Soil Pollution

Introduction:

World Soil Day was established in 2002 by the International Union of Soil Sciences (IUSS) to celebrate the importance of soil and its vital contributions to human health and safety. On December 20, 2013, the 68th UN General Assembly recognized December 5th, 2014 as World Soil Day and 2015 as the International Year of Soils. This official recognition of these events will emphasize the importance of soils beyond the soil science community. It took two years for the leadership of Thailand and the FAO Global Soil Partnership (GSP) to get these dates approved by the UN, but their hard work prevailed and soil has garnered the attention it has so long deserved. World Soil Day is annually held on December 5 to highlight soil's importance on Earth. We need soil for basic survival - energy. It is linked with the United Nations' (UN) Year of Soil. World Soil Day serves as a reminder to all of us that we owe our existence to the soil. As we face mounting global production, climate and sustainability challenges Soil is fundamental to human life on Earth. Most plants require a soil substrate to provide water and nutrients, and whether we farm the plants directly or consume animals that feed on the plants, this means that we don't eat without soil. Having that, it is not hard to see that a) it is possible to have a sea-based diet and b) it is possible to grow our food hydroponically. In those cases, it is possible to reduce the importance of soil. However, we still have the other reasons that soil is fundamental: it is required for trees. I don't think I need to go into the importance of trees for shade, animal habitat, building materials. Soil is a vital part of the natural environment. It is just as important as plants, animals, rocks, landforms, loch and rivers. It influences the distribution of plant species and provides a habitat for a wide range of organisms. It controls the flow of water and chemical substances between the atmosphere and the earth, and acts as both a source and store for gases (like oxygen and carbon dioxide) in the atmosphere. Soils not only reflect natural processes but also record human activities both at present and in the past. They are therefore part of our cultural heritage. The modification of soils for agriculture and the burial of archaeological remains are good examples of this. Soil, together with the plant and animal life it supports, the rock on which it develops its position in the landscape and the climate it experiences, form an amazingly intricate natural system powerful and complex than any machine that man has created. Soil may look still and lifeless, but this impression couldn’t be further from the truth. It is constantly changing and developing through time. Soil is always responding to changes in environmental factors, along with the influences of man and land use.

Some changes in the soil will be of short duration and reversible, others will be a permanent feature of soil.

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, organic manure, chemicals, radioactive wastes, discarded food, clothes, leather goods, plastics, paper, bottles, tins-cans and carcasses-all contribute towards causing soil pollution. Chemicals like iron lead mercury, copper, zinc, cadmium, aluminium, cyanides, acids and alkalies etc. are present in industrial wastes and reach the soil either directly with water or indirectly through air. (e.g. through acid rain). The improper and continuous use of herbicides, pesticides and fungicides to protect the crops from pests, fungi etc. alter the basic composition of the soils and make the soil toxic for plant growth. Organic insecticides like DDT, aldrin, benzene hex chloride etc. are used against soil borne pests. They accumulate in the soil as they degrade very slowly by soil and water bacteria. Consequently, they have a very deleterious effect on the plant growth stunting their growth and reducing the yield and size of fruit. Their degradation products may be absorbed by the plants from where they reach the animals and man through the food chains. Radioactive wastes from mining and nuclear processes may reach the soil via water or as 'fall-out'. From the soil they reach the plants and then into the grazing animals (livestock) from where ultimately reach man through milk and meat etc. resulting in retarded and abnormal growth of man. Human and animal excreta used as organic manure to promote crop yield, pollute the soil by contaminating the soil and vegetable crops with the pathogens that may be present in the excreta. Nitrification, which is the process of forming soluble nitrates from the elemental atmospheric nitrogen or from originally harmless organic materials actually contribute towards water pollution when the nitrates leach out of the soil and accumulate to toxic levels in the water supply. Therefore, intensification of agricultural production by practices of irrigation (causes salination), excessive fertilisers, pesticides, insecticides etc. have created the problems of soil pollution. Soil pollution can be checked by restricting the use of above mentioned soil pollutants resorting to organic farming, adopting better agriculture practices etc. Soil pollution comprises the pollution of soils with materials, mostly chemicals that are out of place or are present at concentrations higher than normal which may have adverse effects on humans or other organisms. It is difficult to define soil pollution exactly because different opinions exist on how to characterize a pollutant; while some consider the use of pesticides acceptable if their effect doe not exceed the intended result, others do not consider any use of pesticides or even

chemical fertilizers acceptable. However, soil pollution is also caused by means other than the direct addition of xenobiotic (man-made) chemicals such as agricultural runoff waters, industrial waste materials, acidic precipitates, and radioactive fallout. Both organic (those that contain carbon and inorganic (those that don't) contaminants are important in soil. The most prominent chemical groups of organic contaminants are fuel hydrocarbons, polynuclear aromatic hydrocarbons, polychlorinated biphenyls, chlorinated aromatic compounds, detergents, and pesticides. Inorganic species include nitrates, phosphates, and heavy metals such as cadmium, chromium and lead; inorganic acids; and radionuclides (radioactive substances). Among the sources of these contaminants are agricultural runoffs, acidic precipitates, industrial waste materials, and radioactive fallout. Soil pollution can lead to water pollution if toxic chemicals leach into groundwater, or if contaminated runoff reaches streams, lakes, or oceans. Soil also naturally contributes to air pollution by releasing volatile compounds into the atmosphere.

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 it structure as well as important nutrients found in the soil. Some 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 effect 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 affects its water holding capacity.

• Unscientific disposal of nuclear waste contaminate 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).

The effects of pesticides on soil micro organisms can cause a ripple effect that can last for years. Micro-organisms are essential to healthy soil. Without them, your plants will not reach their true potential. Micro-organisms 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 micro-organisms which live in the soil including:

• Bacteria

• Fungi

• Algae

• Protozoa

Micro-organisms 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 micro-organisms that can help a plant defend it against pests. These micro-organisms 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.

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 1hange 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 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 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.