

**SHREE H. N. SHUKLA INSTITUTE OF  
PHARMACEUTICAL EDUCATION AND  
RESEARCH**



**B.PHRAM**

(SEMESTER –II)

**SUBJECT NAME: ENVIRONMENTAL SCIENCES**

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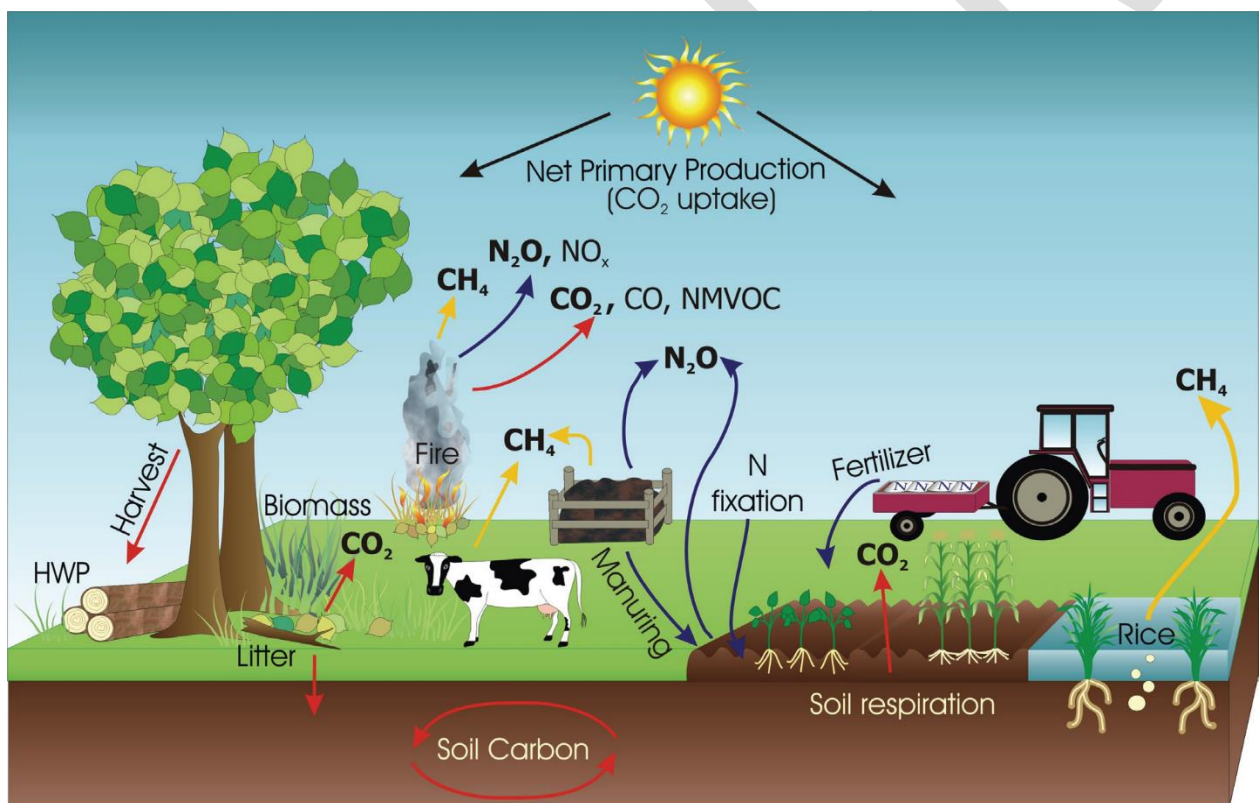
**CHAPTER 1: ENVIRONMENTAL POLLUTION: AIR POLLUTION: WATER  
POLLUTION;SOIL POLLUTION**

## Environmental Pollution

**Environmental Pollution** is defined as any undesirable change in the physical, chemical, or biological characteristics of any component of the **environment** (air,water,soil)which can cause harmful effects on various forms of property.

The combustion of fossil fuels pollutes the air, the soil and the water with noxious gases such as CO<sub>2</sub> and CO. Agricultural waste: Fertilizers and pesticides used in agriculture are key causes of **environmental pollution**.

## BRIDGE



**What is environmental pollution in easy language?**

**Pollution** is when some harmful substances are added in the **environment** which alter its natural composition. **Polluted** water or garbage in the water bodies is a type of **pollution**. It adds germs and viruses. ... When people use these alternative forms of energy, they put less carbon dioxide into the **environment**.

**Causes of environmental pollution**

The **causes of environmental pollution** are many, including oil, air **pollution**, and soil erosion. Soil erosion is another **factor** that can **cause environmental pollution**. Through soil erosion, silt is transported to water bodies, making water unclean for human consumption.

## **Air Pollution**

### **What is Air Pollution?**

Air pollution is caused by solid and liquid particles and certain gases that are suspended in the air. These particles and gases can come from car and truck exhaust, factories, dust, pollen, mold spores, volcanoes and wildfires. The solid and liquid particles suspended in our air are called aerosols.

**Definition :** An undesirable change in the physical, chemical and biological characteristics of air that can cause harmful effects on humans and other living organisms is called air pollution. Some of the air pollutants include particulate pollutants such as dust particles, aerosols, smoke etc. and gaseous pollutants such as carbon monoxide, nitrogen dioxide, sulfur dioxide etc.

Air pollution happens when solid and liquid particles—called **aerosols**—and certain gases end up in our air. These particles and gases can be bad for the planet and for our health.

### **Where do aerosols come from?**

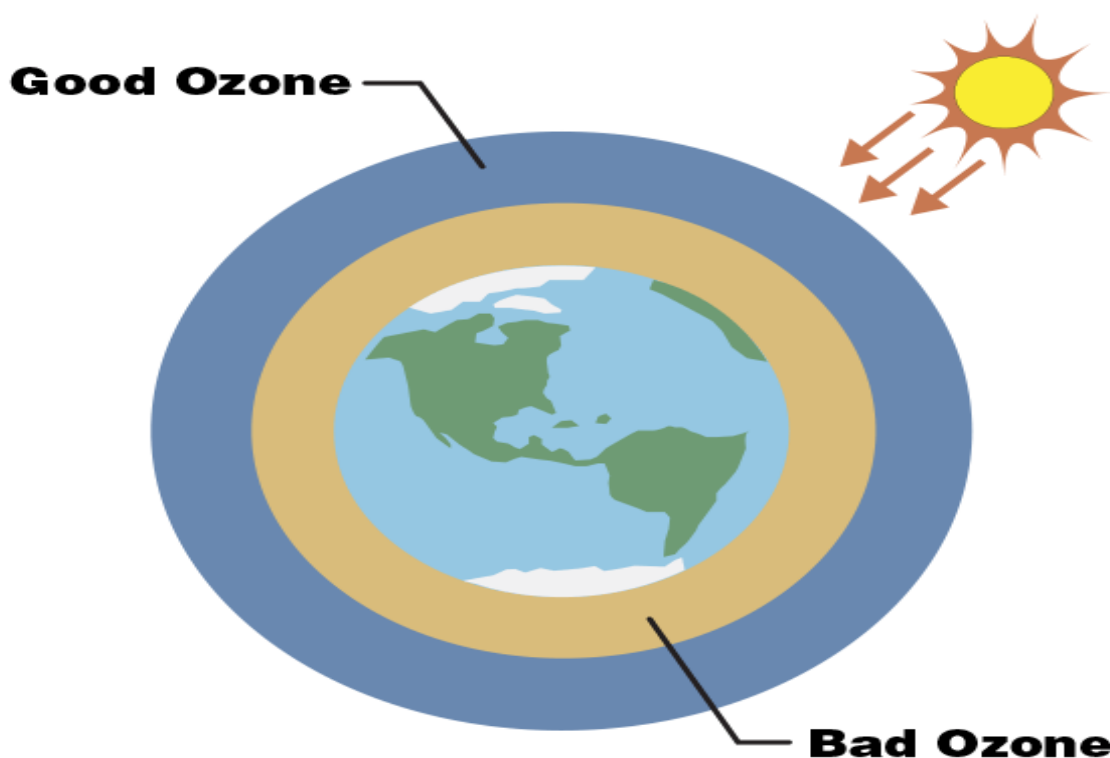
Any particle that gets picked up into the air or is formed from chemical reactions in the air can be an aerosol. Many aerosols enter the atmosphere when we burn fossil fuels—such as coal and petroleum—and wood. These particles can come from many sources, including car exhaust, factories and even wildfires. Some of the particles and gases come directly from these sources, but others form through chemical reactions in the air.

Aerosols can come from other places, too, such as ash from an erupting volcano. Dust, pollen from plants and mold spores are also examples of aerosols.

### **What else causes air pollution?**

Certain gases in the atmosphere can cause air pollution. For example, in cities, a gas called **ozone** is a major cause of air pollution. Ozone is also a greenhouse gas that can be both

good and bad for our environment. It all depends where it is in Earth's **atmosphere**.



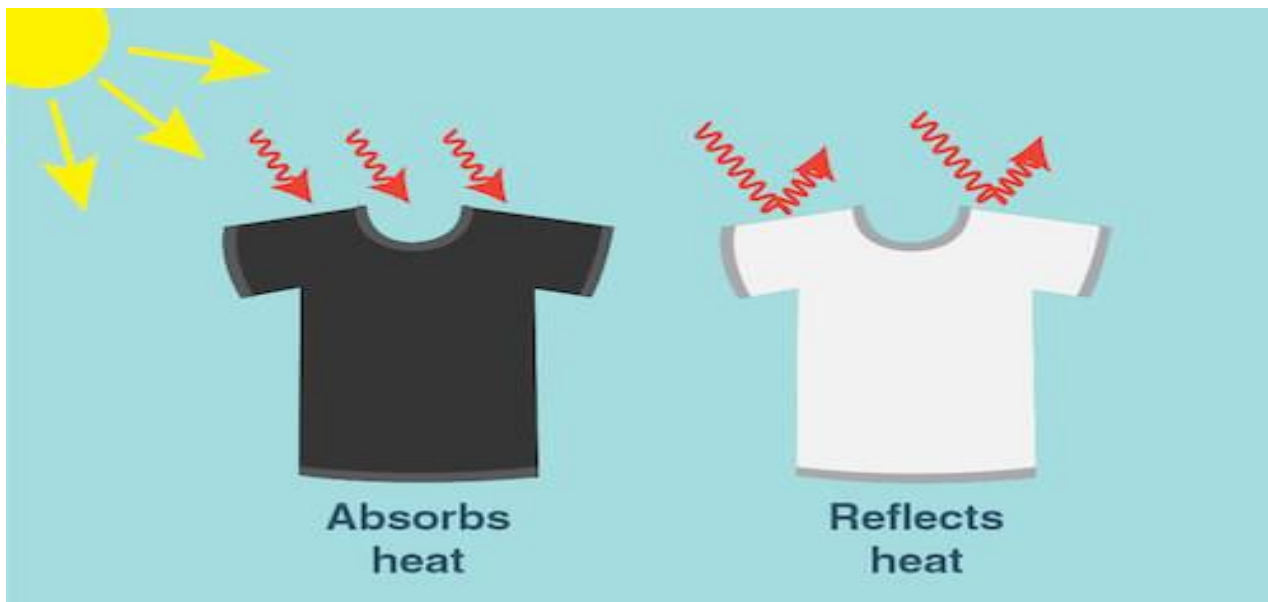
Ozone high up in our atmosphere is a good thing. It helps block harmful energy from the Sun, called **radiation**. But, when ozone is closer to the ground, it can be really bad for our health. Ground level ozone is created when sunlight reacts with certain chemicals that come from sources of burning fossil fuels, such as factories or car exhaust.



When particles in the air combine with ozone, they create smog. **Smog** is a type of air pollution that looks like smoky fog and makes it difficult to see.

**How does air pollution affect Earth's climate?**

Aerosols can impact how the Sun's light hits Earth. For example, some aerosols reflect sunlight while others absorb sunlight. It depends on the color of the particle.



**BRIDGE:** Dark surfaces—whether it's a black t-shirt or a dark particle in the atmosphere—absorb the Sun's heat. Lighter-colored surfaces reflect heat from the Sun.

A white t-shirt reflects the Sun on a hot day, making you feel cooler. In the same way, light-colored particles that reflect the Sun's light and heat away from Earth can make the global temperature cooler. Dark-colored particles that absorb the Sun's light can make the global temperature warmer.

**How does air pollution affect our health?**

Breathing in polluted air can be very bad for our health. Long-term exposure to air pollution has been associated with diseases of the heart and lungs, cancers and other health problems. That's why it's important for us to monitor air pollution.

## Water pollution



### What is Water Pollution?

Water pollution is the contamination of water bodies, usually as a result of human activities. Water bodies include for example lakes, rivers, oceans, aquifers and groundwater. Water pollution results when contaminants are introduced into the natural environment.

### Sources of Water Pollution

Some of the most commonly occurring water pollutants are

- Domestic Waste
- Industrial effluents
- Insecticides and pesticides
- Detergents and Fertilizers

Some of the water pollution that is caused is by *Direct Sources*, such as factories, waste management facilities. Refineries etc, that directly release waste and harmful by-products into the nearest water source without treating them. *Indirect sources* include pollutants that enter the water bodies via groundwater or soil or via the atmosphere as acid rain.

### Effects of Pollution of Water

1. Diseases: In humans, drinking or consuming polluted water in any way has many disastrous effects on our health. It causes typhoid, cholera, hepatitis and various other diseases.

2. Destruction of Ecosystems: Ecosystems are extremely dynamic and respond to even small changes in the environment. Water pollution can cause an entire ecosystem to collapse if left unchecked.
3. Eutrophication: Chemicals in a water body, encourage the growth of algae. These algae form a layer on top of the pond or lake. Bacteria feed on this algae and this decreases the amount of oxygen in the water body, severely affecting the aquatic life there.
4. Effects the food chain: Disruption in food chains happens when toxins and pollutants in the water are consumed by aquatic animals (fish, shellfish etc) which are then consumed by humans.

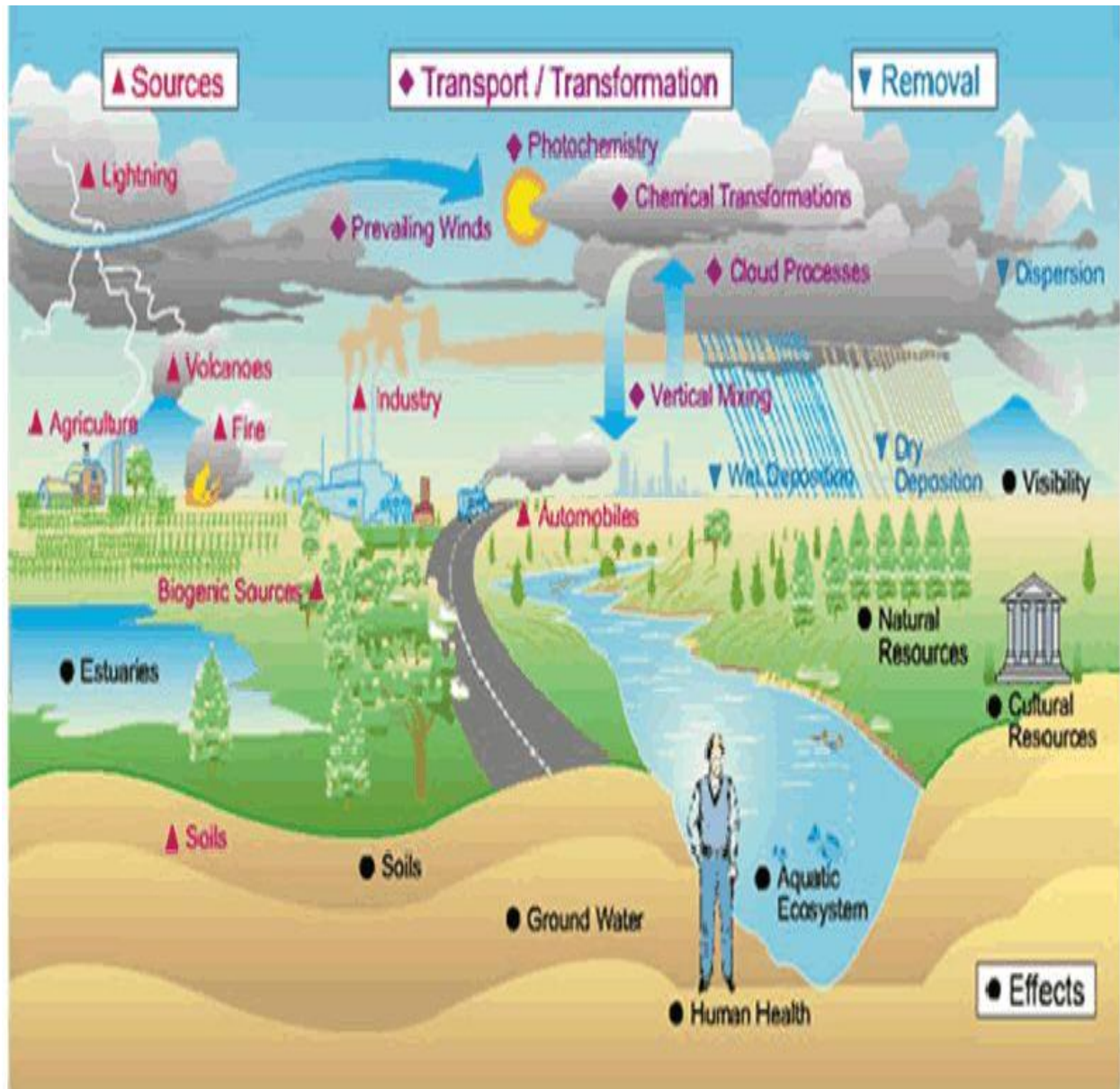
### Prevention

The best way to prevent large-scale water pollution is to try and reduce its harmful effects. There are various small changes we can make to protect ourselves from a scary future where water is scarce.

1. Save Water: Conserving water is our first aim. Water wastage is a major problem globally and we are only now waking up to the issue. Simply small changes you can make domestically will make a huge difference.
2. Better treatment of sewage: So treating waste products before disposing of it in a water body helps reduce water pollution on a large scale. Agriculture or other industries can reuse this wastewater by reducing its toxic contents.
3. Use environmentally friendly products: By using soluble products that do not go on to become pollutants, we can reduce the amount of water pollution caused by a household.

## SOIL POLLUTION

## BRIDGE

**What is soil pollution?**

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.

There are many different ways that soil can become polluted, such as:



- Seepage from a landfill
- Discharge of industrial waste into the soil
- Percolation of contaminated water into the soil
- Rupture of underground storage tanks
- Excess application of pesticides, herbicides or fertilizer
- Solid waste seepage

the most common chemicals involved in causing soil pollution are:

- Petroleum hydrocarbons
- Heavy metals
- Pesticides
- Solvents

#### **Inorganic toxic compounds**

- Inorganic residues in industrial waste cause serious problems as regards their disposal. They contain metals which have high potential for toxicity. Industrial activity also emits large amounts of arsenic fluorides and sulphur dioxide (SO<sub>2</sub>)
- Fluorides are found in the atmosphere from superphosphate, phosphoric acid, aluminium, steel and ceramic industries.
- Sulphur dioxide emitted by factories and thermal plants may make soils very acidic. These metals cause leaf injury and destroy vegetation.
- Copper, mercury, cadmium, lead, nickel, arsenic are the elements which can accumulate in the soil, if they get entry either through sewage, industrial waste or mine washings. Some of the fungicides containing copper and mercury also add to soil pollution.
- Smokes from automobiles contain lead which gets adsorbed by soil particles and is toxic to plants. The toxicity can be minimized by building up soil organic matter, adding lime to soils and keeping the soil alkaline .

#### **Sewage and sewage sludge**

Soil pollution is often caused by the uncontrolled disposal of sewage and other liquid wastes resulting from domestic uses of water, industrial wastes containing a variety of pollutants, agricultural effluents from animal husbandry and drainage of irrigation water and urban runoff [9-10]. Irrigation with sewage water causes profound changes in the irrigated soils. Amongst

various changes that are brought about in the soil as an outlet of sewage irrigation include physical changes like leaching, changes in humus content, and porosity etc., chemical changes like soil reaction, base exchange status, salinity, quantity and availability of nutrients like nitrogen, potash, phosphorus, etc. Sewage sludges pollute the soil by accumulating the metals like lead, nickel, zinc, cadmium, etc. This may lead to the phytotoxicity of plants.

### Heavy metal pollutants

Heavy metals are elements having a density greater than five in their elemental form. They mostly find specific absorption sites in the soil where they are retained very strongly either on the inorganic or organic colloids. They are widely distributed in the environment, soils, plants, animals and in their tissues. These are essential for plants and animals in trace amounts. Mainly urban and industrial aerosols, combustion of fuels, liquid and solid from animals and human beings, mining wastes, industrial and agricultural chemicals etc. are contributing heavy metal pollution. Heavy metals are present in all uncontaminated soils as the result of weathering from their parent materials. Concentration of heavy metals in soils.

### Types of soil pollution

1. Agricultural Soil Pollution
2. pollution of surface soil
3. pollution of underground soil
4. Soil pollution by industrial effluents and solid wastes
5. disturbances in soil profile
6. Pollution due to urban activities

### Sources of soil pollution

1. Agricultural sources
2. non-agricultural sources.

### Agricultural sources

Soil pollution comes from different sources including agriculture and animal husbandry. Some of the agricultural practices lead to soil pollution. They are animal wastes, use of long lived pesticides, herbicides, fungicides, nematocides, etc. fertilizers and some agricultural practices.

### Non-agricultural sources

Soil pollution by non-agricultural sources is usually the direct result of urban sprawl caused by rapidly increasing population and a rapidly per capita output of waste related to our modern way of life. Its materials that find their entry into the soil system have long persistence and accumulate in toxic concentration and thus become sources of pollution. Some of those most important soil pollutants are inorganic toxic compounds.

### Effects of soil pollution

1. Agricultural
2. Reduced soil fertility
3. Reduced nitrogen fixation
4. Increased erodibility
5. Larger loss of soil and nutrients
6. Deposition of silt in tanks and reservoirs
7. Reduced crop yield
8. Imbalance in soil fauna and flora
9. Industrial
10. Dangerous chemicals entering underground water
11. Ecological imbalance
12. Release of pollutant gases
13. Release of radioactive rays causing health problems
14. Increased salinity
15. Reduced vegetation
16. Urban
17. Clogging of drains
18. Inundation of areas
19. Public health problems
20. Pollution of drinking water sources
21. Foul smell and release of gases
22. Waste management problems
23. Environmental
24. Soil becomes unavailable to grow food

If contaminated soil is used to grow food, the land will usually produce lower yields

Can cause even more harm because a lack of plants on the soil will cause more erosion

The pollutants will change the makeup of the soil and the types of microorganisms that will live in it.

### Control of soil pollution

The following steps have been suggested to control soil pollution. To help prevent soil erosion, 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.

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### **Extraction and separation techniques**

In solvent extraction, the contaminated & oil is mixed with an extracting agent in general (an aqueous solution but preferably an organic solvent). Potential applications include the removal of metals such as cadmium, copper, zinc, nickel, chromium, arsenic, antimony and lead using a mineral solution, zinc lead, organo-metallic compounds and some cyanides using sodium hydroxide solution. Hydrocarbons and halogenated hydrocarbons can also be removed [21]. Contamination is often preferentially present in the finer or coarser fraction of the soil or the organic components (ex. humus), contamination can therefore, be removed in some cases using a process which separates the soil into fractions on the basis of specific gravity or particle size or settling velocity.

### **Thermal methods**

In thermal methods, there are two ways of heat treatment; removal of contaminants by evaporation either by direct heat transfer from heated air or an open flame or by indirect heat transfer, and destruction of the contaminants directly or indirectly at an appropriate temperature. The gas leaving the heating appliance must be treated to destroy or remove any contaminants or unwanted products of combustion. A related process is steam stripping in which steam is injected into soil to aid evaporation of relatively volatile contaminants which may be water soluble or insoluble.

### **Chemical methods**

Treatment of the soil in suspension in a suitable liquid and without sludging is the two possible methods. In these, intimate, contact between soil and chemical is essential and should be frequently done so that the process of detoxification is complete.

### **Microbial treatment methods**

The microbial treatment methods appear to be more promising which can deal with whole range of organic contaminants including phenol, polychlorinated hydrocarbons, oil and oil products, dioxins, etc. There are two different ways of approaching the problems.

A community of microbes already existing on the site is collected and cultured in the laboratory. Strains of microbes are developed in the laboratory that is capable of metabolizing particular chemicals.

Excavation of the soil prior to treatment offers the greatest scope for creating optimum conditions. The excavated soil can be placed on thin layers to various depth using standard earth moving techniques and microbes and nutrients applied using standard agricultural techniques such as fertilizing, ploughing, harrowing, etc.

### **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, recovery of one tonne of paper can save 17 trees.

**Reforestation**

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 treatment**

Proper methods should be adopted for management of solid waste disposal. 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.