrial processes that are released in nature or environment.

Inorganic Fertilizers

Excessive use of inorganic nitrogen fertilizers leads to acidification of soil and contaminate the agricultural soil. Also known as agrochemical pollution.

Inferior Irrigation Practices

Poor irrigation methods increase the soil salinity. Moreover, excess watering, improper maintenance of canals and irrigation channels, lack of crop rotation and intensive farming gradually decreases the quality of soil over time and cause degradation of land.

Solid Waste

Disposal of plastics, cans, and other solid waste falls into the category of soil pollution. Disposal of electrical goods such as batteries causes an adverse effect on the soil due to the presence of harmful chemicals. For instance, lithium present in batteries can cause leaching of soil.

Urban Activities

Lack of proper waste disposal, regular constructions can cause excessive damage to the soil due to lack of proper drainage and surface run-off. These waste disposed of by humans contain chemical waste from residential areas. Moreover leaking of sewerage system can also affect soil quality and cause soil pollution by changing the chemical composition of the soil.

Effects of Soil Pollution

Soil pollution is not only the problem in India but it is a global problem. It causes harmful effect on the soil and the environment at large. Contamination of soil will decrease the agricultural output of a land. Major soil pollution after-effects are as follows.

Inferior Crop Quality

It can decrease the quality of the crop. Regular use of chemical fertilizers, inorganic fertilizers, pesticides will decrease the fertility of the soil at a rapid rate and alter the structure of the soil. This will lead to decrease in soil quality

and poor quality of crops. Over the time the soil will become less productive due to the accumulation of toxic chemicals in large quantity.

Harmful Effect on Human Health

It will increase the exposure to toxic and harmful chemicals thus increasing health threats to people living nearby and on the degraded land. Living, working or playing in the contaminated soil can lead to respiratory diseases, skin diseases, and other diseases. Moreover, it can cause other health problems.

Water Sources Contamination

The surface run-off after raining will carry the polluted soil and enter into different water resource. Thus, it can cause underground water contamination thereby causing water pollution. This water after contamination is not fit for human as well as animal use due to the presence of toxic chemicals.

Negative Impact on Ecosystem and Biodiversity

Soil pollution can cause an imbalance of the ecosystem of the soil. The soil is an important habitat and is the house of different type of microorganisms, animals, reptiles, mammals, birds, and insects. Thus, soil pollution can negatively impact the lives of the living organisms and can result in the gradual death of many organisms. It can cause health threats to animals grazing in the contaminated soil or microorganisms residing in the soil.

Therefore, human activities are responsible for the majority of the soil pollution. We as humans buy things that are harmful and not necessary, use agricultural chemicals (fertilizers, pesticides, herbicides, etc.), drop waste here and there. Without being aware we harm our own environment.

Therefore, it is very important to educate people around you the importance of environment if they are not aware. Prevention of soil erosion will help to cease soil pollution. Thus, it is our small steps and activities that can help us to achieve a healthier planet for us. Therefore, it is essential for industries, individuals and businesses to understand the importance of soil and prevent soil pollution and stop the devastation caused to plant and animal life (Nath, 2003).

Remediation

- Use of correct farming techniques.
- Recycling of waste before disposal, recycle and reuse products.
- Use of organic fertilizers instead of chemical fertilizers and pesticides.
- Community education and awareness. Get the locals involved.
- Proper maintenance of sewage system, proper disposal method of household and industrial waste.

- Reforestation and afforestation should be promoted.
- Planting new trees and plants is afforestation. We live because plants live. If the plants die, all living things will also die. Thus, whenever trees are cut down new trees should be planted. Planting trees in hilly areas are most effective for conservation (Yasiri, 2019).

Conclusion

Soil pollution is a result of many activities and experiments done by mankind which end up contaminating the soil. Industrial wastes such as harmful gases and chemicals, agricultural pesticides, fertilizers and insecticides are the most common causes of soil pollution. The others are ignorance towards soil management and related systems, unfavourable and harmful irrigation practices, improper septic system and management and maintenance of the same, leakages from sanitary sewage. There is urgent need for a tiered approach in ecological risk assessment of contaminated soils. Generic soil screening levels are needed as a first tier. Higher tiers of ecological risk assessment should, however, contain some kind of site-specific assessment. It is furthermore

important to organize the various studies in a framework or decision support system that is transparent and useful for all stakeholders.

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