
Polluted soils : Causes, Management and Impact on Crop

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Introduction :-

- The United Nations declared 2015 as **“International Year of Soils”**.
 - Soil is one of the important and valuable resources of the nature. Life and living on the earth would be impossible without healthy soil. 95% of human food is derived from the earth.
 - Soil pollution is the reduction in the productivity of soil due to the presence of soil pollutants.
 - Soil pollutants have an adverse effect on the physical chemical and biological properties of the soil and reduce its productivity.
 - Pesticides, fertilizers, chemicals, radioactive wastes, discarded food, clothes, leather goods, plastics, paper, bottles etc. contributed towards causing soil pollution.
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- Chemicals like Fe, Pb, Hg, Cu, Al, acids and alkalies etc. are present in industrial wastes and reach the soil either directly with water or indirectly through air (acid rain).
- Soil pollution can lead to water pollution if toxic chemicals leach into groundwater, or by runoff, which reaches to lakes or rivers.
- Soil also naturally contributes to air pollution by releasing volatile compounds into the atmosphere.

Environmental Pollution

Land Pollution

- Deterioration of earth's land surface
- Caused due to garbage, factories, mining



Soil Pollution

- Contamination of soil and degrades the soil quality
- Occurs due to human activities
- Herbicides, pesticides are also responsible



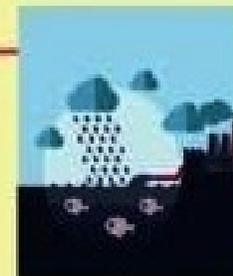
Air Pollution

- Mixture of solid particles and gases in air is caused by gaseous pollutants and particulate pollutants



Water Pollution

- Contamination of water by various organic waste, chemical pollutants



Pollution and Soil Pollution :-

- The word pollution is derived from Latin word **"POLLUTIONEM"** which means to make dirty.
 - The **pollution** is defined as the harmful changes in natural environment of air, water and soil caused by anthropogenic activities.
 - The soil pollution is defined as the deterioration of physical, chemical and biological properties of soil which have adverse effect on crop production, human and animal health.
 - Soil pollution refers to anything that causes contamination of soil and degrades the soil quality.
 - Soil contamination or soil pollution can occur either because of human activities or because of natural processes. However, mostly it is due to human activities.
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Causes of Soil Pollution :-

- **Soil pollution can be natural or due to human activity. However, the activities of the human that causes the majority of soil pollution such as heavy industries, or use of pesticides in agriculture.**

1. Industrial Activity:

- **Mining, manufacturing, and the use of synthetic products (e.g. pesticides, paints, batteries, industrial waste, and land application of industrial or domestic sludge) can result in heavy metal contamination of urban and agricultural soils.**
 - **The incorrect way of chemical waste disposal from different types of industries can also cause for contamination of soil.**
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2. Agricultural Activities :

- **Chemical utilization has gone up tremendously since technology provided us with modern pesticides / herbicides and fertilizers.**
 - **They are full of chemicals that are not produced in nature and cannot be broken down by it.**
 - **Plants absorb many of these pesticides and when they decompose, it may cause soil pollution.**
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a. Pesticides :

- **Pesticides (DDT, Aldrin and Dieldrin) are synthetic toxic chemicals that definitely kill different types of pests and insects causing damage to agriculture but it has contaminated the soils.**
 - **They are non-biodegradable chemicals. Therefore, these chemicals will not gradually decompose and keep on accumulating in the soil.**
 - **Hence, the concentration of these chemicals will increase in food chain through contaminated soils, it will cause many metabolic and physiological disorders in humans.**
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b. Herbicides :

- **Slowly, the industries began production of herbicides like sodium arsenite (Na_3AsO_3), sodium chlorate (NaClO_3), etc. for the weed control but they are also not environmental friendly.**
 - **Herbicides are not as harmful as pesticides but most of the herbicides are toxic.**
 - **Research suggested that the spraying herbicides causes more insect attack and diseases of plants in comparison to manual weeding.**
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c. Inorganic Fertilizers :

- **Excessive use of inorganic nitrogen fertilizers leads to acidification of soil and contaminate the agricultural soil. Also known as agrochemical pollution.**
 - **Large quantities of fertilizers are regularly added to soils in intensive farming systems to provide adequate N, P, and K for crop growth. The compounds used to supply these elements contain trace amounts of heavy metals (e.g., Cd and Pb) as impurities.**
 - **Continuous application of inorganic fertilizers may significantly increase the heavy metals content in the soil.**
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Fertilizers	Heavy Metals (mg kg⁻¹)				
	Pb	Cr	Cd	As	Ni
Urea	4.0	6.0	1.0	-	-
Ammonium Nitrate	<0.40	-	<0.20	<0.40	<0.20
Calcium Ammonium Nitrate	116	9.0	6.0	-	-
Single Super Phosphate	487	88	187	-	-
Rock Phosphate	962	184	303	20.5	17-50
Diammonium Phosphate	195	81	109	-	-

3. Waste Disposal :

- **Industrial waste is sure to cause soil contamination.**
 - **Disposal of plastics, cans, and other solid waste falls into the category of soil pollution.**
 - **Leaking of sewerage system can also affect soil quality and cause soil pollution by changing the chemical composition of the soil.**
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Effect of Soil Pollution :-

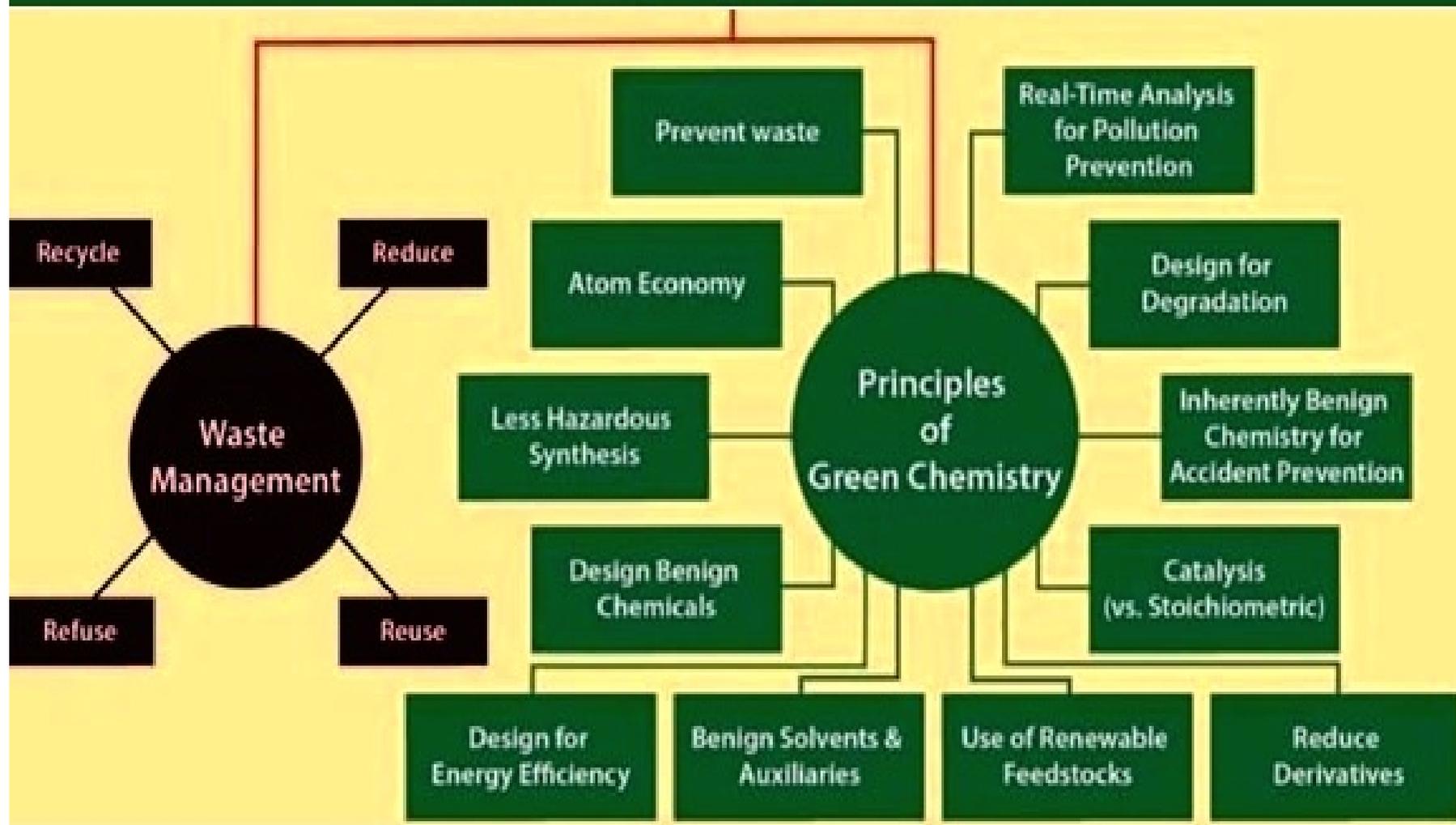
- It causes harmful effect on the soil and the environment. Contamination of soil will decrease the agricultural output. Major soil pollution effects are :
 1. **Inferior Crop Quality** : It can decrease the quality of the crop. Regular use of chemical fertilizers, pesticides will decrease the fertility 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.
 2. **Harmful Effect on Human Health** : It will increase the exposure to toxic and harmful chemicals thus increasing health threats to people living nearby 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.
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- 3. 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.
 - 4. 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 etc. 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.
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Prevention/Management of Soil Pollution :-

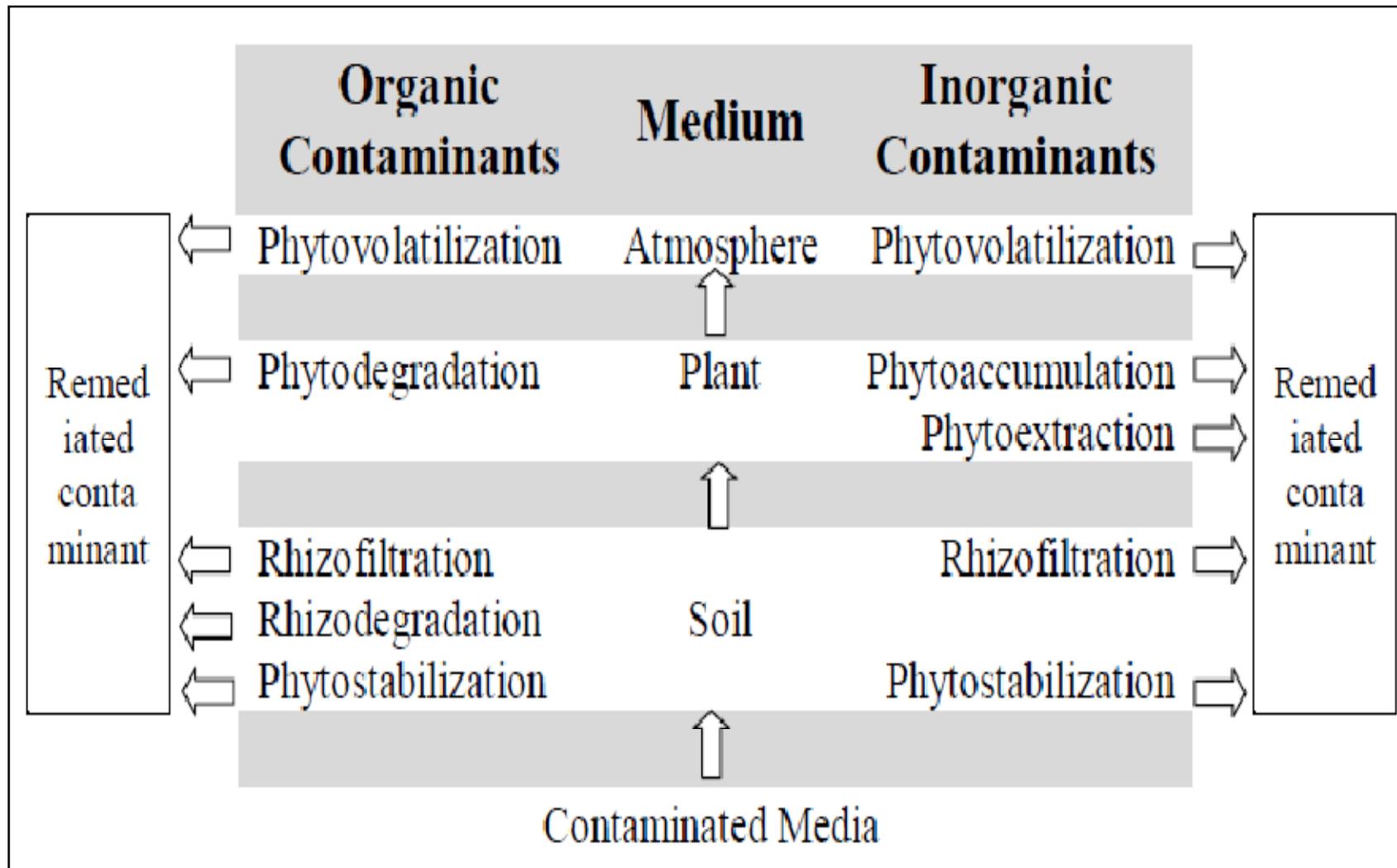
- **Recycling of waste before disposal.**
 - **Proper disposal method of household and industrial waste.**
 - **Proper maintenance of sewage system.**
 - **Use of organic manures /pesticides instead of chemical fertilizers and pesticides.**
 - **Encouraging the integrated application of inorganic fertilizers, organic manures and bio-fertilizers (INM system)**
 - **Avoiding deforestation and promoting forestation.**
 - **Encouraging plantation by social and agro forestry programmes.**
 - **Suitable and safe disposal of including nuclear wastes.**
 - **Conducting many pollution awareness programs.**
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Environmental Pollution



Remediation of Polluted Soils :-

- **Phytoremediation** : During recent years the concept of using plants to remediate contaminated sites has received greater attention.
 - It consists of the Greek prefix *phyton* (plant), attached to the Latin root *remedium* (to correct or to remedy).
 - Phytoextraction
 - Phytostabilisation
 - Rhizofiltration
 - Phytovolatilization
 - Phytodegradation
 - Hyper accumulation : *Brassica juncea* (Mustard), *Thlaspi spp.* (Brassicaceae) - *T. caerulescens*, *T. montanum*, *T. ochlecum*.
Alyssum spp. (Brassicaceae) - *A. argentum*, *A. Corsicum*, *A. euboicum*, *A. heldrechii*, *A. murale*, *A. cnium*, *A. Troodii*
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Uptake mechanisms on phytoremediation technology

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- **Soil scraping** : Replacement of uppermost contaminated soil (0-15 cm depth) from cultivated field has been possible.
 - The maximum amount of lead was absorbed / adsorbed by soil in clay – humus complexes.
 - By scraping of contaminated soil highest quality of heavy metals can be removed from the soil and become suitable from growing the crops.

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. Hence, it is very important to educate people around you the importance of environment if they are not aware.

Thanks
