

Soil Pollution



Our planet consists of atmosphere (air), lithosphere (earth), hydrosphere (water) and biosphere (living organisms) are continuing for years together interacting with each other. 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 deforestation etc. These activities are desirable for human development and welfare but these release unwanted materials into the environment causing an imbalanced that makes our life miserable.

We have learnt about the structure of soil formation and its properties in class VII and also about air and water pollution in previous class VIII. Here we will study about 'Land Pollution'. But before that, let us recall what we have learnt about soil.

We the Indians consider the **earth as our mother**. We get everything for our living from soil. Recall, what you have learnt in class VII.

What is soil?

Air, water and soil are three major natural resources, alongside soil is one of the marvellous products of nature without which there would be no life. It is a natural medium for plants to grow.

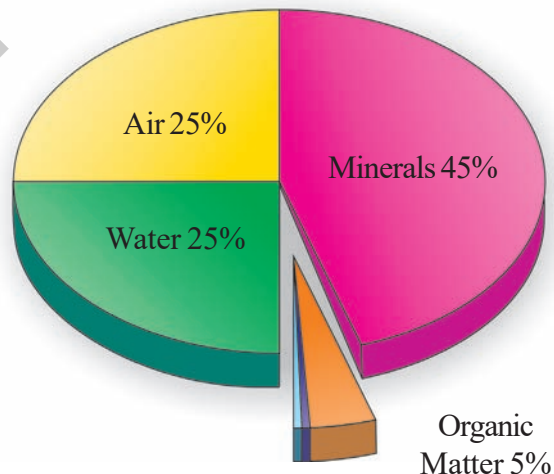


Fig-1 : Components of soil

(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 is a habitat for many

organisms like worms, insects, bacteria etc. and it also supports plant and animal life.

Healthy soil means the soil which produces healthy plants, on eating which animals also remain healthy.

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 the time, the parent materials are weathered by the effects of freezing, thawing, wetting, drying, heating, cooling, erosion, plants, animals and 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 is mainly the parent material.

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 also live 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 know the quality of the soil, we must understand the fundamental properties of it. 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 influence the physical properties of soil including colour, texture, structure and porosity. These properties regulate the air and water movement in the soil and thus affect the ability of soil to functions. Organic matter is the organic component of soil which includes the dead and decaying plants, animals and residues of 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 soils; all other soils are identified as mineral soils. Organic matter in soil improves water infiltration, decreases evaporation, and increases the water holding capacity. The organic matter contains numerous organisms which convert the matter back to nutrients. These organisms help to create a crumb, that is ideal for cultivation. Thus, a natural state of soil is maintained.

(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 to know the type of vegetation that grows in the soil and the type of organisms that 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 that produces various acids in soil. Availability of the nutrients depends on the pH of soil.

The availability of Na, K, Ca, Mg and S tends to decrease with decreasing pH. Weathering and plant uptake also result in removal of these nutrients or decrease in microbial activity which makes soil acidic.

- What happens if the acidic nature and alkalinity of the soil increases?

(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 microscopic Viruses to Earthworms, to large burrowing animals such as rats, gophers (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.

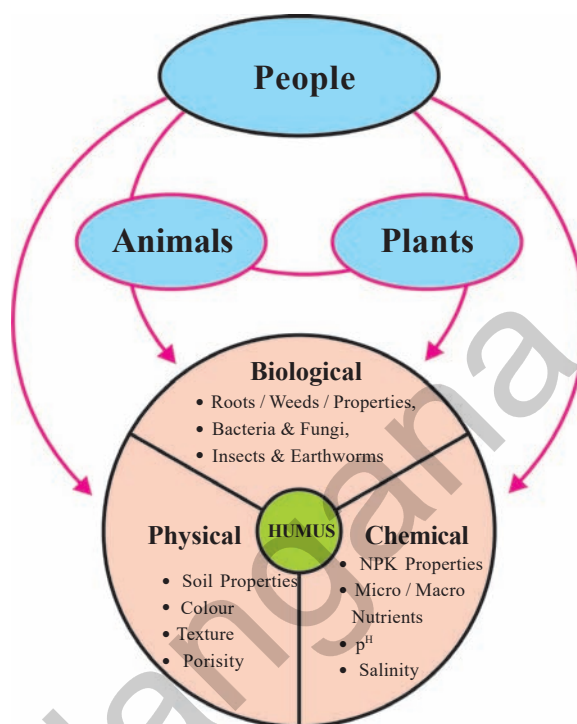


Fig-2 : Properties of soil

Soil microbes also have an influence in controlling the quantities and effects 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 promoting fertility. Soil microbes convert organic forms of elements to their inorganic forms and liberate Carbon dioxide, Ammonium, Sulphate, Phosphates 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 occur. We shall study this in detail in the chapter '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

- How can you say the soil is a fertile one. Discuss with your classmate and write your opinion.

Fertility of soil depends on 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.

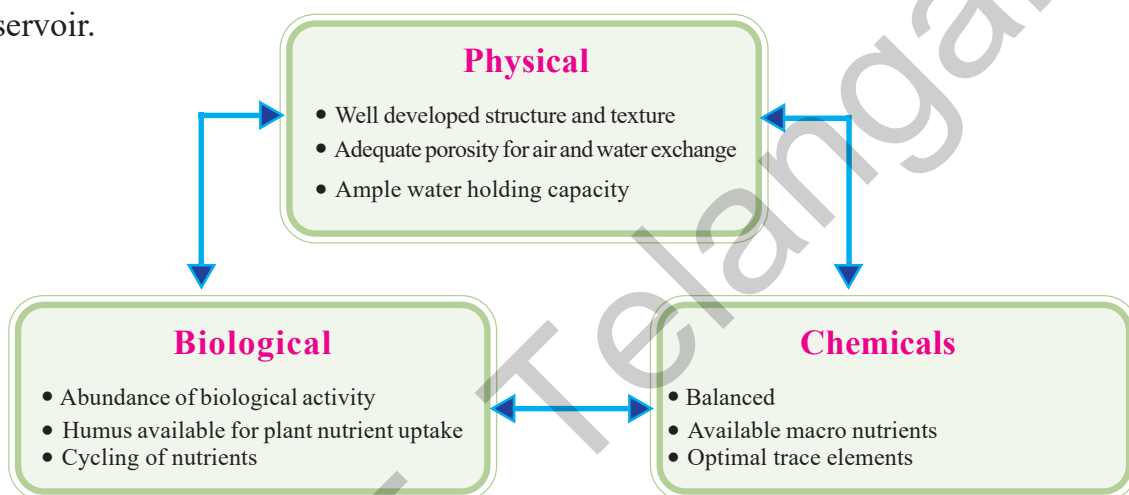


Fig-3 : Fertility of soil

When nutrients are bound in biological or organic form, they are neither lost nor bound to soil particles but they are unavailable to the plants. Therefore, soil fertility can be described in terms of soil organic matter, good living conditions for soil organisms and growing conditions for the roots, the availability of nutrients, water holding capacity and its biological activity of the soil.

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. Soil structure and Mycorrhizal action help to absorb nutrients from the soil and deposit it into soil organic matter thus stabilizing soil structure.

In addition to the above, factors the soil pH, i.e. the acidity or alkalinity, is highly relevant to the availability of nutrients in the soil.

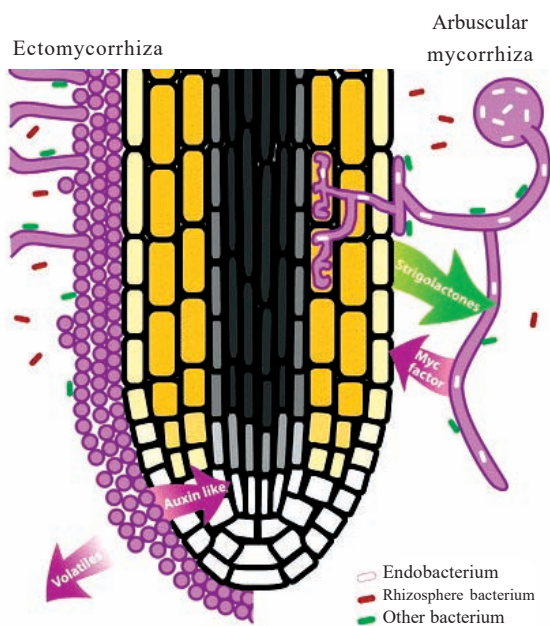


Fig-4 :

Mycorrhiza with soil Bacteria

Proper soil fertility management is very important for successful crop production and farming. Organic farmers regulate soil fertility by protecting the soil and feeding it organic material, thus ensuring quality yield. When the soil is fertile in the organic sense, it can produce good crop yields for several years (You learned about organic farming 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 dumped 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 responsible for producing those wastes.

Activity-1

Let us observe the following situation and fill the table table-1 as per suggestions given.

The incident occurred in the school during the interval Venu ate a fruit. He was about to throw the peel in corner of the varandah. His friend Ramu stopped him in doing so and advised venu to put the peel in the dust bin.

Now let us think, what would happen if you throw the wastes wherever you want?

Table - 1

Prepare a list of waste materials we throw out in a day from morning to evening. Classify them as wet and dry wastes with the help of the example given in the table-1.

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

Weigh the wet wastes produced in a day that you have listed in the table. Divide this total weight by the number of persons live in your house. The result will be the per capita wet wastes produced in a day.

$$\text{Per capita wet wastes produced} = \frac{\text{Total weight of wet waste materials}}{\text{Number of persons in your house}}$$

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 produce in a year.

- Do you know what happens to the waste materials we produce?

Dumping and decomposing

We are producing tonnes of wastes in our daily activities. These are dumped at wherever the vacant place is available in Urban as well as Rural areas. Some of these wastes decomposed but some are not.

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

Let us do the following activity. For this you need to observe more than one month.

Activity-2

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

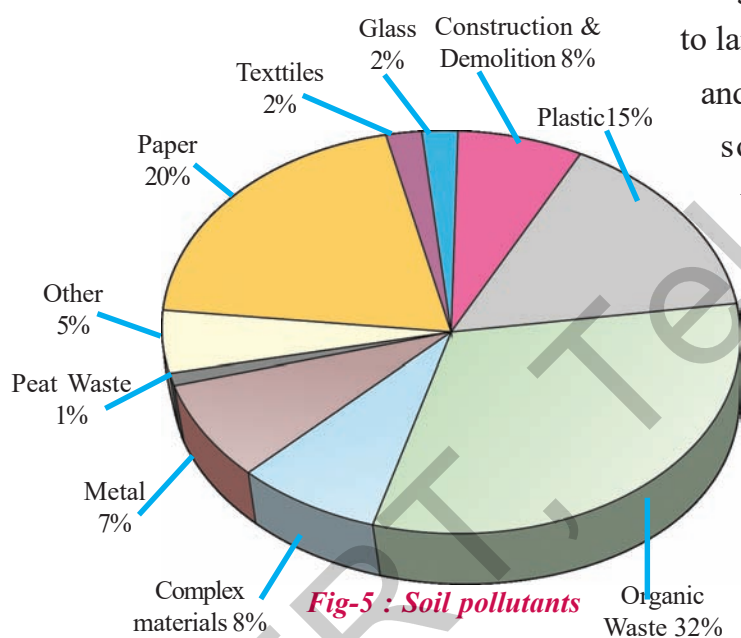
Table - 2

Wastes	1 st fortnight	2 nd fortnight	3 rd fortnight
Vegetable peels			
Vegetable with removed peel			
Banana			
Plastic cup			
Paper			
Rubber			

Take vegetable peel, banana, plastic cup, paper and rubber. Now think, why are some of the waste materials mix with soil quickly while some do not?

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

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



ii) Non-biodegradable waste cannot be easily degraded. Aluminium cans, plastics, glass, chemicals like 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-days 'e-waste' (computers, mobile waste) also leads to soil pollution.

Decomposition is the process of degradation of materials into simpler substances turning them into nutrients and making available to plants. Thus, bio-degradable materials contribute directly to the fertility of the soil. However when there is an excess of bio-degradable material, it creates an imbalance in the nature with negative impact. On the other hand, non-biodegradable materials directly contribute to land pollution due to their abundance and improper waste management. Thus, soil or land pollution can be understood as an addition of substances which adversely affect the quality of soil or its fertility. Polluted water also pollutes soil. Solid waste is a mixture of plastics, cloth, glass, metal, organic matter, sewage, sewage sludge, building debris, generated from households etc., commercial and industrial establishments also 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 the soil as run-off and land filling by municipal waste are growing causes 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 ways by which land pollution can occur. Some 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. Due to atmospheric deposition (air pollution) soil gets contaminated significantly. Soil pollution can be classified into the following categories based on sources:

- 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 intensity of pollution correlates 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 shows an 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, Sulphur 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.

Over usage of NPK fertilizers reduce quantity of vegetables and crops grown on soil over the years. It also reduces the protein content of Wheat, Maize, Pulses 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

We depend on plants for various purposes, but they are under constant 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 use of insecticide began at the end of World War II that included DDT (Dichloro Diphenyl Trichloroethane) and Gammaxene. Insects soon became resistant to DDT as the chemical did not decompose readily, it persisted in the environment.

Since DDT is soluble in fat rather than water, it biomagnified up in 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 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, other most important pesticides are BHC (Benzene Hexa Chloride), Chlorinated di Hydro Carbons, Organo Phosphates, Aldrin, Malathion, Dieldrin, Furodan, etc. The remnants of such pesticides used on pests may get absorbed by the soil particles, which then contaminate crops grown in that soil. The consumption of such crops causes the pesticide 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 pesticides. These may be present in the

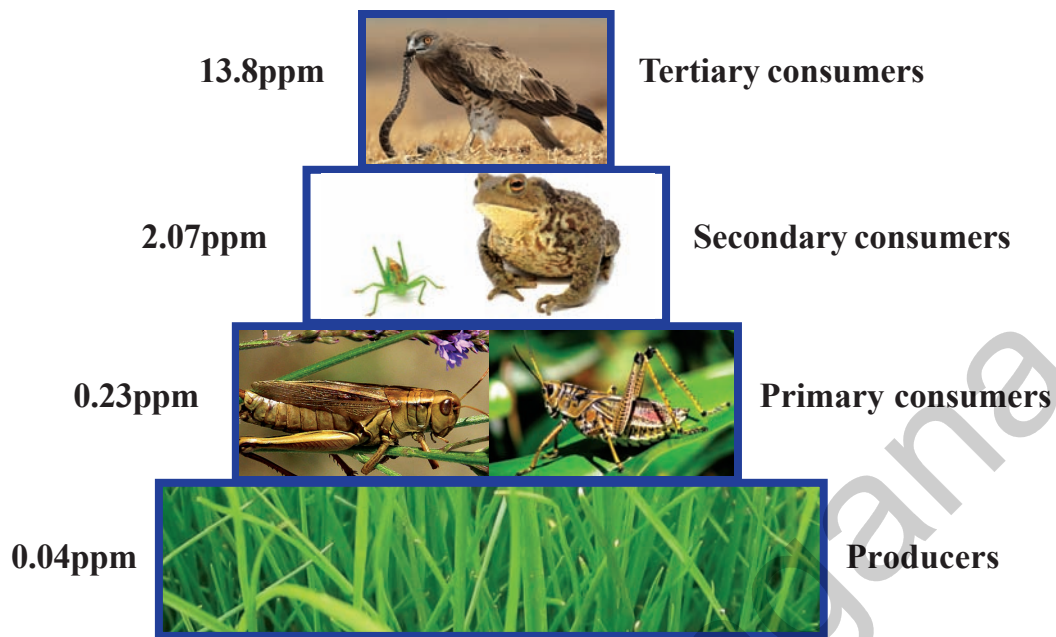


Fig-6 : Biomagnification

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

water at a very low concentrations that they cannot be measured even with 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 or 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 overflowing and the stench rising from dustbin is 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, mankind has been generating waste, from 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 because of the Industrial Revolution there is a rise of the world of consumers. Not only did the air get more and more polluted, but also the Earth 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 tyres, sludge from a waste treatment plant, water supply treatment plant and other discarded materials, including solid, liquid, semisolid or 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 and poisonous waste as they contain toxic substances.
3. **Infectious Solid Waste:** Biomedical or hospital waste generated during diagnosis treatment etc. which include sharp instruments, 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.

We have to pay attention to hazardous solid waste like oils, battery metals, heavy metals from smelting industries and organic solvents. 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 business such as dry cleaners and gas stations contribute as well.

Toxic chemicals leached from oozing storage drums into the soil underneath homes, cause 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 land 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 soil erosion.

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



Fig-7 : People cutting trees

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 : Waste dump

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 tonnes 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
- **Hospital wastes create many health problems:** They may have dangerous pathogens besides dangerous medicines and injections.

Pollution of underground Soil

Underground soil in cities is likely to be polluted by

- Chemicals released by 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

Luckily, when right atmospheric conditions arrive, air and water pollutions can get reduced at great extent. But in case of land pollution unless some removes the pollutants, soil can't be restored. Land that's polluted stays polluted; land that's urbanized almost invariably stays urbanized.

As we know, plastics take hundreds of years to degrade 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 for building or for agriculture. Houses might be built on brown field (former industrial land), the 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 resources 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 chemicals enter into the food chain from soil and causes disruption of biochemical process.
2. Soil becomes infertile because of water logging and salinity.
3. Toxic chemicals affect plant growth and animal life.

Effects of Agricultural wastes

- 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

Effects of Industrial wastes

- Dangerous chemicals entering underground water
- Ecological imbalance
- Release of poisonous and hazardous gases
- Release of radioactive rays causing health problems
- Increased salinity in the soil.
- Reduced vegetation

Effects in Urban areas

- Clogging of drains
- Inundation of areas
- Public health problems

- Pollution of drinking water sources
- Foul smell and release of gases
- Waste management problems

Long term effects of soil pollution on the Environment

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 crops, because the chemicals can leach into the food and harm people who eat it.

If contaminated soil is used to grow food crops, 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 prey. 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 four (4Rs) "R": Reduce, Reuse, Recover and Recycle. This would give us less solid waste.

Reducing chemical fertilizers 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.

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 be recycled. This decreases the volume of refuse and helps in the conservation of natural resources. For example, recycling of one ton of paper can save 17 trees.

Reforestation / Recovery of materials

Control of land loss and soil erosion can be attempted through restoring forests and grass cover. 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.

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 2021.

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.

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



Fig-9 : Waste Management

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.

The Pyrolysis is a process of combustion in the 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 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

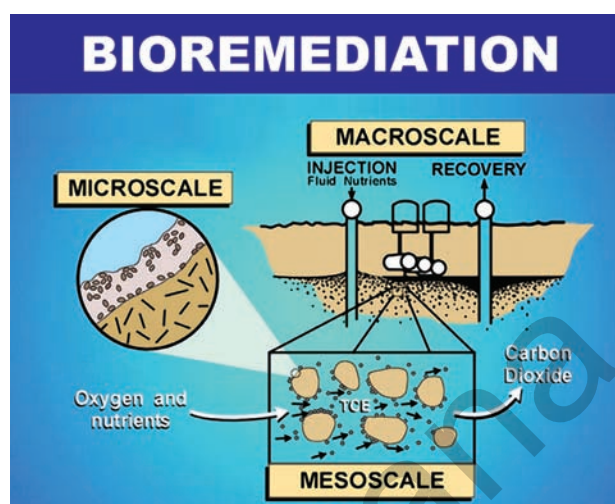


Fig-10 : Bioremediation

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 off 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 mass, 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 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 tilling.

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 fertility.

Watering the soil

We water plants, we water the crops, but do we water the soil? If the answer is no, 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

Soil pollution, Organic soil, mycorrhiza, mineralisation, biodegradable waste, non biodegradable waste, biomagnification, bioremediation, Incineration, Pyrolysis, Phytoremediation, bioaccumulation.



What we have learnt?

- Our environment is composed of air, earth, water and space and the interaction of the atmosphere, lithosphere, hydrosphere and biosphere is continuing for years together.
- Human and animal activities have 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 and 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 soil pollution.
- 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, four "R" : Reduce, Reuse, Recover and Recycle and reforestation, proper solid waste management and bioremediation.



Improve your learning



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



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. 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 magnesium 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?

They are called dung beetles (Scrab Beetle) 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 boring 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 used 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. They live in habitat that range from forests to deserts. Most of them prefer the dung of Herbivores. Some eat excreta of omnivores.

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

On a busy night 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 us. 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.