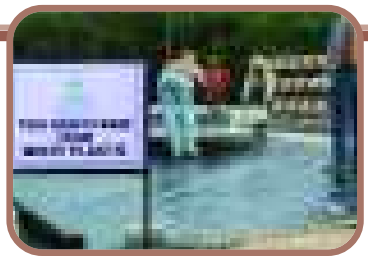
Chapter 10

Soil pollution



Our environment is composed of atmosphere, earth and water. The interaction of the atmosphere, lithosphere, hydrosphere and biosphere is continuing for years together. It was clean and enjoyable. But due to the various activities of man, the composition and complex nature of environment got changed. The activities include industrialization, construction, transportation, agriculture and deforestation. Such activities are though desirable for human development and welfare release unwanted materials into the environment causing it to be imbalanced rendering our life miserable.

We have learnt so far about soil formation and its properties in class VII, and also about air and water pollution in previous chapters. Here we will study about 'land pollution'. But before that, let us recall what we have learnt about soil.

We Indians worship **earth as mother**. We get everything for our living from soil. You have studied about structure of the soil in class VII. Let us recall, what you have learnt in class VII.

What is soil?

Soil is one of the th ree major natural resources, alongside air and water. It is one of the marvellous products of nature and without which there would be no life. It is a natural medium on the surface of the earth in which plants grow.

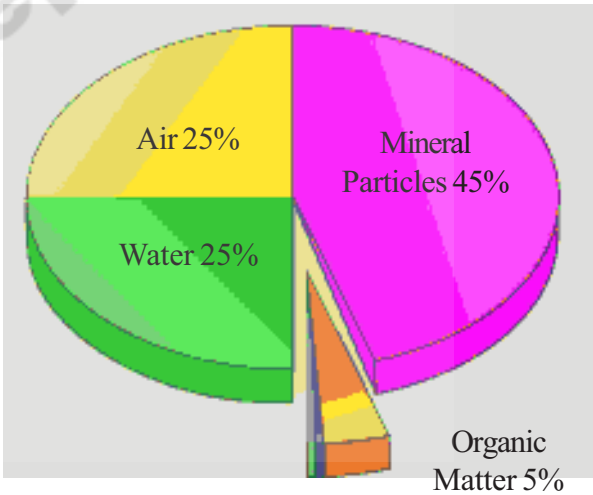


Fig-1 Components of soil

(Organic matter contains Organisms 10%, Roots 10%, Humus 80%)

Soil is made up of minerals and decomposed organic matter, along with air and water. Soil can create a habitat for fungi,

bacteria and related organisms, which in turn feed and support plant life.

Healthy soil is fundamental to the quality of food it produces and to the health of those who eat the food produced from it.

How is soil formed?

Soil formation is a long and complex process and it can take 100 to 10,000 years to create one inch of top soil! It is driven by many factors such as climate, topography, living organisms and the type of parent material. Parent materials come from break down of underlying rocks or from deposits by streams and rivers, seas and gulfs, hills, wind and glaciers or organic plant residues.

Over time, these materials are weathered by the effects of freezing, thawing, wetting, drying, heating, cooling, erosion, plants and animals and from chemical reactions. Eventually the parent material is divided into three horizontal layers, the top layer consists of mostly organic matter and biological activity, the middle layer is the zone of maximum material accumulation and the bottom layer bold is mainly the parent material, but slightly altered.

The top soil is important since it is the foundation for the life on the earth.

Do you know?

In one acre of land where the top soil is eight inches thick nearly five and half tons of Bacteria are present. 50,000 Earthworms are also present in it.

Soil properties

Crop quality directly depends on the quality of the agricultural soil in which it is grown. The higher the quality of the soil, the higher the quality of the crop produced. To determine how to obtain high quality soil, we must first understand the fundamental properties of soil. These can be divided into three major categories- physical, chemical and biological properties.

(i) Physical properties of soil

Soil comprises of minerals, organic matter, water and air. The composition and proportion of these components greatly influences soil physical properties including colour texture, structure and porosity. These properties regulate and affect air and water movement in the soil and thus, soil ability to function. Organic matter is the organic component of soil which includes the residues of dead plants, animals and organisms.

It consists of nutrients necessary for plants growth such as nitrogen, phosphorus and potassium. Soils which contain 30% or more organic matter are considered organic soil; all other soils are identified as mineral soils. Organic matter in soil improves water infiltration, decreases evaporation, and increases the water holding capacity. Also, where there is organic matter, there will be numerous organisms present helping to convert it back to nutrients and these organisms help to create crumb, ideal for cultivation. Thus, balancing a natural state of soil.

(ii) Chemical properties of soil

The term pH is used to indicate the level of acidity or alkalinity of a soil. The range of pH values of a good soil lies from 5.5 to 7.5. Below pH 7 the soils are termed as acidic and above pH 7 alkaline.

The pH of soil is important in determining the type of vegetation that will grow in the soil and the type of organisms that will live there. Also, presence of organic matter in soil has a close relationship with soil pH. Soil richer in organic matter is acidic in nature as a result of degradation of various substances produces various acids in soil. Availability of plants nutrients is strongly tied to the pH in soil.

The availability of N, K, Ca, Mg and S tends to decrease with decreasing pH since conditions which acidify the soil such as weathering and plant uptake also result in removal of these nutrients or in decreased microbial activity.

What will happen if there is increase in acidic or basic nature of soil?

(iii) Biological properties of Soil

Soil is not a dead mass but an abode of millions of organisms. It is the most abundant and diverse ecosystem on the earth. Soil organisms include both plants and animal forms ranging from sub microscopic viruses to earthworms, to large burrowing animals such as gophers and ground squirrels. Major microbial groups in soil are bacteria, fungi, algae and protozoa. These feed on plant residues burrow the soil and help in aeration and percolation of water.

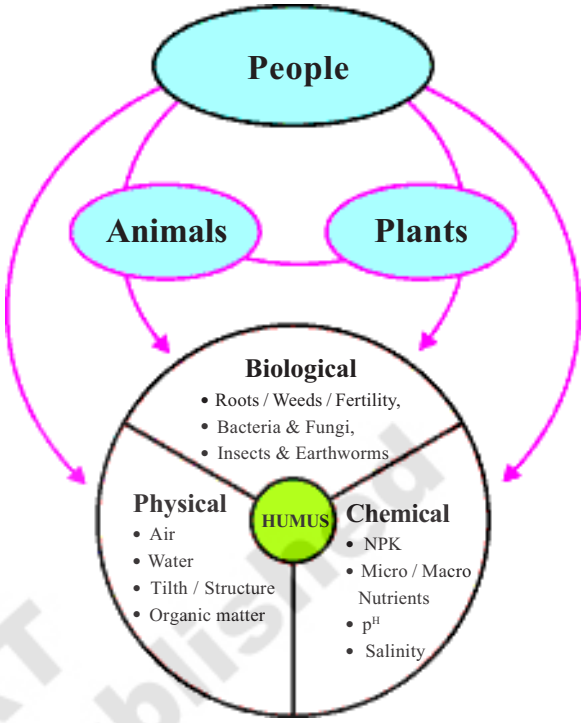


Fig-2 Biological properties of soil

Soil microbes also have influence in controlling the quantities and forms of various chemical elements found in soil. Most notable are the cycles of carbon, nitrogen, sulphur and phosphorus, all of which are elements important in soil fertility. Soil microbes convert organic forms of elements to their inorganic forms and liberate carbon dioxide, ammonia, sulphate, phosphate and inorganic forms of other elements. This process is known as 'mineralization'.

This is the basis of nutrient cycles in all major ecosystems of the world. Besides their role in controlling the rates of production of inorganic forms from various organic forms, soil microbes, particularly, soil bacteria also control the forms of ions in which these nutrients occurs. We shall study this in detail in the chapter of **'Biogeochemical cycles'.**

Thus, we can conclude that physical, chemical and biological properties of soils affect many processes in the soil that make it suitable for cultivation and other purposes.

SOIL FERTILITY

Fertility of soil is closely associated with the properties of soil and is defined by its capacity to hold water and nutrients and supply them to plants when they need them, independent of direct application of nutrients. Transfer of nutrients from the soil's organic matter to the mineral stage strongly depends on the soil organisms' activity and diversity. Soil organisms also contribute to buildup soil organic matter, including humus, the soil's most important nutrient reservoir.

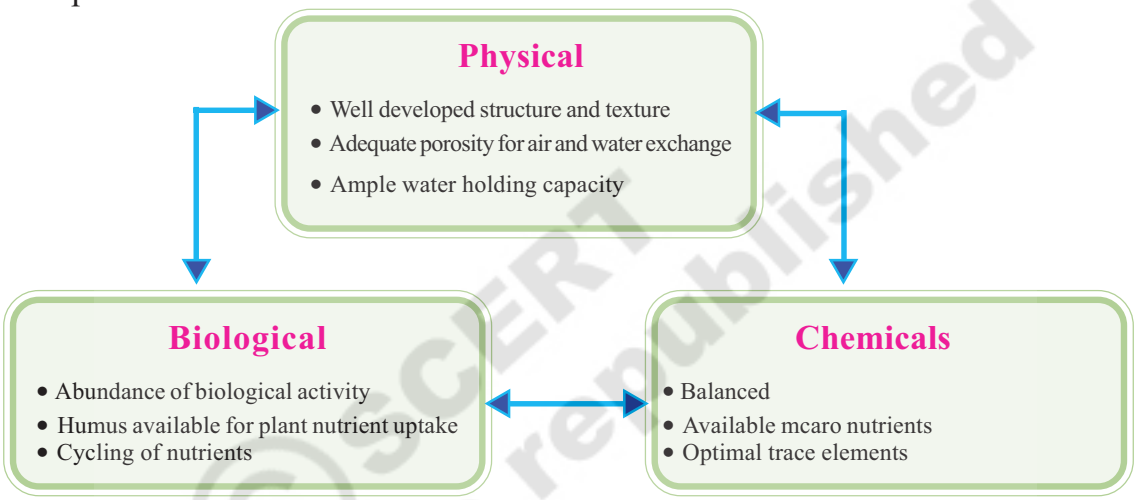


Fig-3 Properties of soil

When nutrients are bound in biological or organic form, they are neither lost nor bound to soil particles in a way which makes them unavailable to plants. Therefore, soil fertility can be described in terms of soil organic matter content of the soil, with good living conditions for soil organisms and growing conditions for the roots, which are closely linked to soil structure, the availability of nutrients, the soil's water holding capacity and its biological activity.

It is interesting to know that a major part of the soil microbial biomass is composed of fungi. Important representatives of the soil fungi, the mycorrhizae, grow in symbiosis with about 90% of all plant roots. The plant roots provide sugar for the growth of mycorrhiza. In reverse, the fungus explores the soil and brings back water as well nutrients such as phosphate, zinc and copper that are not easily available to plants. Mycorrhizae enlarge the rooting zone of plants and enter small soil pores, where plant roots cannot access. Iimproving soil structure, mycorrhizal action in soil and take plant carbon from the air and deposit into soil organic matter and stable soil aggregates.

In addition to the above, soil P^H, its acidity or alkalinity, is highly relevant to how readily nutrients become available in soil.

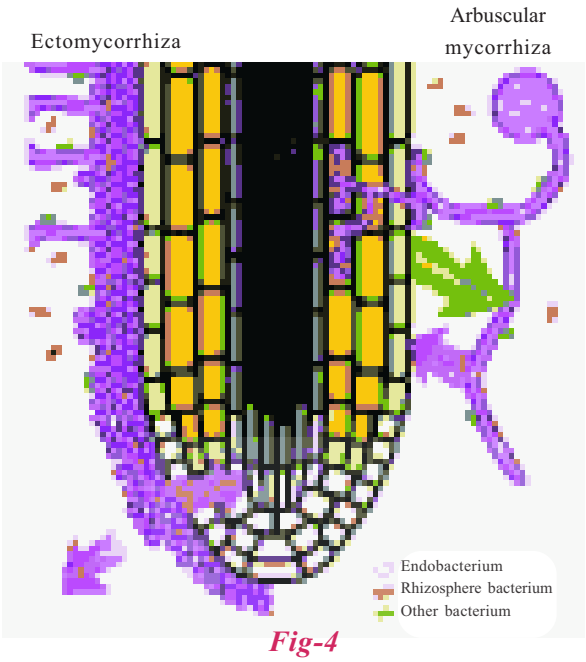


Fig-4

Proper soil fertility management is very important for successful crop production and farming. Organic farmers approach soil fertility management by protecting the soil and feeding it organic material, and then letting it feed the plants in a balanced way. When the soil is fertile in the organic sense, it can produce good crop yields for several years. You learned about organic forming in the chapter 'Challenges in improving agriculture.'

Soil pollution

"The Earth, the air, the land and the water are not an inheritance from our forefathers but on loan from our children. So we have to handover to them atleast as it was handed over to us." - *Mahatma Gandhi.*

As we discussed above, soil serves as the interface between earth, air and water; fulfilling a variety of complex, interdependent functions essential to life. Yet human activities alter its ability to perform its job. As compared to the other resources, it has taken a long time to become aware of the wealth, complexity, usefulness and fragility of the soil. When the quality of air and water deteriorates, the threat to public health is felt immediately. But as long as we can walk on the earth under our feet, where's the danger?

The impacts of various human activities for development and welfare are invisible and land pollution is a good example of that. We can't easily see the poisons that seep from underground mines, the garbage we have dip into landfills or from industrialization, agriculture and other mismanagement by human being. Land pollution, in short, is a much bigger and more subtle problem than it might appear. How does it occur? And what can we do about it? These are the questions to think about. But first let us understand up to what extent we are as human being, responsible for producing this waste.

Let us read the following conversation and prepare the list as per the instructions.

During interval time Venu was eating a fruit. He was about to throw the peel in corner of the varandah. His friend Ramu stopped her. Ramu said you should not throw waste in the varandah. Drop it in the litter given.

Now let us think, what will happen if you throw the wastes where ever you want?

Prepare a list of waste materials we throw out in a day from morning to evening classifying them as wet wastes and dry wastes with the help of the example given in the table below.

S. No.	Wet waste	Dry waste
1.	Vegetable peels	Biscuit wrapper
2.		
3.		
4.		
5.		

Can you imagine the quantity of waste we produce in a day and what happens to the waste materials we throw or dispose?

Activity-1

Weight the wet wastes, which you have listed in the table for one day. Divide the weight by number of people in your home. The result will be the per capita wet waste we are producing in one day.

$$\textit{Per capita wet Wastes produced at home} = \frac{\textit{Total weight of wet waste materials}}{\textit{No. of persons in your family}}$$

Multiply it by 30 = ... per month
Multiply it by 365 = ... per year

You will be surprised to note this astonishing figure of the waste we are producing in a day. Do you know what happens to the waste materials we produce?

Activity-2

Dumping and decomposing

We are producing tons of wastes in our daily activities. It is dumped at wherever the vacant place is available in Urban as well as Rural areas. Some of these wastes are decomposed but some are not. Let us do the following activity. For this you need to observe more than one month.

Take a polythene bag/plastic bucket / or any container. Fill half of it with soil. Keep wet wastes and other wastes in it. (Wastes should include vegetable peels, rubber, plastic etc). Add some more soil and sprinkle water regularly on it. Dig it and observe in 15 days intervals. Note your observations in the table.

Material	What has happened in the 1st fortnight	What has happened in the 2nd fortnight	What has happened in the 3nd fortnight
Vegetable peels Vegetable with removed peel Banana Plastic cup paper rubber			

Now think, why some of the waste materials are mixing with soil quickly while some do not?

The waste generated from various sources can be categorized into two types:

i) Biodegradable waste includes substances that can be degraded by microbes into harmless and non-toxic substances. Agricultural and animal wastes like leaves, twigs, hay, dung, etc. are biodegradable wastes.

ii) Non-biodegradable waste cannot be easily degraded. Aluminium cans, plastics, glass, DDT, etc. are examples of non-biodegradable wastes. Radioactive wastes produced during nuclear reactions take a long time to decay and are harmful to human beings. Now a dyas 'e-waste' (computer, mobile wastes) is also leads to soil pollution

Decomposition is the process of materials being digested and broken down into simpler substances, making nutrients

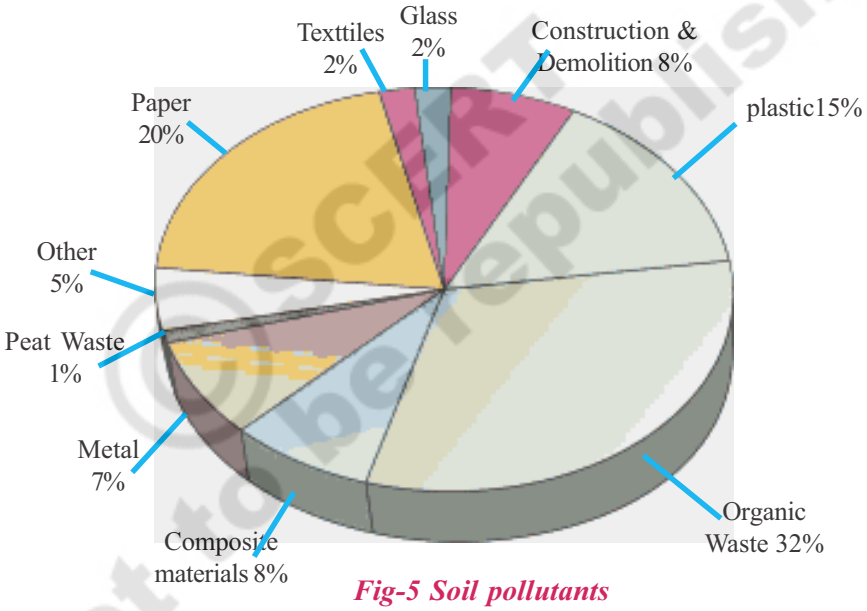


Fig-5 Soil pollutants

more available to plants. Thus, bio-degradable materials contribute directly to the fertility of the soil. But when the disposed amount of bio-degradable materials exceed it contributes the imbalance in the nature creating negative impacts. On the other hand, non-biodegradable materials directly contribute to land pollution due to the excessive amount and improper waste management. Thus, soil or land pollution can be understood as addition of substances which adversely affect the quality of soil or its fertility Generally polluted water also pollute soil. Solid waste is a mixture of plastics, cloth, glass, metal and organic matter, sewage, sewage sludge, building debris, generated from households, commercial and industries establishments add to soil pollution. Fly ash, iron and steel slag, medical and industrial wastes disposed on land are important sources of soil pollution. In addition, fertilizers and pesticides from agricultural use which

reach soil as run-off and land filling by municipal waste are growing cause of soil pollution. Acid rain and dry deposition of pollutants on land surface also contribute to soil pollution.

Think and discuss

- Today what are the pollutants produced from your school. How many of these are non-degradables.

Causes of land pollution

There are many different ways by which land pollution can occur. Soils are commonly used as dumps for household and industrial wastes. In many intensively farmed areas, leaching of nutrients from manure or inorganic fertilizers and effluents from processing plants may lead to high level of nitrate and other chemicals in ground water. Atmospheric deposition where soil gets contaminated when air pollution falls on to it, are much apparent still contributing to soil pollution. Thus, on the basis of sources of pollutants, soil pollution can be classified into the following categories:

- Agricultural Soil Pollution
- Soil pollution by industrial effluents and solid wastes
- Pollution due to urban activities

Soil pollution is caused by the presence of man-made chemicals or other alteration in the natural soil environment. This type of contamination typically arises from the rupture of underground storage links, application of pesticides, and percolation of contaminated surface water to subsurface strata, oil and fuel dumping, leaching of wastes from landfills or direct discharge of industrial wastes to the soil. The most common chemicals involved are petroleum hydrocarbons, solvents, pesticides, lead and other heavy metals. The occurrence of this phenomenon is correlated with the degree of industrialization and intensities of chemical usage.

A soil pollutant is any factor which deteriorates the quality, texture and mineral content of the soil or which disturbs the biological balance of the organisms in the soil. Pollution in soil has adverse effect on plant growth and living organisms in the soil.

Pollution in soil is associated with

- Indiscriminate use of fertilizers
- Indiscriminate use of pesticides, insecticides and herbicides
- Dumping of large quantities of solid waste
- Deforestation and soil erosion

Indiscriminate use of fertilizers

Soil nutrients are important for plant growth and development. Plants obtain carbon, hydrogen and oxygen from air and water. But other necessary nutrients like nitrogen, phosphorus, potassium, calcium, magnesium, sulfur etc., must be obtained from the soil. Farmers generally use fertilizers to correct soil deficiencies.

Fertilizers contaminate the soil with impurities, which come from the raw materials used for their manufacture. Mixed fertilizers often contain nitrogen as

ammonium nitrate (NH_4NO_3), phosphorus as P_2O_5, and potassium as K_2O. For instance, As, Pb and Cd present in traces in rock phosphate mineral get transferred to super phosphate fertilizer. Since the metals are not degradable, their accumulation in the soil above their toxic levels due to excessive use of phosphate fertilizers becomes an indestructible poison for crops.

The over use of NPK fertilizers reduce quantity of vegetables and crops grown on soil over the years. It also reduces the protein content of wheat, maize, grams, etc., grown on that soil. The carbohydrate quality of such crops also gets degraded. Excess potassium content in soil decreases Vitamin C and carotene content in vegetables and fruits. The vegetables and fruits grown on over fertilized soil are more prone to attacks by insects and diseases.

Indiscriminate use of pesticides, insecticides and herbicides

Plants on which we depend for food are under attack from insects, fungi, bacteria, viruses, rodents and other animals, and must compete with weeds for nutrients. To kill unwanted populations living in or on their crops, farmers use pesticides.

The first widespread insecticide use began at the end of World War II that included DDT (dichloro diphenyl trichloro ethane) and gammaxene. Insects soon became resistant to DDT and as the chemical did not decompose readily, it persisted in the environment.

Since it was soluble in fat rather than water, it biomagnified up the food chain and disrupted calcium metabolism in birds, causing eggshells to be thin and fragile. As a result, large birds of prey such as the brown pelican, ospreys, falcons and eagles became endangered. DDT is now banned in the most of the western countries. Ironically many of them including USA still produce DDT for export to other developing nations whose needs outweigh the problems caused by it.

Besides DDT the most important pesticides are BHC, chlorinate dihydro carbons, organo phosphates, aldrin, malathion, dieldrin, furodan, etc. The remnants of such pesticides used on pests may get adsorbed by the soil particles, which then contaminate root crops grown in that soil. The consumption of such crops causes the pesticides remnants to enter human biological systems, affecting them adversely.

Pesticides not only have toxic effect on human and animals but also decrease the fertility of the soil. Some of the pesticides are quite stable and their bio- degradation may take weeks and even months.

Biomagnification

The nutrients necessary for plant growth (e.g., nitrogen and phosphorus) are found at very low concentrations in most natural waters. In order to obtain sufficient quantities for growth, phytoplankton must collect these chemical elements from a relatively large volume of water.

In the process of collecting nutrients, phytoplankton also collects certain human-made chemicals, such as some persistent

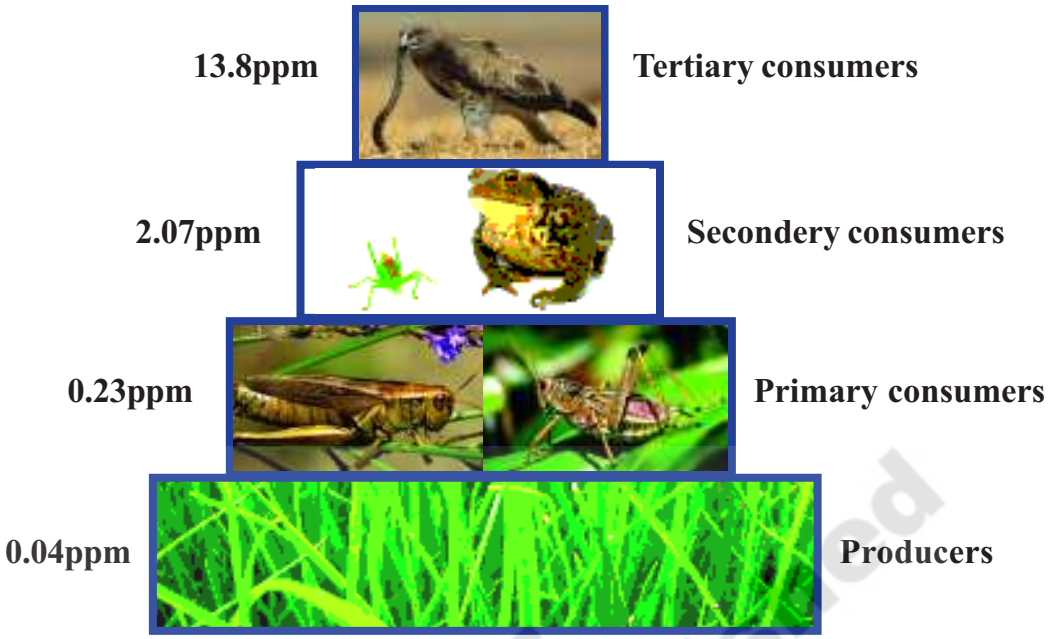


Fig-6 Bio magnification

The numbers are representative values of the concentration of DDT and its derivatives (in parts per million, ppm) in the tissues.

pesticides. These may be present in the water at a very low concentrations that they cannot be measured even with a very sensitive instruments. The chemicals, however, biologically accumulate (bioaccumulation) in the organism and become concentrated at levels that are much higher in the living cells than in the open water. This is especially true for persistent chemicals-substances that do not break down readily in the environment - like DDT and BHCs that are stored in fatty tissues.

The small fish and zooplankton eat vast quantities of phytoplankton. In doing so, any toxic chemicals accumulated by the phytoplankton are further concentrated in the bodies of the animals that eat them. This is repeated at each step in the food chain. This process of increasing concentration through the food chain is known as biomagnification.

Dumping of solid wastes

The sight of a dustbin overflowing and the stench rising from it are all too familiar sights and smells of a crowded city.

You look in some other direction and hold your nose as you cross it. Since the beginning, humankind has been generating waste, be it the bones and other parts of animals they slaughter for their food or the wood they cut to make their carts. With the progress of civilization, the waste generated became a more complex issue. At the end of the 19th century the industrial revolution saw the rise of the world of consumers. Not only did the air get more and more polluted but the earth itself became more polluted with the generation of non-biodegradable solid waste. The increase in population and urbanization are largely responsible for the increase in solid waste.

Solid waste means any garbage, trash, waste tire, sludge from a waste treatment plant, water supply treatment plant and other discarded materials, including solid, liquid, semisolid or contained gaseous materials arises from human and animal activities. In other words, solid waste may be defined as the organic and inorganic waste produced by various activities of the society which have lost their value to the first user.

Solid waste, on the basis of its sources of origin can be classified as:

1. Municipal Solid Waste: It consists of household waste; construction and demolition debris, sanitation residue.
2. Hazardous Solid Waste: industrial and hospital waste is considered to be hazardous waste as they contain toxic substances.
3. Infectious Solid Waste: Biomedical or hospital waste generated during diagnosis treatment etc. which include sharp, chemical wastes, discarded medicines and human excreta etc.

In general, solid waste includes garbage, domestic refuse and discarded solid materials such as those from commercial, industrial and agricultural operations. They contain increasing amounts of paper, cardboards, plastics, glass, old construction material, packaging material and toxic or otherwise hazardous substances. Since a significant amount of urban solid waste tends to be paper and food waste, the majority is recyclable or biodegradable in landfills. Similarly, most agricultural waste is recycled and mining waste is left on site.

The portion of solid waste that is hazardous such as oils, battery metals, heavy metals from smelting industries and organic solvents are the ones we have to pay particular attention to. These can in the long run, get deposited to the soils of the surrounding area and pollute them by altering their chemical and biological properties. They also contaminate drinking water aquifer sources. More than 90% of hazardous waste is produced by chemical, petroleum and metal-related industries and small businesses such as dry cleaners and gas stations contribute as well.

Toxic chemicals leached from oozing storage drums into the soil underneath homes, causing an unusually large number of birth defects, cancers and respiratory, nervous and kidney diseases.

Deforestation

Soil Erosion occurs when the weathered soil particles are dislodged and carried away by wind or water. Deforestation, agricultural development, temperature extremes, precipitation including acid rain, and human activities contribute to this erosion. Humans speed up this process by construction, mining, cutting of timber, over cropping and overgrazing. It results in floods and cause soil erosion.

Forests and grasslands are an excellent binding material that keeps the soil intact

Fig-7

and healthy. They support many habitats and ecosystems, which provide innumerable feeding pathways or food chains to all species. Their loss would threaten food chains and the survival of many species. During the past few years quite a lot of vast green land has been converted into deserts. Deforestation is slowly destroying the most productive flora and fauna areas in the world, which also form vast tracts of a very valuable sink for CO2.

Pollution due to urbanization

Pollution of surface soils

Urban activities generate large quantities of city wastes including several

Fig-8

Biodegradable materials (like vegetables, animal wastes, papers, wooden pieces, carcasses, plant twigs, leaves, cloth wastes as well as sweepings) and many non-biodegradable materials (such as plastic bags, plastic bottles, plastic wastes, glass bottles, glass pieces, stone / cement pieces). On a rough estimate Indian cities are producing solid city wastes to the tune of 50,000 - 80,000 metric tons every day. If left uncollected and decomposed, they are a cause of several problems such as:

- Clogging of drains: Causing serious drainage problems including the burst / leakage of drainage lines leading to health problems.
- Barrier to movement of water: Solid wastes have seriously damaged the normal movement of water thus creating problem of inundation, damage to foundation of buildings as well as public health hazards.
- Foul smell: Generated by dumping the wastes at a place.
- Increased microbial activities: Microbial decomposition of organic wastes generate large quantities of methane besides many chemicals to pollute the soil and water flowing on its surface
- When such solid wastes are hospital wastes they create many health problems: As they may have dangerous pathogen within them

besides dangerous medicines, injections.

Pollution of underground Soil

Underground soil in cities is likely to be polluted by

- Chemicals released by industrial wastes and industrial wastes.
- Decomposed and partially decomposed materials of sanitary wastes.

Many dangerous chemicals like cadmium, chromium, lead, arsenic, selenium products are likely to be deposited in underground soil. Similarly underground soil polluted by sanitary wastes generates many harmful chemicals. These can damage the normal activities and ecological balance in the underground soil.

Effects of soil pollution

With luck and the right atmospheric conditions, air and water pollution disperse and disappear. What makes land pollution such a problem is that land is static, so land pollution stays exactly where it is until and unless someone cleans it up. Land that's polluted stays polluted; land that's urbanized almost invariably stays urbanized.

As we know, plastics take hundreds of years to disappear while radiation can contaminate land for ten times longer. That means landfill sites and radioactive waste dumps remain that way pretty much indefinitely.

The simplest effect of land pollution is that it takes land out of circulation. The more land we use up, the less we have remaining. That might not sound a problem where there's plenty of land in rural areas, but it's certainly a concern where productive agricultural land is concerned, especially as the world's population continues to increase.

The biggest problem comes when contaminated land is returned to use, either as building or agricultural land. Houses might be built on brown field (former industrial) sites that haven't been cleaned up properly, putting future owners and their families at risk. Or people might get their water from rivers supplied by groundwater contaminated by landfill sites, mine workings, or otherwise polluted land some distance away.

Illnesses such as cancer develop over years or decades for a variety of reasons and it's extremely difficult to prove that they've been caused by something like local environmental pollution, especially when people move homes during their lifetime. No-one knows how much land is contaminated, how contamination varies from one place to another, or how land contaminants react with one another once they enter water resourses and become water pollution. So the scale of the problem and its ultimate effects are impossible to determine.

However, we do know what effect individual pollutants have. We know, for example, that lead is a toxic heavy metal that has all kinds of unpleasant effects on human health; it's been implicated in developmental deficits (such as reductions in intelligence) in children. We know that

some chemicals are carcinogenic (cancer-causing) while others cause congenital defects such as heart disease.

Thus, effects of soil pollution are vast and these can be summarized into three broad categories as follows:

1. Hazardous chemical entered into the food chain from soil, causes disruption of biochemical process.
2. Soil becomes infertile because of water logging and salinity.
3. Toxic chemicals affect plant growth and animal life.

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

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 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 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.

Control of soil pollution

The following steps have been suggested to control soil pollution. To help prevent soil pollution, we can limit construction in sensitive area. In general we would need less fertilizer and fewer pesticides if we could all adopt the three R's: Reduce, Reuse, and Recycle. This

would give us less solid waste.

Reducing chemical fertilizer and pesticide use

Applying bio-fertilizers and manures can reduce chemical fertilizer and pesticide use. Biological methods of pest control can also reduce the use of pesticides and thereby minimize 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, recycling of one tonne of paper can save 17 trees.

Reforesting

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.

Solid waste management

The solid wastes which are accumulated on the soil will pose a great problem to us. Throwing the wastes in dump yards is not the solution to the problem. For throwing wastes we need enormous land area.

For example in the state of Andhra Pradesh 32 large towns and cities are there. The average per capita solid wastes produced per day is 364 grams. To dispose all the wastes we need an area equal to the size of Hyderabad city(590 sq km) by the year 2012.

Thus, Proper methods should be adopted for management of solid waste disposal. Solid waste management involves activities including collection, transfer and transport to suitable sites, and safe disposal of wastes by methods which are environmentally compatible.

Fig-9 Water recycling

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.

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 combs, 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, may reduce soil pollution.

Anaerobic/aerobic decomposition of biodegradable municipal and domestic waste is also being done and gives organic manure. Cow dung which releases methane into the atmosphere, should be processed further in 'gobar gas plants' to produce 'gobar gas' and good manure.

Bioremediation

Bioremediation means to use a biological remedy to abate or clean up contamination. This makes it different from remedies where contaminated soil or water is removed for chemical treatment or decontamination, incineration, or burial in a landfill. Microbes are often used to remedy environmental problems found in

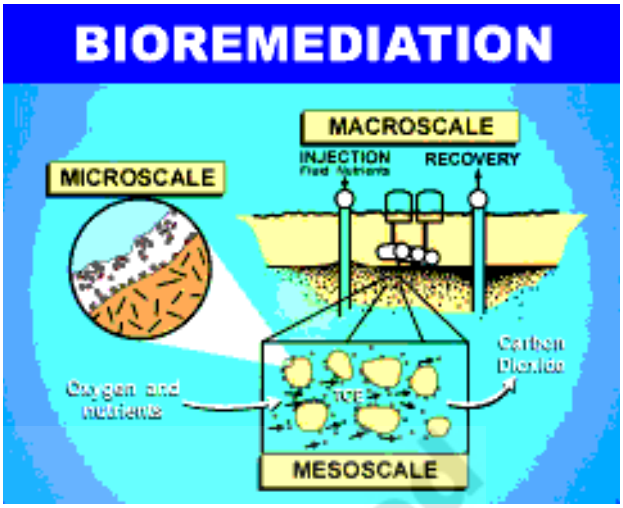


Fig-10 Bio remediation

soil, water, and sediments. Plants have also been used to assist bioremediation processes. This is called phytoremediation. Biological processes have been used for some inorganic materials, like metals, to lower radioactivity and to remediate organic contaminants. With metal contamination the usual challenge is to accumulate the metal into harvestable plant parts, which must then be disposed of in a hazardous waste landfill before or after incineration to reduce the plant to ash. Two exceptions are mercury and selenium, which can be released as volatile elements directly from plants to atmosphere.

Natural land pollution

Land pollution occurs massively during earth quakes, landslides, hurricanes and floods. All cause hard to clean mess, which is expensive to clean, and may sometimes take years to restore the affected area. These kinds of natural disasters are not only a problem in that they cause pollution but also because they leave many victims homeless.

Soil conservation

Soil is one of the most important natural resources. The importance of soil conservation is relatively less talked about as compared to the conservation of water and other natural resources. The almost-omnipresent soil is mostly taken for granted. Its omnipresence is ironically the reason behind us, human beings, taking it for a ride. We rarely even think of it as a natural resource that needs to be conserved, a part of the natural wealth that needs to be preserved. There are several ways possible for soil conservation that can be achieved through agricultural practices and measures that can be taken at home.

Plant trees

We all know that the roots of trees firmly hold on to the soil. As trees grow tall, they also keep rooting deeper into the soil. As the roots of the trees spread deep into the layers of soil, they contribute to the prevention of soil erosion. Soil that is under a vegetative cover has hardly any chance of getting eroded as the vegetative cover acts as a wind barrier as well.

Terraces

Terracing is one of the very good methods of soil conservation. A terrace is a leveled section of a hilly cultivated area. Owing to its unique structure, it prevents the rapid surface runoff of water. Terracing gives the landmass a stepped appearance thus slowing the easy washing down of the soil. Dry stonewalling is a method used to create terraces in which stone structures are created without using mortar for binding.

No-till farming

When soil is prepared for farming by ploughing it, the process is known as tiling. No-till farming is a way of growing crops without disturbing it through tillage. The process of tilling is beneficial in mixing fertilizers in the soil, shaping it into rows and preparing a surface for sowing. But the tilling activity can lead to compaction of soil, loss of organic matter in soil and the death of the organisms in soil. No-till farming is a way to prevent the soil from being affected by these adversities.

Contour ploughing

This practice of farming across the slopes takes into account the slope gradient and the elevation of soil across the slope. It is the method of ploughing across the contour lines of a slope. This method helps in slowing the water runoff and prevents the soil from being washed away along the slope. Contour ploughing also helps in the percolation of water into the soil.

Crop rotation

Some pathogens tend to build up in soil if the same crops are cultivated consecutively. Continuous cultivation of the same crop also leads to an imbalance in the fertility demands of the soil. To prevent these adverse effects from taking place, crop rotation is practiced. It is a method of growing a series of dissimilar crops in an area sequentially. Crop rotation also helps in the improvement of soil structure and fertility.

Soil pH

The contamination of soil by addition of acidic or basic pollutants and acid rains

has an adverse effect on the pH of soil. Soil pH is one of the determinants of the availability of nutrients in soil. The uptake of nutrients in plants is also governed to a certain extent, by the soil pH. The maintenance of the most suitable value of pH, is thus, essential for the conservation of soil.

Water the soil

We water plants, we water the crops, but do we water the soil? If the answer is negative, it is high time we adopt the method of watering soil as a measure of conserving soil. Watering the soil along with the plants is a way to prevent soil erosion caused by wind.

Salinity management

The salinity of soil that is caused by the excessive accumulation of salts has a negative effect on the metabolism of the crops in soil. Salinity of soil is detrimental to the vegetative life in the soil. The death of vegetation is bound to cause soil erosion. Hence, salinity management is one of the indirect ways to conserve soil.

Soil organisms

Organisms like earthworms and others benefiting the soil should be promoted. Earthworms, through aeration of soil, enhance the availability of macronutrients in soil. They also enhance the porosity of soil. The helpful organisms of soil promote its fertility and form an element in the conservation of soil.

Indigenous Crops

Planting of native crops is known to be beneficial for soil conservation. If non-native plants are grown, the fields should be bordered by indigenous crops to prevent soil erosion and achieve soil conservation.

Key words

Parent Material, soil fertility, mycorrhizal, minaralisation, bio degradable waste, non bio degradable waste, soil errosion, bio magnification, bio remediation.

What we have learnt

- Our environment is composed of atmosphere, earth, water and space and the interaction of the atmosphere, lithosphere, hydrosphere and biosphere is continuing for years together.
- Human and animal activities has interfered the composition and complex nature of environment and hence the problem of pollution raised.
- Soil is one of the three major natural resources alongside air and water composed of minerals and organic matter along with air and water. Soil is the most abundant and diverse ecosystem on the earth

- Soil formation is a long and complex process that takes from 100 to 10,000 years and driven by many factors including climate, topography, living organisms and types of parent material.
- Soil properties are classified into three groups, i.e., Physical, chemical and biological properties of the soil.
- Soil fertility is closely associated with soil properties and it is defined as its capacity to hold water and nutrients and supply them to plants when they need them, independent of direct application of nutrients.
- Soil or land pollution can be defined as Soil pollution is defined as the build-up in soils of persistent toxic compounds, chemicals, salts, radioactive materials, or disease causing agents, which have adverse effects on plant growth and animal health.
- Wastes generated from various sources are categorized into biodegradable and non-biodegradable waste.
- Biodegradable material is any organic material that can be broken down by microorganisms into simpler more stable compounds. Most organic wastes like-wood, paper, are biodegradable.
- Materials that cannot be degraded by microbial action are said to be non-biodegradable materials.
- Land pollution is broadly caused by agricultural practices, Industrial wastes, urban activities.
- Biomagnification is the sequence of processes in an ecosystem by which higher concentrations of a particular chemical, such as the pesticide DDT, are reached in organisms higher up the food chain, generally through a series of prey-predator relationships.
- Soil erosion is a natural process. It became a problem due to various human activities causing it to occur much faster than under natural conditions.
- Deforestation, agriculture development, temperature extremes, precipitation including acid rain and human activities contributed to this faster soil erosion.
- Soil pollution leads to an imbalance in ecosystem and is closely associated with air and water pollution. The harmful effects are not seen clearly but reduced crop yield due to reduced soil fertility and loss of soil and nutrients, groundwater pollution, foul smell and public health problems are some of the effects that attract human being to think of this problem.
- There are many ways to control soil pollution which includes, three R's principles: Reduce, Reuse and Recycle, reforesting, proper solid waste management and bioremediation.
- Conservation of soil can be achieved through agricultural practices and measures that can be taken at home.

Improve your learning

1. Define soil pollution. (AS1)
2. Why are plastic bags a big environmental nuisance? (AS 6)
3. Describe an environmental friendly method to profitably dispose off human waste and cattle waste. (AS1)
4. Chemical fertilizers are useful to crops. In which way they cause environmental pollution? (AS1)
5. What steps can be taken to reduce pollution due to particulate matter from industries?
6. What is a medical waste? Why it is called hazardous waste? What is the safe way to dispose medical waste? (AS1)
7. Prepare flow chart to describe soil pollution, causes and methods of control.(AS 5)
8. What soil problems do you find in your area? Prepare a list of those problems and suggest a method for each of them to control those problems.(AS 7)
9. What farm practices impact soil? Do they impact soil in a positive or a negative way?
10. Rank the negative impact practices in your area in the order in which you think they should be eliminated. (AS1)
11. Rank the positive impact practices in order in which you think they should be used for the most benefit on your farm. (AS1)
12. Ravi said soil health is important? How can you support him? (AS 7)
13. How would soil texture affect the nutrients in soil? What would be its impact on crop production? (AS 2)
14. What are the three main physical properties of soil? What effects do this have on the plants? (AS1)
15. What is pH? What is its range? What are the negative impacts if the pH of soil is too low or too high?(AS1)
16. What is soil fertility? What are the sources of soil fertility? (AS1)
17. Name 10 living things that live in soil. What do these things do to affect the soil? (4)
18. What is organic matter? Why it is important to plants? (AS1)
19. What are the factors affecting organic matter levels in soil? How this level of organic matter can be increased? (AS1)
20. What is solid waste? Explain best practices for solid waste management. (AS1)
21. What is bioremediation? How it helps in controlling soil pollution? (AS1)
22. Why soil conservation is important to us? What will happen if no preventive measures would be taken? (AS 2)
23. Look at the following symbol what does its mean.

ANNEXURE

Earthworm

Most farmers are well aware that the presence of earthworms is a sign of fertile soil. But what makes them so valuable? Earthworms fulfill several crucial functions. First, they accelerate the decomposition of plant material on the soil surface by removing dead plant material from the soil surface. During the digestion of organic material, they mix organic and mineral soil particles and build stable crumbs in their excrements, which help improve the soil structure.

Earthworm excrements contain 5 times more nitrogen, 7 times more phosphate, 11 times more potash and 2 times more magnesia and calcium than normal earth. The tunnels created by earthworms promote infiltration and drainage of rainwater and thus contribute to prevention of soil erosion and water-logging.

Dung beetle:

Have you noticed one or two small black, insects rolling a large ball of dung which is larger than their size? There are called dung beetles (Scrab Beatle) Shiny metallic coloured. What do they do with that ball of dung? Dung is their food. They collect the dung makes it a ball and rolls it to a safety place and bury it in soft soil. (Fifty times its own weight)

During breeding season the female lays eggs in dung. The larvae grow by eating dung. They play remarkable role in agriculture. By burying and consuming dung they improve nutrient recycling and soil structure. They also protect the live stock, such as cattle, by removing the dung which, if left could provide habitat for pests/such as flies.

Many countries introduced dung beetle in their country for the benefit of animal husbandry. In Northern Thailand, it is taken as food. Chinese use dried beetles in medicine. The Dung beetles help in reducing green house gas emission from agricultural sector. In Ancient Egypt it is worshipped.

They are found on every continent except Antarctica. These live in habitat that range from forests to deserts. Most prefer the dung of Herbivores. Some eat excreta of omnivores.

They help new trees to grow for us. The seeds which the animals eat pan out undigested. The seeds are buried along with dung. Soon a new tree sprouts.

On a busy might the Dung beetle can bury 250 times its own weight of dung.

The plastic nightmare?

Plastic with its exclusive qualities of being light yet strong and economical has invaded every aspect of our day-to-day life. It has many advantages: it is durable, light, and easy to mould, and can be adapted to different user requirements. Once hailed

as a 'wonder material', plastic is now a serious worldwide environmental and health concern, essentially due to its non-biodegradable nature.

In India, the plastic industry is growing phenomenally. Plastics have use in all sectors of the economy – infrastructure, construction, agriculture, consumer goods, telecommunications, and packaging. But the good news is that along with a growth in the use, a country-wide network for collection of plastic waste through rag pickers, waste collectors and waste dealers and recycling enterprises has sprung all over the country over the last decade or so. More than 50% of the plastic waste generated in the country is recycled and used in the manufacture of various plastic products.

Conventional plastics have been associated with reproductive problems in both wildlife and humans. Studies have shown a decline in human sperm count and quality, genital abnormalities and a rise in the incidence of breast cancer. Dioxin a highly carcinogenic and toxic by-product of the manufacturing process of plastics is one of the chemicals believed to be passed on through breast milk to the nursing infant. Burning of plastics, especially PVC releases this dioxin and also furan into the atmosphere. Thus, conventional plastics, right from their manufacture to their disposal are a major problem to the environment.

Plastics are so versatile in use that their impact on the environment are extremely wide ranging. Careless disposal of plastic bags chokes drains, blocks the porosity of the soil and causes problems for groundwater recharge. Plastic disturbs the soil microbe activity, and once ingested, can kill animals. Plastic bags can also contaminate foodstuffs due to leaching of toxic dyes and transfer of pathogens. In fact, a major portion of the plastic bags i.e. approximately 60-80% of the plastic waste generated in India is collected and segregated to be recycled. The rest remains strewn on the ground, littered around in open drains, or in unmanaged garbage dumps. Though only a small percentage lies strewn, it is this portion that is of concern as it causes extensive damage to the environment.

The plastic industry in the developed world has realized the need of environmentally acceptable modes for recycling plastics wastes and has set out targets and missions. Prominent among such missions are the Plastic Waste Management Institute in Japan, the European Centre for Plastics in Environment, the Plastic Waste Management Task Force in Malaysia. Manufacturers, civic authorities, environmentalists and the public have begun to acknowledge the need for plastics to conform to certain guidelines/standards and code of conduct for its use. Designing eco-friendly, biodegradable plastics are the need of the hour. Though partially biodegradable plastics have been developed and used, completely biodegradable plastics based on renewable starch rather than petrochemicals have only recently been developed and are in the early stages of commercialization.