

## UNIT – 5

# ENVIRONMENTAL POLLUTION

### Lesson Structure

- 5•0 Objective**
- 5•1 Introduction**
- 5•2 Definition and Classification of Pollutants**
- 5•3 Types of Pollution**
- 5•4 (i) Sources, Effects and Control Measures of Air Pollution**  
**(ii) Sources, Effects and Control measures of Water**  
**Pollutions**  
**(iii) Sources, Effects and Control Measures of Soil Pollution**
- 5•5 Noise Pollution : Sources and Consequences**
- 5•6 Radiation Pollution and Nuclear Hazards**
- 5•7 Role of Individuals in Preventing Pollution**
- 5•8 Summary**
- 5•9 Questions for Exercise**
- 5•8 Suggested Reading**

### **5.0 Objective:**

After going through this lesson you will be acquainted with

- 1 The Meaning and definition of Pollutants and Pollution.
- 1 Different types of pollution–Air, Water, Soil, Noise and Radiation pollution.
- 1 Sources of different types of pollution, their effect on human beings and other life forms of biosphere, and different measure which can be taken for effective control of pollution.
- 1 The role an individual and the community can play in preventing and controlling pollution.

### **5.1 Introduction:**

“Environment includes water, air and land and the inter-relationship which exists among and between water, air and land, and human beings, other living creatures, plants, micro-organisms and property.” [EPA-1986]

A solid, liquid or gaseous substance present in the biosphere in such concentrations that may be, or tend to be injurious to living and non-living components of the environment is termed as environmental pollutant.

Any undesirable change in the physical, chemical or biological segments of the biosphere caused by excessive accumulation of pollutants that is harmful to humans, other biological species and /or abiotic components of the environment is termed as **environmental pollution**.

Pollution may be of air, water and soil. Excessive loud sound and sources emitting harmful radiation are also injurious to humans, other life forms and/or physical components of the environment. They are termed as noise pollution and radiation pollution respectively.

Pollution adversely affects us by harming our physical and mental health and by damaging our agricultural and industrial processes, living conditions, physical environment and cultural assets. It may cause short term or long term, temporary or permanent damage. Pollution may harm an individual, engulf an entire community or affect the population of a region.

Pollution may be caused by natural processes as well as human activities (called anthropogenic sources). Natural processes include volcanic eruptions, forest fires, dust storms, land slides, floods etc. man-made pollution is the outcome of greed for short term economic gains achieved at the cost of long term ecological benefits. First, growth in world population, large scale industrializations, expanding urbanization, increasing mining activities and agricultural practices leading to unprecedented deforestation, and automobile transportation are the major causes of anthropogenic pollution. It may be noted that the harm inflicted by natural causes is insignificant as compared to man-made causes as natural causes don't stay long in the biosphere and are mostly localized.

As the things stand today air, water, and soil-the three life support systems of nature are gradually becoming unfit for human use and for other life forms on the earth.

Some 45 years ago, the governments of industrialized nations released the negative impacts of human activities on the environment and genuinely felt the urgency to build up pollution prevention and control strategy.

For the last 4-5 decades numerous conferences, summits etc on the status of world environment have been organized in different countries of the world and a few treaties to control causes of pollution, including ozone layer depletion have been signed. Simultaneously standards have been set for pollution levels of different pollutants, and various devices / methods have been designed / developed for prevention and control of pollutants of air, water and soil, and highly hazardous nuclear materials.

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## **5.2 Definition and Classification of Pollutants :**

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**Definition :** As has been mentioned in section 5.1 above "A solid, liquid or gaseous substance present in the biosphere in such concentrations that may be or tend to be injurious to living and non living components of the environment is termed as environmental pollutant."

### **Classification of Pollutants :**

Different types of pollutants have been classified under the following four headings :

#### **(i) Biodegradable and Nonbiodegradable pollution :**

On the basis of whether a particular pollutant can be degraded by microbes or not, pollutants have been classified into the following two categories :

**Biodegradable Pollutants :** The pollutants which can be degraded into simpler non-toxic substances by the action of micro-organisms are called biodegradable pollutants. They consist mainly of organic matter. Domestic garbage trash paper, garden litter, cotton items, plant, crop and vegetable residues, animal dung, human excreta, organic components of sewage, sludge, dead and decaying remains of animals and plants are all biodegradable pollutants which are degraded in due course under the action of micro-organisms when left upon in air. When bio-decomposed they end up as manure.

**Non-biodegradable-Pollutants :** The pollutants which cannot be degraded into simpler substances by microbes and remain in their original form in the biosphere for a pretty long duration are termed as non-biodegradable pollutants.

These pollutants are mainly inorganic substances and organic polymers. Among organic polymers, plastics are the most notorious non-biodegradable pollutants. Other examples of organic non biodegradable pollutants are synthetic pesticides, synthetic fibres, synthetic rubber, aromatic hydrocarbons etc. Toxic metals like mercury lead, tin, arsenic and coal ash are common examples of non-biodegradable inorganic pollutants.

**(ii) Primary and Secondary Pollutants :**

On the basis of their origin in the environment, pollutants (especially air pollutants) are put into the following two broad categories :

**Primary Pollutants :** The pollutants such as carbon monoxide, hydrocarbons, sulphur dioxide etc which enter the environment directly from various sources (natural or anthropogenic) are termed as primary pollutants.

**Secondary Pollutants :** The pollutants which are formed by chemical interactions between primary pollutants themselves or between primary pollutants and atmospheric gases are termed as secondary pollutants. Nitric acid and Peroxy Acetyl Nitrate (PAN) are some common examples of secondary pollutants.

**(iii) Point Source and Non Point Source Pollutants :**

Based on whether the source of pollutants (especially water pollutant) is readily identified or not, pollutants are categorised into the following two types :

**Point Source Pollutants :** The pollutants whose source can be readily identified because they have defined source and place from where they enter the environment are termed as point source pollutants. Municipal solid waste, industrial effluents, sewer effluents etc. are the examples of point source pollutants.

**Not Point Source Pollutants :** The pollutants whose source cannot be readily identified are called nonpoint source pollutants. Agricultural run-off, acid rain etc are the examples of nonpoint source pollutants.

**(iv) Solid, liquid and Gaseous Pollutants**

On the basis of their physical state, pollutants are classified as solid, liquid and gaseous pollutants.

**Solid Pollutants :** Solid Pollutants originate from solid wastes such as mining wastes, agricultural wastes, industrial wastes, food processing wastes, commercial wastes, municipal wastes etc.

**Liquid Pollutants :** Liquid Pollutants originate from various industries, sewerage and waste water from kitchens and toilets and agricultural run off containing; toxic pesticides, insecticides and herbicides.

**Gaseous Pollutants :** Gaseous pollutants and air pollutants may be taken as synonyms as almost all the air pollutants are gaseous in nature. Many chemical industries, metallurgical turnacer and chimneys, fertilizer and medicine industries generate various gases, smoke and fumes most of which are toxic in nature. The gaseous pollutants include oxides of sulphur, oxides of nitrogen, hydrogen sulphides, ammonia, carbon monoxide, chlorofluoro carbons etc.

### **5.3 Types of Pollution :**

Various types of pollution may be placed under the following categories :

- |                   |                       |
|-------------------|-----------------------|
| ∩ Air Pollution   | ∩ Noise Pollution     |
| ∩ Water Pollution | ∩ Radiation Pollution |
| ∩ Soil Pollution  | ∩ Thermal Pollution   |

#### **Air Pollution**

Air pollution may be defined as the entry and presence of undesirable solid particulate matter, liquids and gases in the atmosphere of a level that causes harm to living and non living components of the environment. An average man inhales 16 kg air per day which is nearly 16 to 20 times greater than the amount of food he eats. So air pollutants, even in very small quantities, become more significant compared to similar levels in food. Oxides of carbon (carbon mono oxide and carbon dioxide), oxides of sulphur and oxides of nitrogen, hydrocarbons and suspended particulate matter (SPM) are the major pollutants of air, which together contribute to about 90 percents of the global air pollution. Burning of fossil fuel (coal, diesel and petrol) has always been a major source of air pollutants. The problems related to air pollution began to show its ill effects particularly in urban areas of Europe in the beginning of 20th century with the development of transport systems and large scale use of fossil fuels (petrol and diesel) for driving transport automobiles.

#### **Water Pollution**

Water pollution may be defined, as the presence of undesirable substances (organic, inorganic biological or radioactive in wather or alteration in such physical factors as heat and pH (acidity/ alkalinity) which make it unfit and harmful for use by man, animals and aquatic life.

Water pollution can be described under two broad headings : They are fresh water pollution and Marine pollution.

**Freshwater Pollution :** It is rightly said that ‘water is life’. Everything is originated from water, and everything is sustained by water.”–**Groeche**

Clean (fresh) water is an essential requirement for the sustenance and good health of both terrestrial as well as aquatic life. It is the habitat for vast number and varieties of aquatic creatures. Water is the medium for various life processes. Freshwater as a natural resource has influence on almost every aspect of development including agricultural production and industrial growth.

Water is an amazing solvent capable of dissolving or suspending various kinds of substance both natural as well as man-made. Because of this property, water gets easily contaminated.

In the present age of technology and industrialization, due to various activities of humans most of water bodies are highly polluted. Consumption of contaminated water is the cause of various diseases of human and animals throughout the world. In fact pollution of fresh water resources is one of the most serious environmental problems of the entire world.

### **Marine Pollution**

In the modern times human activities have not spared even seas oceans and estuaries from being polluted. Oceans and seas are being used as endless dustbin for wastes. For industries located in coastal regions, seas and oceans are used as a convenient dumping ground for wastes of all kinds, most of which are toxic in nature. Millions of tones of wastes have already been dumped into seas and oceans. Despite their vast stretches, seas and oceans are reeling under the reckless attack of human activities of varied nature. Oil pollution of the seas and oceans has increased over the years due to oil losses during offshore explorations and extraction of oil, leakage from underground pipelines and oil spills from cargo oil tankes in the oceans and estuaries.

### **Soil Pollution**

Soil pollution is defined as decrease in soil quality and soil productivity because of the presence of various toxic chemicals in the soil from different sources and human activities.

Like air and water, soil is one of the precious natural resources. Healthy and productive soil is essential as it fulfil our requirements of food, clothing and shelter from the plants that are grown in soil.

During the last 40-50 years such human activities as waste dumping, use of agrochemicals, mining activities and urbanization have resulted in degradation in quality and productivity of soil to different degrees.

### **Noise Pollution :**

Any sound which is unwanted disagreeable and unpleasant to our ears is termed as noise. Noise pollution may be defined as any undesirable sound which adversely affects the physical and mental health of its recipient.

Noise is essentially a feature of the technology based society of modern times. Scientific and technological advancement has benefited us in many ways but simultaneously it has increased human miseries. Noise is one among them, which is found to have physiological and psychological effect of damaging nature on human beings.

### **Radiation Pollution :**

Radiation pollution refers to the presence of high energy radiation from various sources, degrading the quality of the environment and endangering animals and plants. Those energy sources are natural as well as man-made. Natural sources include high energy cosmic rays, ultraviolet, visible and infrared radiation reaching the earth from the sun and other stars. Natural radiation also includes invisible radiation (radioactive rays) from unstable atoms of elements such as uranium, thorium and radium. Man has been exposed to such radiations since the beginning of his evolution. But these natural radiations have rarely posed health hazard as it was at extremely low levels.

However, things took a serious turn for the worse when scientists mastered X-ray production, and nuclear fission and fusion processes.

High energy ionizing radiation can be both beneficial and harmful. It depends on how we use it. The discovery of X-rays was welcomed as a miracle of science because of their application in disease diagnosis. But now it is known that X-ray account for over 90 percent of harmful artificial radiation exposure to humans. The mastery over nuclear fission and fusion processes has ushered in a dangerous age of nuclear weapons. Though nuclear nations of the world say that their nuclear

programs aims at peaceful applications of nuclear energy, the nuclear accidents of Chernobyl in the erstwhile USSR, the Three Mile Island in the USA, occurred inflicting untold misery on the people there for a long time.

X-ray and radioactivity related diseases are increasing especially among the children and pregnant women. Research indicates that low energy emitting devices such as televisions, computers and mobile phones may also have serious health implications. Therefore, radiation pollution demands serious attention in view of the permanent and grave damage it inflicts.

#### **Thermal Pollution :**

Thermal pollution refers to warming up of an aquatic ecosystem to a temperature at which it has detrimental effect on the organisms there. Various industrial plants like thermal power plants, oil refineries, nuclear power plants and various coal fired plants, factories and mills require huge quantity of water for steam generation in boilers and for cooling purposes. After the use, the heated effluents are discharged into the nearby water bodies at temperature which are 8° to 10°C higher than the temperature of the intake waters. A sudden rise in temperature of lakes, river streams, ponds etc. by 8° to 10°C lead to reduced concentration of dissolved oxygen which causes distinct changes in aquatic biota-bacteria, protozoa and other micro and macroorganism. Sudden rise in temperature causes overall deleterious effects on these aquatic ecosystems. As a consequence, temperature sensitive aquatic organisms such as fish and algae are wiped out in due course. Heated effluents, if contaminated are all the more injurious to aquatic life because of enhanced toxicity and greater reduction in dissolved oxygen (DO) concentration in water. Moreover, heated water, even if clean, is aesthetically unsuitable for human consumption.

Thermal pollution is by-product of rapid, reckless and unplanned industrial progress coupled with expanding urbanization and ever increasing human population :

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### **5.4 (i) Sources, Effects and Control Measures of Air Pollution :**

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#### **Sources & Effects**

**Sources of Air Pollution :** Sources of air pollution are natural as well as anthropogenic. Natural sources may be biotic or abiotic. Biotic sources include pollens from seed bearing plants, spores from fungi, microorganisms and ferns. Abiotic sources include volcanic eruption, forest fire dust storms and gases emanating from decaying plants, animals or inorganic substances.

However, the major sources of air pollution are anthropogenic. Generation of waste in amount and in kind, and contamination of various components of the environment including air have strong links with huge human population size, great advancement in technology and massive industrialization. Smoke and gases from chimneys and furnaces of factories and thermal power plants, automobile exhausts, gases produced on burning of domestic fuels and wastes, gases and toxic suspended particulate matter from agricultural activities, industries, power plants and mining activities are common air pollutants generated by human activities. Industrialization, urbanization and fast rate of population growth have led to growing cities through unplanned urban and industrial development, increase in traffic, increase in consumption patterns and higher levels of energy consumption. All these factors have contributed to the problem of air pollution which is wide spread in urban areas and in those areas where there is high concentration of industries and thermal power plants vehicles (i.e. transport sector) are the major contributor to air pollution comprising over 45% of the total pollutants produced per

year. Industries are the second largest source of air pollution in our country, other important sources include thermal power plants, domestic sector, agricultural sector and mining activities.

Air pollutants can be put into two broad categories : Primary air pollutants and secondary air pollutants.

**Primary Air Pollutants :** These are air pollutants such as carbon monoxide, sulphur dioxide, hydrocarbons etc. which enter the atmosphere directly from various sources (natural or anthropogenic)

**Secondary Air Pollutants :** These are air pollutants formed by chemical interactions between primary air pollutants and atmospheric gases such as water vapour usually in the presence of sunlight sulphuric acid, Nitric acid, ozone, peroxyacetylnitrate (PAN) etc. are the examples of secondary air pollutants.

**Major Primary Air Pollutant and their effects :** Oxides of carbon (carbon monoxide and carbon dioxide), oxides of sulphur, oxides of nitrogen, hydrocarbons and suspected particulate matter (SPM) are the major air pollutants which together contribute to about 90 per cent of the global air pollution.

**(i) Carbon Monoxide (CO) :** It is the major individual pollutant of air in terms of tonnage.

**Source :** It is produced by incomplete combustion of carbon based fuels like petrol, diesel, coal and wood. Vehicular exhaust is the single largest source, contributing of about 50 percent of CO emissions. High concentration of CO is present in the air along roads with a heavy traffic load. It is also present in cigarette smoke.

**Effect :** Carbon monoxide has a damaging effect on haemoglobin in the blood stream. It combines with hemoglobin and thereby reduces the oxygen carrying capacity of the haemoglobin. Thus inhibits the delivery of oxygen to various parts of our body. In high concentrations it causes headache, giddiness, exhaustion, and reduces physical and mental activities. Long exposure may cause death. However, carbon monoxide is short lived in air and gets oxidized to carbon dioxide, which is not as harmful as carbon monoxide.

**(ii) Carbon dioxide (CO<sub>2</sub>) :** It is released in air by combustion of carbon based fuels in homes, factories and automobiles. It is also produced during the process of respiration by humans and other organisms.

**Effect :** Though small concentrations of CO<sub>2</sub> in the atmosphere are essential for CO<sub>2</sub> O<sub>2</sub> balance in nature through photosynthesis, high concentrations are an environmental hazard. Due to ever increasing rate of burning of fossil fuels (coal and petroleum) in automobile, factories and power plants, and shrinking forest cover due to rapid rate of deforestation the content of CO<sub>2</sub> in the atmosphere is increasing at an alarming rate. With excessive concentrations of CO<sub>2</sub> in the atmosphere Global warming is poised to affect us adversely in more ways than one.

**(iii) Suspended Particulate Matter (SPM) :** SPM are fine solid particles or liquid droplets (aerosols), small enough (diameter less than 10<sup>-6</sup>m or 1 micrometer, μm) to stay suspended in air as smoke, soot dust, mist and vapour.

**Source :** They are produced by factories, thermal power plants, steel plants, mining, cement plants, and burning of fuels. A huge amount of dust is also blown by running vehicles. SPM also

includes fine asbestos fibres, pesticides, some fine metal particles and biological agents such as tiny dusts, mites, spores and pollens.

**Effect :** SPM is major air pollutant, when present in the lower atmosphere (i.e. troposphere) it causes respiratory disorders like asthma chronic bronchitis, lung damage and allergies in humans. The inhaled biological microbes may cause diseases. SPM is the most dangerous and widespread among the primary pollutants. affecting more people globally than any other pollutant of air, water and soil When accumulated in the upper atmosphere (i.e. stratosphere) SPM may significantly disturb the radiation and thermal phenomenon occurring there and may lead to lowering of temperature on the earth's surface.

**(iv) Oxides of Sulphur :** The oxides of sulphur include sulphur dioxide ( $\text{SO}_2$ ) and sulphur trioxide ( $\text{SO}_3$ ), the main one being  $\text{SO}_2$

**Source :**  $\text{SO}_2$  is produced due to burning of coal in power plants and industries, in the smelting of metals, in paper production and from oil refineries.

**Effect :** High concentrations of sulphur dioxide in air make breathing difficult and causes occurrence of asthma and bronchitis in human beings. Exposure to high  $\text{SO}_2$  concentrations is also harmful to buildings, clothing as well as to plants and animals. In air, Sulphur dioxide is oxidised to sulphur trioxide ( $\text{SO}_3$ ).  $\text{SO}_2$  and  $\text{SO}_3$  on combination with water produce sulphurous acid ( $\text{H}_2\text{SO}_3$ ) and sulphuric acid ( $\text{H}_2\text{SO}_4$ ) respectively and lead to occurrence of acid rain has damaging effect on plants, aquatic life and buildings.

**(v) Oxides of Nitrogen ( $\text{NO}_x$ )**  $\text{NO}_x$  stands for a mixture of nitrogen monoxide (nitric oxide, NO) and Nitrogen dioxide ( $\text{NO}_2$ )

**Source :** Oxides of nitrogen are produced due to combination of nitrogen ( $\text{N}_2$ ) and oxygen ( $\text{O}_2$ ) during combustion of fossil fuels at high temperatures in automobiles and aircraft and in coal based industries.

**Effects :** Inhalation of oxides of nitrogen causes eye irritation, pulmonary congestion and may be carcinogenic.  $\text{NO}_2$  is responsible for formation of smog (reddish brown haze) in traffic congested areas, which is a potent health hazard.  $\text{NO}_2$  is the main contributor of acid rain that contains nitric acid ( $\text{HNO}_3$ ) and nitrous acid formed by the combination of  $\text{NO}_2$  and water droplets in the air.

**(vi) Hydrocarbons :** These are the organic compounds composed of hydrogen and carbon. Methane ( $\text{CH}_4$ ) is the most abundant hydrocarbon in the atmosphere.

**Source :** Methane ( $\text{CH}_4$ ) produced naturally during paddy cultivation and during food digestion by ruminating animals. Some hydrocarbons enter the atmosphere by evaporation of fuel supplies and during burning of fossil fuels (coal and petroleum).

**Effects :** Hydrocarbons of higher concentrations have a carcinogenic effect. Aromatic hydrocarbons like benzene, toluene and benzenopyrene are more dangerous to human beings than aliphatic and alicyclic hydrocarbons. Some relatively active hydrocarbons, contribute to the production of secondary pollutants such as peroxyacetylnitrate (PAN)

**(vii) Chlorofluoro carbons (CFCs) :** These are the organic compounds containing chlorine and fluorine.

**Source :** CFCs are released mainly from refrigerators, air conditioners, foam plastics, fire extinguishers, cosmetic goods etc.

**Effect :** When CFCs enter the air (i.e. troposphere) They rise into the stratosphere and take part in the chemical reactions there. This results in the depletion of the stratospheric ozone layer which protects humans and other life forms on the earth from harmful ultraviolet radiations from the sun.

**(viii) volatile organic compounds (VOCs) :** These are the organic compounds released into the air by burning petrol, wood, coal or natural gas or by evaporation of solvents, paints, glues and other products that are used at work or at home. volatile organic compounds are mostly indoor air pollutants (gases, vaporous and particulates) that are emitted in high concentration in newly constructed buildings (i.e. from wall covering, furnishings, carpets etc.)

**Effects :** Exposure to pollutants is often far higher indoors than outdoors. The World Bank has designated indoor air pollution in developing countries as one of the four most critical global environmental problems adversely affecting the health of inmates.

**Photochemical smog :** A major secondary air pollutant, photochemical smog, is a classical example of secondary air pollutant. The term smog is derived from a combination of the two terms :

Smoke and fog.

Smog formation often occurs in traffic congested big cities. It reduces atmosphere visibility and affects plants as well as animal life.

Broadly two types of smog have been recognized. They are :

Y Classical (Sulphurous) smog or London smog, and

Y Photochemical smog or Los Angeles smog

**London Smog :** It consists of carbon based soot and sulphur dioxide. In humid air, water condenses on carbon particles, reacts with  $\text{SO}_2$  and forms irritating smog. The earliest recorded major disaster due to sulphurous smog formation occurred in London in 1952, hence the name London smog. The disaster affected nearly half the population of the city and resulted in the death of over 4,000 people mostly due to aggravated respiratory problems.

**Los Angeles Smog :** Photochemical smog or Los Angeles smog formation involves unburnt gaseous hydrocarbons and nitrous oxides, both of which are present in the emissions of internal combustion engines (particularly motor vehicles), These chemical play an important role in the photochemical formation (i.e. chemical formation in the presence of photon in the sunlight) of ozone ( $\text{O}_3$ ) and PAN (peroxyacetylnitrate). The smog itself consists of nitrogen oxide, ozone and PAN.

**Effect :** smog formation produces a haze in the atmosphere, thereby reducing visibility leading to increased number of accidents, smog causes a toxic effect on humans, animals and the physical environment. It causes acute eye irritation and aggravates lung related diseases in human beings. It adversely affects plant's growth and can corrode marble statues and monuments. PAN in smog reduces photosynthetic efficiency of plants.

Los Angeles in California, USA first experienced a serious form of secondary air pollution due to photochemical smog formation in 1944 hence the name.

Aci drain : Acid rain formation is another classical example of a secondary air pollutant.

**Control Measureb of Air Pollution :**

In the highly industrialised world of today, it is very difficult to bring air pollution down to zero levels. However, in view of the alarming levels of air pollution in India and globally, the prevention and control of air pollution demands serious attention. The following preventive and control measures, practices and technical devices, can be and are being adopted to reduce air pollution.

**(i) Control of Vehicular Pollution :** Fossil fuel operated vehicles are a major source of air pollution. Therefore, vehicular pollution must receive urgent attention for prevention and control of air pollution.

**Preventive Measures :**

Y The use of fossil fuel—petrol and diesel—should be replaced as far as possible with fossil fuel with low sulphur content and compressed natural Gas (CNG) which are less polluting.

Y One should get one's vehicle checked for vehicular emissions regularly and keep the engines of vehicles properly tuned.

**Control Measures :** Control measures using technical devices should focus on two fronts :

Y To improve internal combustion engines and body weight of vehicles for enhanced fuel efficiency. In many countries, especially Japan, North America and parts of Europe the petrol-powered four stroke internal combustion engines have largely replaced two stroke gassoline engines. The improved technology has greatly enhanced fuel efficiency.

Y To reduce the level of pollutants being generated, use of filters and catalytic converters in motor engines has been found to annul the toxicity of the exhaust gases to acceptable levels. Catlytic converters convert pollutants into less toxic forms.

**(ii) Control of Industrial Pollution :**

Smoke, toxic gases and vapour from the chimneys and furnaces of the industries are another well know sources of air pollution. To prevent the generation of those pollutants and to lessen the impact of released pollutants, the following measures can be adopted :

**Preventive measures**

Y Correct selection of sites for setting up of industrial units should be adopted so that pollutants are effectively disposed of before reaching human settlements.

Y Factories should have tall chimneys so that most of the particulate matter settles at the base and does not reach the air.

Y Large scale tree plantation is a highly effective and eco-friendly method of reducing air pollution. Many plants fix carbon monoxide and nitrogen oxides and convert them to useful plant prodcuts. Plants absorb carbondioxide through photosynthesis and release oxygen.

Y Awareness programmes to highlight the importance of clean, pollution free air and the injurious effect of polluted air should be undertaken among the common people by the Government, NGOs and enlightened segments of the community.

Y Environment protection laws should be strictly enforced and violaters should be punished.

**Control Measures :**

Removal of particulate matter from the smoke released from chimneys of the industries is an essential step to check pollution produced by industries. For this purpose various types of mechanical/technical devices have been designed and fabricated to separate particulate matter of different sizes. Some of these devices remove / control gaseous pollutants as well. These mechanical /technical devices are as described below in brief.

**Arresters :** Particulate matter arresters are of different kinds. Cyclone collectors and trajectory separators are the commonly used arresters which work on the principle of dust separation by centrifugal force. Polluted air is passed through a metallic cylinder at high speed. Centrifugal force is produced on suspended particles thereby they dash against the wall of the cylinder and fall at the bottom. Arresters are efficient for coarse dust particles.

**Filters :** They are generally used to separate extremely fine particulate matter.

**Gravity Settling chamber :** The chamber is generally rectangular in shape into which polluted air is passed from one end. The velocity of the gas stream is kept low which permits the dust particles to settle down. The method is suitable for coarse particles only and not for fine particles which require longer settling time.

**Scrubber :** They are used for the removal of particulate matter as well as gaseous pollutants from polluted air. In a scrubber, polluted air is passed either through dry packing material such as activated alumina, silica and material such as water, alkali solution or oil. Depending on the nature of absorbent used it can remove solid liquid or gaseous contaminants. Thus lime water or alkali solution neutralizes acidic gases  $\text{CO}_2$ ,  $\text{SO}_2$ , oxides of nitrogen etc.

**Electrostatic Precipitators :** They are very sensitive and efficient devices for removing particulate matter from polluted air. They work on the principle that particulate matter (aerosol particles) acquires a charge when subjected to an electrical field. Dirty gases are charged of high potential and particulate matter is collected on a differently charged platform. The efficiency level of modern electrostatic precipitators are as high as 99.9 percent, thus ensuring almost clean air after treatment.

Gaseous pollutants from industries and power plants are also controlled by using combustion, absorption and adsorption techniques. In the combustion process oxidizable pollutants are burnt in excess of air at a high temperature to produce less polluting products. In absorption technique gaseous pollutants are absorbed in a suitable absorbent while in adsorption technique they are adsorbed on large solid surfaces.

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## **5.4 (ii) Sources, Effects and Control Measures of Water Pollution:**

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Major sources of water pollution and their effect on human beings and other life forms are as described below :

**(i) Domestic wastes (Municipal waste water) :** Domestic sewage and garbage from urban and rural settlements discharged directly into nearby water bodies (rivers, lakes, ponds etc.) without proper treatments is a major source of water pollution. Major rivers of one country including Ganga, Yamuna, Krishna, Cauvery etc. and lakes including the famous Dal Lake in Kashmir are heavily polluted and their water is unfit for drinking and bathing.

Domestic water contains plenty of organic matter in the form of food and food residues, human excreta, soaps and detergents, and large number of pathogens.

**Effect :** Water pollution due to sewage and domestic water is of major concern because infectious diseases like typhoid, cholera, jaundice, dysentery diarrhoea and amobiasis spread chiefly through contaminated water. According to one estimate, nearly two third of all illness in our country are due to water borne diseases caused by pathogenic bacteria present in polluted water.

**(ii) Industrial effluents :** Most of the industries use huge quantity of water at various stages of production. When water is discharged after use, it is invariably mixed with soluble as well as insoluble organic and inorganic chemicals including toxic heavy metals and even pathogens in some cases. Industrial effluents are the most hazardous of all water pollutants. Most Indian rivers passing through major cities and industrial areas are heavily polluted by the discharge of industrial effluents in them. Toxic metals such as lead, Mercury, zinc, copper, chromium and cadmium, non-metals like Arsenic and numerous petrochemicals, Benzene, polyphenylchloride and gammexane). acids, alkalis, cellulose fibers, colouring and bleaching materials etc. enter into water bodies through industrial effluents.

**Effects :** Most parts of the industrial effluents are toxic to human organisms even in minute quantities and many of them are non bio-degradable. These pollutants lead to various types of diseases. Their presence in the water bodies make them unfit for drinking and bathing. Fish from these sources are also not safe to eat.

**(iii) Agricultural water Pollutants :** The surface run off from agricultural land carries a heavy load of fertilizers, pesticides, insecticides, manures and other agrochemical, with it. These pollutants ultimately reach natural water bodies and pollute them. Rain water which flows through grazing lands and abandoned mines also carries a load of pollutants.

**Effects :** Soluble nitrates coming into drinking water bodies due to excessive use of nitrogenous fertilizers cause a disease called methaemoglobinemia (lack of oxygen) in infants. This disease is also known as the blue baby syndrome because babies are born blue in colour and die soon. Pesticides penetrate the epiderms of the skin and produce lethal effects. On inhalation they cause lung related diseases. Pesticides like DDT and gammexane, and chemical like poly chlorinated biphenyls (PCBs) enter the food chain. Through food they enter the body of animals including human beings and can cause severe health problem including brain disorder and cancer. Pesticides like DDT and Aldrin have destroyed many useful organisms in soil and water.

**(iv) Waste heat :** Many industries including thermal power plants and oil refineries discharge hot water into nearby water bodies. A sudden rise in temperature (8 to 10 degrees higher than the temperature of the intake water) has an injurious effect on the temperature sensitive aquatic organisms such as fishes and algae which are wiped out in due course.

**Eutrophication :** Sewage and organic wastes from the dairy industry, tanneries, slaughter houses, paper mills, food processing plants and runoff from agricultural fields carrying residual chemical fertilizers are all rich in nutrients. When they discharge into or reach static water bodies, they cause excessive growth of aquatic vegetation (algae and weeds). Sometimes such algal blooms may totally cover the water surface often release toxin in water and cause decrease in oxygen content in water. This excessive growth of weeds in nutrient rich water bodies is called algal bloom or eutrophication. It harms aquatic life and often leads to loss of life in water bodies. Eutrophication occurs in stagnant water bodies like ponds and lakes, and not in flowing water.

## Groundwater Pollution

Over 98% of the fresh water on the earth occurs below its surface as groundwater. This ground water is the major source of freshwater for drinking purposes, in industries and for irrigation. Rainwater is the main source of groundwater. Rainwater undergoes natural filtration as it passes through different layers of the soil. For this reason groundwater is regarded as free from contamination and suitable for human consumption. But due to natural causes as well as due to various human activities in today's world of rapid industrialization, fast growing population density and changing life styles. Groundwater too is getting contaminated at an alarming rate. Following are the main causes of contamination of ground water.

**(i) Natural sources :** In some regions of the world including India earth crust is rich in fluoride bearing minerals due to which the ground water is naturally fluoridated. Intake of fluoridated ground water for a prolonged period causes fluorosis which is a crippling disease affecting large number of people of all ages in fluorosis endemic areas of our country and the globe.

Similarly Arsenic contamination of ground water in different parts of the world and in some states of our country including West Bengal, Bihar, and U.P. is an outcome of natural as well as anthropogenic sources leading to adverse effect on human health and ecosystem. According to the study arsenic contamination in some states of our country is due to the reason that Arsenic originates naturally from Himalayan sediment, is transported down the major river system and is deposited in low-lying regions (sedimentary basins and deltas).

**Anthropogenic sources :** Following are the main anthropogenic causes of contamination of ground water, especially on the outskirts of larger cities and villages.

- ∇ Seepage of hazardous chemicals from industrial and municipal community wastes and effluents from sewage channels and septic tanks.

- ∇ Agricultural run-off having excess of chemical fertilizers and pesticides

- ∇ Leakage from underground storage tanks of hazardous chemicals and gas line.

- ∇ Leakage from landfills and from mining wastes.

### Consequences (i.e. effects) of Ground water Pollution :

#### (i) Effects of Nitrate Contamination :

In many parts of our country ground water has tested much higher nitrate content than the permissible limit. The excessive presence of nitrates in groundwater used for drinking purposes is detrimental to human health and may be fatal for infants. The disease in children called methaemoglobinemia. (also known as blue baby syndrome) is caused by presence of soluble nitrates above permissible limit in drinking and cooking water

**(ii) Effect of Fluoride contamination : Fluorosis :** Fluorosis is a disease caused by drinking fluoride contaminated ground water. Fluoride has great affinity for calcium phosphate present in the bones of human body. Therefore excess intake of fluoride leads to deformity of teeth and bones (called as dental fluorosis and skeletal fluorosis respectively). In few cases non-skeletal fluorosis is also observed. Whereas dental fluorosis is characterized by blackened mottled and deformed teeth, skeletal fluorosis leads to permanent bone and joint deformities. Non skeletal fluorosis leads to neurological and gastrointestinal problems. Cases of severe fluorosis have been reported from several countries like China, Sri Lanka, Italy, Mexico etc. In our country cases of fluorosis have been reported from different regions across 20 states including Rajasthan, Andhra Pradesh and Bihar.

**(iii) Effect of Arsenic contamination :**

Arsenicosis is a kind of skin disease caused due to drinking of arsenic polluted ground water. The patients with Arsenicosis have skin lesions that resemble the symptoms of leprosy but are not leprosy in reality. Arsenic toxicity develops in some 2-3 years exposure to arsenic contaminated ground water. The patient develops black spots on the chest, back and limbs which turn white in later stages. The skin becomes hard and fibrous. Severe toxicity can lead to gangrene and cancer. Complications of liver, spleen, goiter and skin cancers may also develop due to arsenic poisoning. Several cases of arsenicosis have been reported from West Bengal and recently from Bihar and some other states of India. Bangladesh has some of the most arsenic contaminated ground water in the world. Around 85% of the total area of Bangladesh has arsenic contaminated ground water, with over 1.2 million people there is exposed to arsenic poisoning with millions more at risk.

**Control Measures of Water Pollution :**

Clean water is an essential requirement for the sustenance and good health of both terrestrial as well as aquatic life. A minimum of 40 litres of fresh water is required by a human being per day for drinking, cooking, cleaning and other purposes. Supply of adequate quantity of clean water is one of the priority obligations of a responsible government any where in the world. When water is discharged after use it is invariably turned into waste water. It is required that waste water should be collected, treated and disposed of properly so that it is harmless to different life forms and the environment.

With fast growing population and expanding urbanization it is necessary to adopt not only conservation and proper management of clean (i.e. fresh) water resources but also to collect and treat waste water for reuse in agriculture, industry and for some domestic purposes.

Control measures for water pollution can be described under two main headings.

- (i) Treatment of waste water, and
- (ii) Measures and programmes to reduce the pollution of clean water.

**(i) Treatment of waste water :**

**Need for the treatment :** Towns and cities of most countries invariably have a sewerage system of their own for sewage disposal. Many rural and suburban areas too have some kind of sewage disposal system. An efficient sewer system is important for health of people and the environment. The conventional system of disposal of untreated domestic and industrial wastes into nearby water bodies—rivers and lakes—have become the cause of various diseases of humans and animals throughout the world. Therefore, to fight down the ill effect of pollution of rivers, lakes and ponds due to disposal of untreated domestic and industrial waste water into them. The development of efficient techniques of treatment of waste water before disposal into nearby water bodies has now become an essential component of abatement/ control of water pollution throughout the world.

**Treatment of waste water :**

As water pollution is caused mainly by domestic sewage and industrial waste, an effective and meaningful abatement / control of water pollution depends on the efficiency of treatment of domestic and industrial waste water.

The broad steps adopted for treatment of domestic and industrial waste water are almost the same. But whereas domestic waste water comprises mostly of non-hazardous organic wastes, the industrial waste water contains numerous toxic substances.

The treatment procedures adopted in an effluent treatment plant (EPT) involve the following three successive steps.

**Primary Treatment (Mechanical treatment) :** This method involves mechanical removal (i.e. screening) of large debris (solid wastes) from waste water followed by sedimentation of the liquid waste to remove solids which are likely to settle. The settled solids/semi-solid are called sludge which are treated and disposed of in landfills or are composted.

**Secondary treatment (Biological treatment) :** This is a biological process carried out by aerobic microorganisms. The residual liquid after primary treatment is subjected to biological oxidation of soluble organic matter in the liquid waste. The microbes aerobically (i.e. in presence of oxygen) break down the organic matter into harmless materials such as carbon dioxide, water and sludge. The sludge materials are removed by sedimentation. After the secondary treatment the liquid effluent has a much lower organic load, which after chlorination to kill pathogenic micro organisms is discharged into natural water bodies- rivers, lakes, ponds etc. or is used for agricultural and/or industrial purpose.

**Tertiary Treatment (Advance treatment) :** This treatment involves further purification of water by removing salts like nitrates and phosphates, dissolved organic matter, metals, pathogens and other pollutants by advanced biological, chemical and physical processes. After this treatment, the waste water is clean enough to be discharged directly into rivers, lakes and streams or to be used for irrigation and industrial purposes.

**Reverse Osmosis :** This is an advanced technology which is increasingly being adopted world wide to convert sewage water into fairly clean water suitable for human consumption.

**Other measures to Abate / control water pollution.**

A few other measures which can be adopted and are being adopted by many to control / abate water pollution are as described below :

∩ Plants and microorganisms for removal of toxic heavy metals, cyanides and other chemical pollutants of waste water are being tried and are found to produce encouraging results.

∩ Farmers should be encouraged for using manures and bio-pesticides in crop cultivation in place of chemical fertilizers and pesticides and other toxic agro-chemicals.

∩ Awareness programmes among common people should be undertaken to educate them on importance of clean contamination free water. People should be educated to refrain themselves from bathing, washing clothes or disposal of dead bodies in freshwater bodies. Offering of flowers, clothes and other ritual items in the water bodies should be avoided.

∩ Active participation of NGOs (Non-Governmental Organizations) be encouraged to work with community members to take up the cause of public health through different preventive and control measures to check water pollution.

∩ Laws related to prevention and control of water pollution be strictly enforced and violators of the law should be punished.

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### **5.4 (iii) Source, Effects and Control Measures of Soil Pollution:**

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**Sources :** Following are the common sources of soil pollution.

**(i) Agricultural practices :** Modern agricultural practices are a major source of soil pollution.

Today, with advancing agro technology farmers use huge quantities of chemical fertilizers,

pesticides, weedicides, herbicides and soil conditioning agents to control pests, insects and weeds and increase crop yield. At present about 600 types of agro-chemicals are being used all over the world. About one fourth of applied agrochemicals are not consumed by crops and returned to the soil or are reached and accumulate in the surface as well as groundwater resources. Pesticides, insecticides and weedicides which are used to kill pests, insects or weeds and to protect crops, remain active for a long time after destroying their target, causing harm to and killing species of useful insects and microorganisms in the soils. Moreover these chemicals are non-biodegradable and can enter the food chain to persist in animal and plant bodies for long duration.

**(ii) Farm waste :** Farm wastes comprising animal wastes, wastes from food processing units and animal's manure also pollute the soil to a large extent. Huge amounts of wastes are generated daily from cattle sheds and poultry farms in commercial animal husbandry industries. These waste are generally dumped in heaps, attracting pests and turning into a breeding ground for microbes, flies and rodents.

**(iii) Urban wastes (Municipal wastes) :** Urbanization and industrial development have been associated with both physical degradation as well as chemical contamination of soils. Physical degradation of soil results from construction activities and infrastructural development whereas chemical contamination results from waste disposal activities, discharge of liquid effluents and atmospheric emissions including acid precipitation. Urban wastes comprise both domestic wastes and commercial wastes. In most cases hospital wastes are also mixed with these municipal wastes which are dumped as solid rubbish in heaps here and there. These wastes are a complex mix of biodegradable and nonbiodegradable wastes, and include kitchen garbage, cloth and paper rags, ash, bottles, waste metals and metallic cans, polythene carry bags and discarded plastic items, broken ceramics, street sweeping vegetable and fruit pads from vegetable markets, abandoned vehicle parts and other discarded manufactured products. Hospital wastes which are often dumped along with municipal wastes include used needles, plastic pads, blood soaked cottons, plastic and glass bottles, vials etc. Dumping of animal dung and wastes generated in slaughter houses are other sources of soil pollutants. The soil microorganisms which biodegrade the organic matter in the waste, fail to cope with the huge heaps of solid wastes because a part of the wastes are non-biodegradable materials. Dumping and disposal of urban wastes commonly referred to as refuse, are serious problem causing chronic pollution of soil and water all across the world including developed as well as developing countries.

**(iv) Industrial waste :** Dumping and disposal of industrial waste (solid wastes and sludge) is a major cause of soil pollution. Industries such as paper and pulp mills, cement plants, chemical fertilizer and pesticide industries, plastic and paper industries, textile industries, distilleries and electronic industries generate huge quantity of toxic organic and inorganic chemical compounds and heavy metals which are disposed of either by dumping on waste lands or into rivers and seas. Fine dust particles such as flyash from thermal power plants and fine cement dust from eliminators of cement industries come back to the earth's surface over a large land cover, around these plants. Most of the industrial wastes being non biodegradable persist in soil for a longer duration and spoil the quality and fertility of soil. Heaps of waste may affect the flora and fauna of the area and make the landscape look ugly.

**(v) Mining operations :** Any form of mining is invariably associated with soil damage and environmental degradation. It drastically disturbs the chemical, physical and biological properties of the soil. Open cast or surface mining involves removal of top soil and vegetation leading to total and immediate destruction of flora and fauna, affecting human habitation and ecological balance of the areas undergoing mining operations.

**(vi) Radioactive waste :** Radioactive waste produced by nuclear testing laboratories, nuclear power plants and from explosions of nuclear devices accumulate in soil and contaminate it. They stay in the soil emitting hazardous radioactive rays because they usually have a longer half life period. Radiation emitting nucleides of Thorium, Radium, Uranium, carbon 14, Potassium 40 and Caesium (Cs-137 and Cs-134) have commonly been found in soil and rock.

**Consequences (Effect) of soil pollution on human health and the environment :**

(i) Due to arrival of huge quantities of pollutants from various sources, the soil in which we grow food and clothing, raw materials and build up shelters is highly polluted by several pathogenic organisms, hazardous organic and inorganic chemicals and toxic metals. Some toxic chemicals present in the polluted soil such as DDT, PCBs and gammexane may enter the food and the body of humans and other organisms causing serious health problems. Accumulated municipal and biomedical wastes are in most part organic in nature, biodecomposing slowly and producing harmful air polluting gases. Microorganisms develop and multiply quickly in these waste heaps. Flies, rodents, insects etc. are attracted towards these stinking heaps and spread germs of various diseases. Very often those factors lead to mass illness and outbreak of epidemics.

**(ii) Industrial waste :** It consists of a variety of toxic chemicals, which destroy the biological activity of beneficial microorganisms in soil and in the sewage system. This in turn causes several soil and water borne disiases.

**(iii) Metallic contaminants of soil (e.g. mercury, lead, Arsenic, copper, cadmium, zinc etc.)** indestructible poisons and their presence in air and soil for longer period of time is highly fatal to living organisms.

**(iv)** Radioactive waste dumped into the soil stay in it for thousands of years emitting dangerous radioactive rays. These rays permanently damage vital organis of humans and other organisms. Radioactive pollutants produce human misery of a more serious nature than most other pllutants of soil.

Soil formation is a very slow process. Once the soil is degraded of its qualities and fertility, we shall be deprived of benefit from soil for a longer period of time.

**Control Measures of Soil Pollution :**

Follwing are the preventive and control measure that can be adopted to abate soil pollution :

(i) Excessive use of fertilizers, pesticides, weedicides etc. in crop production should be avoided. They may enhance crop production in a few rotations but are sure to have damaging effect on the soil in the long run

(ii) Farmers should get the soil sample tested regularly and should use right quantity of agro-chemicals in crop cultivation.

(iii) Use of traditional manures, biofertilizers and bio-pesticides should be encouraged for sustainable agriculture. Use of vermicompost should be encousaged. Its natural content is higher as compared to conventional manures.

(iv) Open dumping of sewage, domestic and industrial wastes on the soil should be checked effectively. Options such as composting of organic wastes, deep burial, sanitary landfilling, incineration and cycling of such waste materials as paper, plastics, matals, glass etc. should be adopted.

(v) It should be made mandatory for all industries to make arrangement (including installation of appropriate equipments/devices) to arrest fly ash and particulate matter from being disposed over the soil from their chimneys and furnaces.

(vi) Planned urbanization, which includes proper drainage system, safe disposal and management of municipal solid waste, controlled developmental and mining activities etc. are the measures by which soil pollution can be effectively controlled.

(vii) Reforestation and plantation programmes should be undertaken on massive scale to maintain the quality and fertility of soil.

(viii) Awareness programmes among farmers, industrial workers and the common mass should be organized to make people aware of the importance of soil to humans and the environment, and the ill effects of soil pollution.

(ix) Laws should be enacted for complete ban on disposal of radioactive and toxic wastes into the soil. Existing laws should be strictly enforced and those who violate the law should be punished.

## **5.5 Noise Pollution : Sources and Consequences**

**Introduction :** Any sound which is unwanted, disagreeable and unpleasant to our ears is termed as noise. Noise pollution which adversely affects the physical and mental health of its recipient. It may, however, be noted that degree of annoyance due to loud sound may not necessarily be related to the intensity of sound alone, personal attitude and mood of the recipient is also an important influencing factor. A loudly played music may be liked by someone whereas very feeble sound may be taken as noise by an ailing person or by the one who likes loneliness and tranquility. Moreover noise pollution is a kind of physical pollution which affects its recipient directly without having its effect on the three life supporting systems— air, water and soil.

Noise may be natural (such as thunder) or man-made. But the impact of natural noise is insignificant as compared to man-made noise because of rarity of its occurrence.

Noise is essentially a feature of the technology based society of modern times. It is primarily a problem of city dwellers and industrial workers. Scientific and technological advancement has benefited us in many ways, but simultaneously it has increased human miseries as well. Noise is one among them. It is found to have damaging physiological and psychological effects on human beings

Sound is measured in a unit called decibel (dB). Breathing sound is 10 dB, whispering-20dB, quiet office 50dB, normal conversation-60 dB, printing press and small factory-80dB, running train-100dB, thunder-120dB, and aircraft take off-120-130dB. 140dB is the threshold noise level of pain/physiological disturbances in men. Noise pollution may be broadly categorized into two types—Outdoor Noise Pollution and Indoor Noise Pollution.

### **Sources of Outdoor Noise Pollution :**

The major sources of outdoor noise pollution are the following :

**(i) Industry and Machinery :** High intensity noise produced by heavy machines producing consumer goods such as cement, steel, fabrics, metal products etc., power plants generating electricity, saw and drill machines and grinding and crushing machines upset the recipient mentally and physically to different degrees. Workers on duty near these machineries and industrial units in operation having exposure to high intensity noise (90dB - 110dB) for 8-10 hours a day are the worst sufferers. Blasting, drilling and crushing during mining of minerals and coal also produce sudden as well as constant noise of high decibel value.

**(ii) Transportation :** In modern times vehicular transport is the main noise menace affecting common people, especially in large and overcrowded towns and cities. Traffic noise includes road-traffic noise as well as aircraft noise. With fast increasing number in traffic vehicles-cars, scooters, motor cycles, buses, trucks, especially diesel operated vehicles, levels of noise in most towns and cities, metropolitan cities in particular, have increased to a noise level between 70 and 90 decibels, which demands immediate attention. Rail traffic noise and aircraft noise are increasingly becoming the cause of discomfort and audio problem in nearby areas. Fast running trains and fast jet aircrafts which have been theor introduced over the years and increasing number have enhanced the discomforts and bad health of humans and animals.

**(iii) Community activities :** We, the Indian people celebrate every occasion, be it religious, social, marriage celebrations, birthday parties or even winning of a cricket or football match with fireworks, crackers and playing muscis through loudspeakers. During Durgapuja and Ganeshpuja, playing of loudspeakers of high sound level is an esseatial component of week long programme of festive celebration. Bursting fireworks on Deepawali is taken as the most important component of the celebration. To contain the menace of loudspeakers and music systems there exists a legal provision to restrict the use of loudspeakers and public address system. However, the laws are rarely obeyed particularly in small towns and semi-urban areas.

**Sources of Indoor Noise Pollution :** Sources of noise generated indoor include domestic applicanles like washing machines mixers, vacuum cleaners, coolers, fans, telephones, air conditioners, loudly played televisions, tape recorders, generator sets, radios, musci systems and other electronic gadgets.

**Consequences of Noise Pollution :** Noise pollution has been found to have an adverse effect on humans, animals as well as on the physical environment.

**(i) Effect on human beings :** High decibel noise has physiological as well as psychological effects on human beings. Noise level between 80 and 130 dB can cause temporary or permanent hearing loss to the recipient. The degree of hearing depends on the duration of exposure as well as the intensity of the sound. Constant expoure to high decibel level noise may cause hypertension, loss of appetite, stomach disorders including ulcer, heart diseases and hormone imbalance. Constant exposure to undesired levels for noise of long duration may cause such psychological and emotional effects as anxiety, irritability, sleeplessness, tension, lack of concentration and increased errors, mental tiredness, behavioural problems and lower working efficiency. Workers of noise producing industries and high noise commercial areas, devolop a reduced work rate, frequent absenteeism, higher potential for injuries and accidents, and hearing problems. Medical experts are of the opinion that fire crackers and explosives may lead to stomach ulcers and respireatory disorders.

**(ii) Effect on animals :** Sudden yet high decibel noise from aeroplanes, supersonic jets in particular, is known to cause disturbance to birds and animals around aerodromes and railway tracks. Migratory, birds, in particular, are more sensitive to sudden, loud bursts of sound. Prolonged exposue to noise has been found to cause heart, lever and brain disorders, and reduced hormonal secretions in animals as well.

**(iii) Effect on physical environment :** Sudden and loud noise can damage and cause collapse of fragile parts of buildings including glass panels.

**Noise standards for different categories of areas (zones) :** As per the Environment (protection) second amendment rules, 1999 of Government of India, noise standards for different categories of areas (zones) are as given in the table below :

**Table**

<b>Category of Zone Upper limits of noise in dB</b>		
	<b>Day time (6 AM-9 P.M.)</b>	<b>Night time (9 P.M.-6 AM)</b>
(A) Industrial Zone	75	70
(B) Commercial Zone	65	55
(C) Residential Zone	55	45
(D) Silence Zone	50	40

Y The state Government may categorize the areas as industrial, commercial residential or silence areas / zones for the purpose of implementation of noise standards for different areas.

Y The state Government shall take measures for abatement of noise including noise emanating from vehicular movements and ensure that the existing noise levels do not exceed the ambient air quality standards, specified under these rules.

## **5.6 Radiation Pollution and Nucliar Hazards:**

**Introduction :** For ‘Introduction see unit 5.3. of this chapters under the subheading ‘Radiation Pollution’.

### **Types of Radiations :**

There are two basic types of radration– Ionizing rediation and Non-ionizing radiation.

### **Ionizing radiation :**

Ionizing radiation includes electromagnetic waves (X-rays and Gamma rays) or particles such as alpha ( $\alpha$ -) and beta ( $\beta$ -) particles which carry energy levels so high that they can knockout one or more electrons from neutral atoms of elements and produce ions.

**Non-ionizing Radiation :** These include heat, light, microwaves and radiowaves which carry enough energy to excite atoms but not enough to knockout electrons from atoms and produce ions. The solar radiations are the best example of non-ionizing radiations as they do not have ionizing effect.

**Sources of Radiation Pollution :** As mentioned ealier there are two sources of radiation pollution namely-Natural sources and Anthropogenic (man made) sources.

**Natural sources :** The main natural sources include solar rays and natural radioactivity. Solar rays consist of high energy cosmic rays, gamma rays and ultraviolet rays. Though the protective ozone layer in the stratosphere absorbs most of the harmful solar radiation, enough of it reaches the earth’s surface from different galaxies.

Natural radioactive elecmnts such as uranium (U-2 and U-238), Thorium (Th-232), Radium (Ra-226), Carbon (C-14), Potassium (K-40) etc. release enormons amounts of alpha, beta and gamma rays. Although radioactive elements are present in nature in minute quantities, their ill effects on organisms are serious. Poeple leaving in areas having deposits of radioactive minerals are often found to be victims of these radiations.

Radiations originate within our bodies as well. Our body contains minute amounts of such radioactive elements as Potassium-40, Carbon-14, Uranium-235, Thorium-232 and Strontium-90.

**Anthropogenic Sources :** Harmful radiations entering our environment from man made (i.e. artificial) sources is gradually becoming a more serious threat to humans, plants and animals as compared to natural sources. The major present day man made sources include the following :

**(i) Nuclear Waste :** The main sources of harmful radioactive radiation are nuclear wastes from the nuclear power plants, industries research laboratories and other installations using radioactive materials. These wastes include short lived as well as long lived radioisotopes, which keep on emitting radiations continuously in the environment. Despite all precautions in storage and disposal of such wastes, some leaks of radiation can not be ruled out.

**(ii) Radioactive Ore processing :** Mining and refining of radioactive ores is the first step towards use of nuclear technology. During various stages of mining, washing, refining, separation and milling nuclear waste of various natures are produced which on disposal enter the atmosphere, the earth's surface as well as the groundwater bodies in nearby areas.

**(iii) Nuclear Tests and Nuclear Fallout :** Nuclear explosion tests done very often by nuclear power nations are another source of radioactive pollution. The nuclear fallout of explosion tests contain large quantity of long lived radionuclide, which spread through air in a large geographical area and continue to harm life forms for a longer period of time.

**(iv) Nuclear accidents :** Nuclear power plants are considered to be quite safe, yet even a small lapse in the matter of safety and control measures may lead to devastations. Nuclear disasters in the nuclear power station at Chernobyl USSR in 1986, of three mile Island of USA in 1979 and.....are the worst examples of nuclear accidents due to technical failure and human error.

**(v) X-ray diagnostics :** X-ray are used to diagnose various types of ailments in patients. X-rays are high energy rays and are highly penetrating, like the gamma rays. Indiscriminate uses of x-rays have been found to cause serious damage to internal organs of patients.

**(vi) Therapeutic applications of Radioisotopes :** Radioisotopes such as Radium-226, Cobalt-60, Sodium-24, Iodine-131 etc. are administered to patients during radiation therapy or for diagnostic purposes. However, the indiscriminate use of the radioisotopes, their overdoses to patients and improper handling have been found to be a hazardous source of nuclear pollution.

Other sources of high energy radiation pollution include industries and research laboratories that use various radioactive materials.

**Source of Non-ionizing radiations :** Non-ionizing radiations include low energy infrared, radio waves, micro waves, radar waves etc. which have also been found to pose severe hazards to human health and to plants and animals. The main source of these radiations is the sun itself. Other sources include electrical gadgets and power transmission lines which generate electric fields causing environmental radiation hazards.

### **Consequences of Radiation Pollution :**

Radiation pollution is one of the most horrible ecological crisis of modern times. Radiations are harmful to all living beings-humans, plants and animals. Depending on the intensity and duration of exposure, radiations may cause disorders and miseries ranging from mild skin burns to deformities. They cause damage to cells and tissues which may lead to cancer and inevitable death. High energy

radiations such as ultraviolet rays, X-rays, ionizing radiations from natural as well as man made sources may damage chromosomes and cause aberrations in DNA. These damages may cause genetic deformities which are irreparable and are transmitted to the next generation. Pregnant woman and infants are more susceptible to be effected by exposure to high energy radiations. They may be abosrbed by plants and passing through different trophic levels they finally reach human bodies where they cause many physiological aberrations. High energy radiations cause mutations in plants and may cause many morphological deformities and may lead to sterility. Low-energy radiations from computer sets, television, microwave ovens, mobile phones etc are found to cause fatigue, dizziness, headacht, cataratc, nervousness and skin diseases. The victims of radioactive pollution decline in vitality and fall prey to anaemia and blood cancer.

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### **5.7 Role of Individuals & Community in Preventing, Pollution :**

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All sections of society, rich and poor, literate and illiterate, urban and rural people, underdeveloped and developed nations; have contributed towards increasing pollution and aggravating environmental degradation. It is the primary need of the hour that each individual, community and the nations should rise to the occasion and act rationally to prevent pollution, protect environment and improve its quality.

With enlightened minds, firm determination and proper action, preventive and curativre practise can be adopted to prevent pollution and save and restore the environment.

We often talk of and complain about the increasing menace of environmental pollution and deteriorating environmental situation. We blame others for the deterioration in quality of the environment and the government for inaction. But this kind of thinking cannot alleviate the situation. Individuals are the building blocks of the community and nation. The commulative efforts of individuals group can bring about a miracle, if done with a sense of commitment. There is a need for a positive change in our attitude towards the environment. Many small things which we do in daily life, if properly planned and performed with determination, can produce positive results for the environment. We must remember that many momentous environmental movements began with a small group of enlightened individuals. These movements are now the role models to emulate.

The individual and the community are inseparable. The role of communitis in combating the evils of pollution and bringing about an improvement in the environment has been extensively elaborated in Agenda 21, prepared by the participants in the Earth summit held in Brazil in 1992. Agenda 21 stressed that local authroities would play a vital role in raising awareness and educating people about the environment and in bringing about sustainable development. Agenda 21 also urged that all local authorities be encouraged to implement and monitor programmes to ensure the participation and representation of women and youth in the decision making, planning and implementation processes.

#### **What can we do to prevent pollution and to save and restore the environment ?**

The guiding motto should be that YOU AND I SHARE EQUAL RESPONSIBILITY TO PREVENT POLLUTION AND TO SAVE OUR EARTH AND ITS ENVIRONMENT.

Instead of asking to oneself WHY SHOULD I one should ask WHY NOT SHOULD I ?

The collective voices of individuals and the communities can persuade the government authorities to notice the problems of pllution and the deteriorating environment, and influence industries to

become more mindful of their responsibilities. The activities of individuals and communities can influence the government in the processes of planning, decision making and framing laws relating to the environment.

Here are some important areas where we can make significant contributions in preventing pollution and improving the quality of our environment.

**(i) Tree plantation and protection of trees :**

Trees are the true friends of mankind.

- 1 Trees absorb atmospheric carbon dioxide (CO<sub>2</sub>) through the process of photosynthesis and give us oxygen (O<sub>2</sub>) to breathe in. Thus they regulate the delicate CO<sub>2</sub>-O<sub>2</sub> balance in the atmosphere.
- 1 They reduce the menace of noise pollution
- 1 They help to reduce the suspended particulate matter (SPM) in the air.
- 1 Forest, which represents a well organized community of flora (i.e. all kinds of plants including trees), regulate rainfall and climatic conditions, replenish ground water, control floods, silting and landslides, and prevent soil pollution. Trees give us fruits, timber and many other plant products.

For the protection of trees and promoting their number around us, a few tips for individuals are as follows.

- Y Be a Tarumitral (a Hindi word meaning 'friend of trees')
- Y Plant a tree and get a friend for ever.
- Y Plant a tree on your birthday and nourish it.
- Y Organize a plantation drive or participate in one launched by eco-lovers in your locality institution.
- Y Ask your parents and teachers for help to protect plants and trees from stray animals by putting fences around them.
- Y If someone cuts down a green tree or harms greenery, put up a humble resistance. Your resistance will surely influence him to desist him/her from doing so again in future.

It is well known that the chipko movement is a notable example of a community movement. which began as a local grassroot movement and developed into a broader national movement. It influenced the Government to change its policies and make decisions about the protection of trees and the forests.

**(ii) Energy Conservation :**

Electricity is produced mainly by burning coal, which is a fossil fuel that will not last long, moreover, the burning of coal produces pollutants of the air and generates a huge quantity of fly ash.

It is an area where individual and community efforts can greatly benefit our environment through reduction in pollution of air, water and soil. Individuals can develop habits to save electricity in their homes and working places. Community members can work for the development of community energy parks to promote the use of non-conventional energy sources such as solar, wind and biogas as substitute for fossil fuel based energy.

**(iii) Fuel Conservation :** Most of the fuels we use in our kitchens and in running our vehicles are fossil fuels. Burning of these fuels produces a number of pollutants. An individual can adopt

walking or cycling for short distance travels, proper tuning of personal scooters and cars, forming a car pool and using the public transport system rather than personal vehicles.

**(vi) Water Conservation :** Numerous measures can be adopted at the individual and community levels to reduce the extravagant consumption of fresh water and to protect water bodies from pollution by ignorant community members.

**(vi) Waste Reduction and Proper waste Disposal :**

Waste dumped and decaying here and there in public places is a potent health hazard. An individual can help in the proper management of domestic waste by segregating waste at the source. Composting, including vermicomposting, is an effective and beneficial method of municipal waste disposal. The community can work towards setting up common composting sites. Cooperation and financial assistance can be sought from government agencies as well as from non-governmental organizations.

**(vii) Environmental Awareness :**

The Stockholm Conference (1972) marked the beginning of the era of public participation in governmental environmental policies and programmes. In recent years public awareness of environmental issues is a major driving force in shaping policies and enacting laws relating to the environment. International policies to protect the environment are guided by public opinion.

The community can undertake short term and long term environmental awareness programmes to educate the common people, children, women and less informed sections of society. It should include programmes to

- Y develop respect for 'Mother Earth' with its greenery, scenic beauty and natural resources.
- Y develop respect for old traditions, customs and practices which include praying to trees, rivers and mountains, and adopting a benevolent attitude towards animals and forests.
- Y make people aware of the benefits of a healthy pollution free environment and of the ill effects of pollutants,
- Y make people aware of the harmful effects associated with smoking.
- Y acquaint people with the hazards of using plastic carry bags and other plastic items.
- Y acquaint people with the common pollutants of air, water and soil, and advising what an individual or a group can do to reduce the generation of such pollutants.
- Y organize programmes on World Environment Day (5 June), Earth Day (22 April), wildlife week (1-7 October) World Health Day (7 April) etc. As a part of the celebrations seminars, talks, debates etc. on environmental issues may be organized. Programmes of tree plantations, sweeping of lanes and public places, cleaning of public water sources (e.g. ponds, wells, lakes etc, can be undertaken to arouse the interest of common people in sanitation activities.

Success stories of some individual / community efforts to reduce pollution and benefit the environment.

Following are some examples of individual /community efforts which have influenced government policies and decisions on environmental issues.

(i) In 1962 Rachel Carson's book 'Silent Spring' led to mass resistance in the USA against pesticides use in agriculture. It prompted the then American president to set up an advisory panel on the use of pesticides.

(ii) A team of scientists of the Centre for Science and Environment (CSE), New Delhi found that the content of pesticides in bottled water and beverages was dangerously high. This created furore all over the country. The disclosure by CSE prompted the then central Government to set up a panel of experts to formulate the standards for bottled water and beverages. As a result the Government amended the Prevention of Food Adulteration Rules.'

(iii) Mr. M.C. Metha is a legendary figure known for emphasizing the role of the judiciary in combating environmental problems. In response to Mr. Metha's write petition No. 860 of 1991, the honourable Supreme Court observed that "We accept on principle that through the medium of education, awareness of the environment and its problems related to pollution, should be taught as a compulsory subject.

These are a few of a long list of success stories which emphasise that individual / community efforts can do a lot for a cleaner and healthier environment through many ways than one.

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## **5.8 Summary :**

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A solid, liquid or gaseous substance present in the biosphere in such concentration that may be, or tend to be injurious to living and non-living components of the environment is termed as environmental pollutant. Any undesirable change in the physical, chemical or biological segments of the biosphere caused by excessive accumulation of pollutants that is harmful to humans, other biological species and/or abiotic components of the environment is termed as environmental pollution. Pollution may be of Air, water and soil. Excessive loud sound and sources emitting harmful radiation are also injurious to human, other life forms or physical components of the environment. They are termed as noise pollution and radiation pollution respectively. Pollution adversely affects us by harming our physical and mental health and by damaging the agricultural and industrial processes, living conditions, physical environment and cultural assets. It may cause short term or long term, temporary or permanent damage. Pollution may harm an individual, engulf an entire community or affect the population of a region.

Pollution may be caused by natural processes as well as human activities (called anthropogenic sources).

As the things stand today Air, water and soil-the three life support systems of nature are gradually becoming unfit for human use and for other life forms on the earth.

All sections of society-rich and poor, literate and illiterate, urban and rural people, undeveloped and developed nations have contributed towards increasing pollution and aggravating environmental degradation. It is the primary need of the hour that each individual, community and the nation should rise to the occasion and act rationally to prevent pollution, protect environment and improve its quality.

With enlightened minds, determination and proper action, preventive and curative practices can be adopted to prevent pollution and save and restore the environment.

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### **5.9 Questions for Exercise:**

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1. Define pollutants and environmental pollution. Give a brief description of the air, water and soil pollution.
2. Distinguish between the following pair of terms giving suitable examples :
  - (i) Biodegradable and Nonbiodegradable pollutants
  - (ii) Primary pollutants and secondary pollutants
  - (iii) Point and Non point source pollutants.
  - (iv) Thermal pollution and Radiation pollution.
3. Describe in brief three major sources of air pollution. How do they effect the health of humans and other life forms on the earth ?
4. Write down two point sources and two nonpoint sources of water pollution. Mention the chemicals which are responsible for entrophication and their source.
5. In what way modern agricultural practices are a major source of soil pollution? Explain.
6. "Noise pollution is essentially a feature of the technology based society of modern times". Explain the statement.
7. What are ionising and non ionizing radiations ? What are other man sources in modern times ? Describe the ill effects of nuclear radiation on human health and the environment.
8. "Over 80 percent diseases, particularly in developing contries are linked with soil and water pollution." Give arguments is support of statement.
9. Describe brief the ill effect of high decibel nosie on human health and on animals.
10. Write short notes on the following :
  - (a) Suspended Particulate Matter (SPM)
  - (b) Smog
  - (c) Electrostate precipitator
  - (d) Sewage Treatment Plant (STP)
11. Describe in brief a few measures through which an individual and the community can adopt to prevent pollution and improve the quality of the environment.

**5.10 Suggested Reading:**

1. Environmental science : S.C. Santra :  
New Central Book Agency (P.) Ltd.  
Kolkata
2. Environmental chemistry : A.K. De :  
New Age International (P) Ltd. Publishers  
India.
3. Air Pollution : V.P. Kudesia :  
Pragati Prakashan, Meerut
4. Water Pollution : V.P. Kudesia :  
Praagi Prakashan, Meerut
5. Green Earth : A Text book on Environmental Education  
Dr. Bihari singh Kr. Ramjee Pd. singh  
Srijan Publishers Pvt. Ltd. New Delhi.

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