

Syllabus

Effects of Pollution — on the environment and human health.

All types of pollution — noise, air, water, soil and radioactive have an impact on all living organisms and their environment. Pollutants in the environment are responsible for environmental degradation. The effects of pollution range from mild discomfort to long term effects such as cancer and physical deformities. Increased pollution in the environment also cause psychological and behavioural disorders in human beings.

The effects of each type of pollution on the environment and on human beings are discussed below.

EFFECTS OF NOISE POLLUTION

The effects of noise pollution are multifaceted and interrelated. Noise pollution has ill effects not only on the human beings but also on the environment.

Effects on Environment

The noise booms cause cracks in national and archaeological monuments. Very high levels of noise are the cause of cracks in hills. High intensity explosions can break glass panes and cause vibrations in the buildings.

Effects on Human Health

- Effect on hearing or Deafness:** Continuous exposure to noise levels above 100 dB has

an adverse effect on hearing ability within a fairly short time. Many workers who are exposed to the noise of jet aircraft or very noisy workshops for even moderate periods soon develop detectable hearing defects.

- Effect on Communication:** External sounds can interfere with conversation and use of the telephone, as well as the enjoyment of radio and television programmes. It can thus, affect the efficiency of offices, schools and other places where communication is of vital importance.
- Interference with sleep:** Different people have different depths of sleep and they can adjust to natural sounds. However, noisy conditions near residential areas at night causes difficulties in sleeping.
- Mental or Physiological Effects:** Many people complain that noise makes them mentally ill. Experiments have been performed to confirm or disprove these claims. Doctors and scientists have now medically confirmed that noise disturbs the biological organisms and their respective

Effects of High Intensity Noise on Human Beings

| Noise (dB) | Effects Observed |
|------------|----------------------------------|
| <90 | Threshold of audibility |
| 130-135 | Nausea, vomiting, dizziness. |
| 140 | Pain in ear. |
| 150 | Significant change in pulse rate |
| 190 | Permanent damage to hearing. |

functions. Fire crackers and other excessive and continuous explosives become physically painful giving rise to neurosis, mental illness, cardiovascular diseases, stomach ulcers and respiratory disorders, thereby, reducing human life. Recent researches have concluded that short exposures to noise (in excess of about 100 dB) can lead to adverse effects on the foetus and cause headache, dizziness and stomach problems.

5. Effects on Physical health and Psychological problems: Noise has little physical effect on the biological performance provided that the noise level is below about 90 dB. Damage to the inner ear may result if continuous noise levels exceed about 100 dB and can lead to physical illness. Psychiatrists and psychologists have in recent researches made observations that noise has certain relation with physical health causing tension resulting in problems such as speech interference, annoyance, fatigue, sleep interference and emotional distress. Noise levels in industries cause interference in efficiency and communication and raises possibilities of accidents.

Effects on animals

Noise from industries, railways, crackers, explosions and commotion in the cities and aircraft, affect animals, birds, mice, fishes and domestic animals. Birds avoid migrating to places where noise level is above 100 dB. The noise emissions caused by supersonic aircraft and railways may cause miscarriage in mammals and fishes as well. Some of the birds have been found to have stopped laying eggs due to noise pollution.

EFFECTS OF AIR POLLUTION

Air Pollution is the presence in the air of one or more noxious gases and minute particles of solid and liquid matter (particulates) in harmful concentrations, of such duration and characteristics that is injurious to plants, animals, human beings and other materials.

Effects on Environment

The increase in the concentration of Carbon dioxide (CO_2) and other Greenhouse Gases like Methane, Nitrogen Oxide, Chlorofluorocarbons

and water vapour are responsible for increasing temperature on the earth. These gases trap the earth's heat and cause *Global Warming*, which will have the following effects on the environment:

- (i) Due to Global Warming, the regions of the Northern hemisphere will heat up more than other areas of the planet. In temperate mountains, snowlines will melt earlier.
- (ii) Winter and night time temperatures will tend to rise more than those of summer and day time.
- (iii) Rising warmth will lead to an increase in the level of evaporation of surface water; the air will also expand and this will increase its capacity to hold moisture. This, in turn, will affect water resources, forests, and other natural ecological systems, agriculture, power generation, infrastructure, tourism, and human health.
- (iv) Due to excessive heat, water will evaporate quickly. The soil affected with erosion, and devoid of vegetative cover, will not retain moisture for long. Hence, there would be droughts.
- (v) The rise in temperature would lead to the melting of glaciers which will form natural lakes between the mounds of debris and rocks that are left behind by the sliding glaciers. These will result in an imbalance in the outflow of water. This means that the glacial lakes will be fed with water from the melting ice faster than the rate at which they can be drained, thus making glacier lakes flood more frequently.
- (vi) Deltas will be threatened by flooding, erosion and salt intrusion. Loss of coastal mangroves will have an impact on fisheries. For example, the major delta area of the Ganga, Brahmaputra and Indus rivers, which have large populations will be affected by floods, salt water intrusion and land loss.

Effects on Human Health

The extent to which human beings are affected by air pollution depends on the duration of exposure and the concentration of the pollutants.

Common Air Pollutants and Their Effects on Human Health

| Pollutants | Effects on Human Health |
|--|--|
| 1. Carbon monoxide | Damages lungs, weakens bones, reduces the oxygen carrying capacity of blood and damages heart. |
| 2. Sulphur dioxide | Obstructs breathing, causes irritation of eyes and throat. |
| 3. Suspended Particulate Matter (as soot, smoke) | Causes Asthma, irritation of eyes and cancer. |
| 4. Oxides of Nitrogen (nitric oxide, nitrogen dioxide and nitrous oxide) | Cause acute respiratory infections, bronchitis, lowers resistance to influenza. |
| 5. Hydrocarbons | Affect the respiratory system. |
| 6. Ozone | Causes irritation of eyes and aggravates asthma. |
| 7. Lead | Causes brain damage, affects growth and leads to high blood pressure. |
| 8. Arsenic | Damages kidneys, cause jaundice, lung and skin cancer. |

Based on this criteria, air pollution has both *short-term* and *long-term* effects on human health.

The *short-term* effects of air pollution are:

- (i) irritation in the eyes, nose and throat;
- (ii) respiratory infections such as bronchitis and pneumonia;
- (iii) headaches, nausea, vomiting, dizziness, convulsions and allergic reactions;
- (iv) slurring of speech.

The *long-term* effects of air pollution are:

- (i) chronic respiratory disease;
- (ii) lung cancer;
- (iii) cardiovascular diseases and coma;
- (iv) damage to the nerves, brain, liver and kidneys.

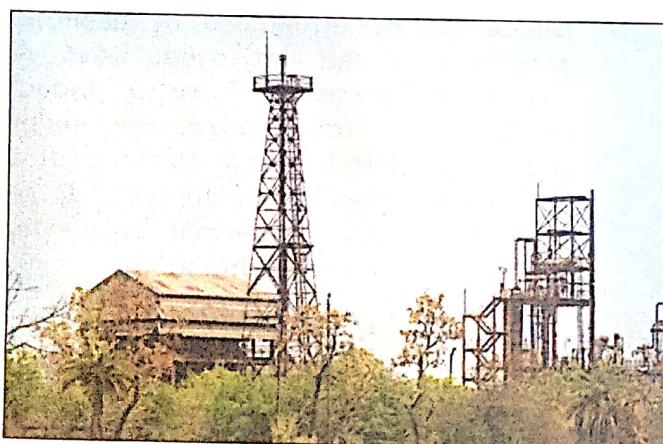


Fig. 18.1. Union Carbide Factory, Bhopal

Example: Bhopal Gas Tragedy was the worst industrial accident that happened on December 3, 1984. About 40 tons of toxic methyl isocyanate (MIC) gas leaked into the atmosphere from Union Carbide's pesticide factory in Bhopal in Madhya Pradesh. As a result of the accident, 3500 people were killed and about 40,000 people were affected in an area of 100 sq km.

The gas leak engulfed the city blinding people, choking their breathing and suffocating them. The gas affected the tissues of their eyes and lungs and attacked their nervous systems. People lost control of their bodies. Urine and faeces ran down their legs. Women lost their unborn children.

Effects of Pollutants on Plants

Air pollutants affect the growth of plants and metabolism by destroying chlorophyll and disrupting photosynthesis. The effects of air pollution on plants are:

- (i) Sulphur dioxide (SO_2) bleaches the surface of the leaves, causes loss of chlorophyll and results in yellowing of the leaves, especially in green leafy vegetables.
- (ii) Nitrogen dioxide (NO_2) results in the premature falling of leaves and suppressed growth of plants. This leads to reduced yield of crops.

- (iii) Ozone damages the leaves of plants.
- (iv) Peroxyacetyl Nitrate (PAN) damages leafy vegetables and causes premature fall, discolouration and curling of sepals.

Effects on Animals

Animals that feed on grass and plants (coated with polluted particulate matter) are affected with arsenic poisoning. Lead poisoning results in bronchitis and lack of appetite in pet animals.

Effects on Materials

The effects of air pollution on materials may be summarised as:

- (i) Soot, dust and fumes from air pollutants cause damage to the painted surfaces, fabrics and buildings.
- (ii) Sulphuric acid mist and acid rains damage marble and limestone. The Taj Mahal has suffered damage caused by sulphur dioxide (SO_2) in the atmosphere. Its marble structure is getting discoloured and corroded.
- (iii) Sulphur dioxide (SO_2) together with moisture forms sulphuric acid (H_2SO_4) and causes corrosion of metals like steel, copper, and zinc.
- (iv) Paper becomes brittle and leather undergoes disintegration by SO_2 and Acid gases.
- (v) Ozone, SO_2 , NO_2 , etc, discolour, deteriorate and reduce the strength of textiles.

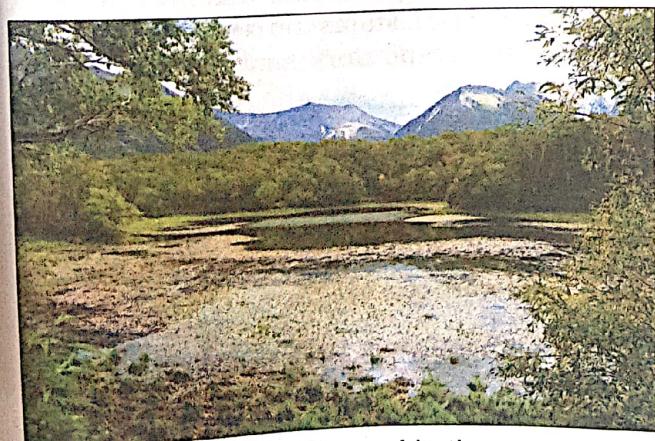


Fig. 18.2. Eutrophication

EFFECTS OF WATER POLLUTION

Water pollution affects man, aquatic animals as well as the environment.

Effects on Environment — Animals, Marine Life and Vegetation

Due to water pollution, the process of photosynthesis is obstructed. This affects the growth of aquatic vegetation. All the chemicals that are drained into the water have harmful effects on every organism that lives there.

The effect of water pollution on marine animals and plants is visible in two phenomena—*eutrophication* and *biomagnification*.

Eutrophication: It is the process of depletion of oxygen from waterbodies occurring either naturally or due to human activities.

The process of eutrophication takes place due to introduction of nutrients and chemicals through discharge of domestic sewage, industrial effluents and fertilisers from agricultural fields. The consequent nutrient accumulation results in phenomenal growth of phytoplankton and algae, thereby, reducing the penetration of oxygen, light and heat into the waterbody. As a result, most of the organisms die, draining water of all its oxygen.

Biomagnification: The term **Biomagnification** means increasing the concentration of various toxic substances along the food chain. Toxic substances at the level of primary producers get concentrated at each trophic level as they move up the food chain. The phenomenon of concentrated toxic deposition at the higher trophic level is known as **Bioaccumulation**. For example, if there are traces of toxic chemicals in water, then their concentration in algae will be much higher. When fish eat the algae, the concentration of toxins will increase further. Therefore, accumulation of a small amount of toxic chemicals in water can have a serious impact on the fish that live in it.

An example of the phenomenon of Biomagnification was first noticed in Illinois (USA) where elm trees were sprayed with DDT. A large number of birds like robins died near these trees. It was later discovered that these birds perished due to DDT poisoning. The lethal dose came from earthworms which they consumed. Earthworms had concentrated DDT residue by feeding on fallen elm leaves.

The other effects of water pollution are:

- (i) Phosphorus and Nitrates from the fertilisers and detergents contaminate surface water where they act as nutrients and promote the growth of oxygen consuming algae. This in turn, reduces the amount of dissolved oxygen in water and kills fish and other aquatic organisms.
- (ii) Industrial effluents result in the addition of poisonous chemicals such as Arsenic, Mercury, Cadmium, Lead etc., which kill aquatic organisms. These chemicals may reach human body through contaminated food (i.e., fishes etc.)
- (iii) Hot waste water released from power stations increases the temperature of water resources, reduces its oxygen level and makes it incapable of supporting life.
- (iv) Sea water polluted with crude oil leakage causes oil spills which contaminate sea water and lead to the death of marine organisms.

Effects on Human Health

Pathogens: Most of the wastewaters especially sewage contain pathogens (disease causing

organisms) like bacteria, viruses and protozoa. These pathogens enter the human body from contaminated drinking water and are responsible for several waterborne diseases like cholera, typhoid, diarrhoea, dysentery, hepatitis, polio and jaundice.

Toxic Compounds: Pollutants such as heavy metals, pesticides, cyanides and many other organic and inorganic compounds are harmful to all organisms. Some of the toxic substances do not undergo biodegradation and remain in the environment for a long time.

Toxic substances polluting the water ultimately affect human health. Some heavy metals like lead, mercury and cadmium cause various types of diseases.

- (i) Mercury dumped into water is transformed into water soluble methyl mercury by bacterial action. Methyl mercury accumulates in fish. People in Japan suffered from a disease called *Minamata* which resulted in numbness of body parts, vision and hearing problems and abnormal mental behaviour. This was caused by the consumption of methyl mercury contaminated fish caught from Minamata Bay in Japan.
- (ii) Pollution by the heavy metal, cadmium, caused the disease called *Itai-itai* among the people in Japan.
- (iii) Water contaminated with arsenic causes mental disorders, liver damage (cirrhosis), lung cancer, ulcers in gastrointestinal tract and kidney failure.
- (iv) Fluoride containing pollutants cause a disease called *fluorosis*, which causes discolouring of dental enamel and black and brown stains on the teeth. It also causes respiratory and gastrointestinal problems.

EFFECTS OF SOIL POLLUTION

Soil pollution affects human beings and animals indirectly through food chains. The effects of soil pollution on environment, human health and other organisms are discussed below.

Effects on Environment

- (i) Nitrogenous fertilisers produce toxic concentration of nitrate and nitrite in the leaves.

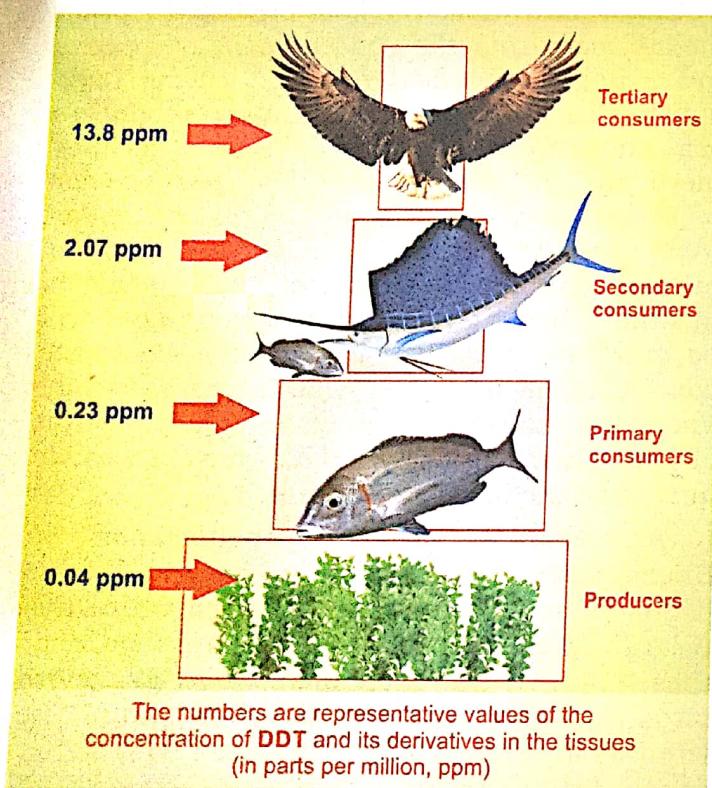


Fig. 18.3. Biomagnification

- (ii) Industrial and chemical wastes cause pollution of underground water.
- (iii) Nitrogen and phosphorous from the fertilisers accumulate in nearby water bodies with agricultural run-off and cause eutrophication. Chemicals may percolate and contaminate groundwater resources.
- (iv) Land and soil pollution is responsible for loss of fertility and productivity of soil.

Effects on Human Health

- (i) Soil contains many pathogenic bacteria, viruses and intestinal worms which are transmitted to man by the consumption of fruits and vegetables. These pathogens cause various types of diseases.
- (ii) Radioactive fallout on vegetation is the source of radioisotopes which enter the food chain through the grazing animals. Some of these radioisotopes cause abnormalities.
- (iii) Use of human and animal excreta as manure pollutes the soil. Excreta contains pathogens that contaminate the soil and vegetable crops and affect the health of human beings.

Effects on other Organisms

- (i) Particles in the sewage may clog the micro holes of the soil and destroy the micro-organisms necessary for the soil enrichment.
- (ii) Radioactive material moves away from the soil into crops, livestock and human bodies through food chains.
- (iii) Many pesticides are absorbed by plants and reach animals and humans via food chains.

EFFECTS OF RADIOACTIVE POLLUTION

Radioactive pollution is caused by testing of nuclear weapons, establishment of nuclear power plants, mining and refining of radioactive substances like uranium, thorium and plutonium and during medical treatment using X-rays.

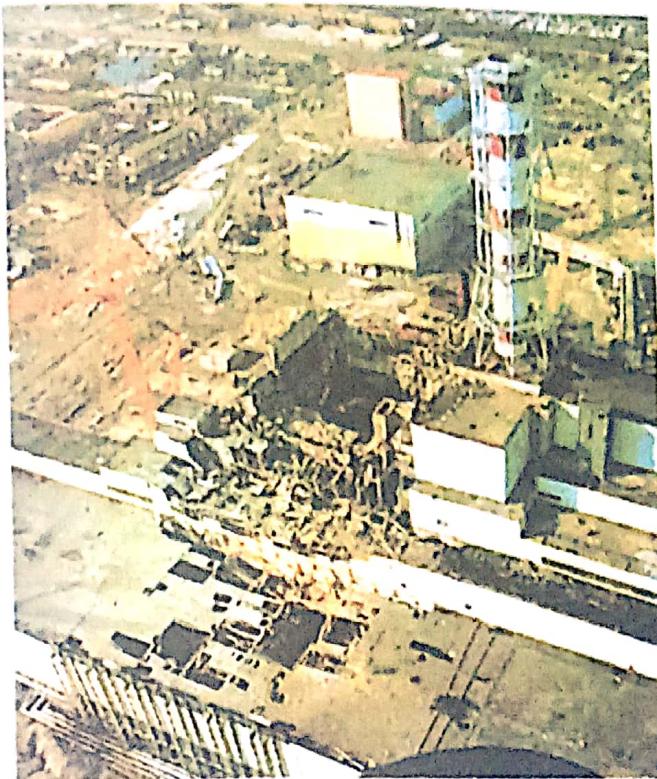


Fig. 18.4. Chernobyl Disaster

Effects on Environment

Radiations emitting from radioactive materials and the disposal of radioactive wastes cause pollution and damage the environment.

The high level products of nuclear wastes remain in the environment for several hundred years. Other radioactive threats to the environment are the accidents connected with the activities of nuclear reactors, nuclear-powered vessels and satellites, etc.

Effects on Human Health

Radiations affect living organisms. They cause harmful changes in the body cells and at genetic level.

- (i) **Genetic Variation:** The damage caused by radiations is often seen in the offspring and may be transmitted to many generations.
- (ii) **Somatic Variation:** Short term exposures to radiation can cause damage to organs of the body. The harm done by them includes breast cancer, thyroid cancer, lung cancer and brain cancer, sterility and defective eyesight.

Effects on Animals

Radioactive substances resulting from explosion of nuclear devices or nuclear wastes penetrate the soil from where they enter into the food chain and get concentrated in the body tissue of animals and have adverse effects on them.

Example: There was a radioactive accident in 1986 in Chernobyl in the Ukraine (then a part of the former USSR). On April 26, 1986, a Reactor at the nuclear power complex at Chernobyl exploded. There was a massive steam explosion. The core of the reactor combined with water

to produce hydrogen which exploded blowing toxic radioactive gases into the air. There were numerous fires. The Chernobyl accident is considered as the most disastrous nuclear power plant accident, both in terms of cost and casualties.

Due to the accident, 237 people suffered from acute radiation sickness, of whom 31 died within the first three months. After the disaster, four square kilometres of pine forest near the reactor turned reddish-brown and died, earning the name of the "Red Forest". Some animals in the worst-hit areas died or stopped reproducing.

EXERCISES

I. Choose the correct option:

1. What is the effect of 150 dB of noise?
(a) Pain in ear
(c) Permanent damage to hearing
(b) Significant change in pulse rate
(d) Nausea, vomiting, dizziness
2. Birds avoid migrating to places where noise level is above _____.
(a) 100 dB
(b) 90 dB
(c) 150 dB
(d) 140 dB
3. The process of depletion of oxygen from waterbodies occurring either naturally or due to human activities.
(a) Biomagnification
(c) Bioaccumulation
(b) Eutrophication
(d) Pollution
4. The increase in the concentration of various toxic substances along the food chain:
(a) Biomagnification
(c) Bioaccumulation
(b) Eutrophication
(d) Pollution
5. The phenomenon of concentrated toxic deposition at the higher trophic level is known as:
(a) Biomagnification
(c) Bioaccumulation
(b) Eutrophication
(d) Pollution
6. Name the disease which resulted in numbness of body parts, vision and hearing problems and abnormal mental behaviour in Japan.
(a) Corona Virus
(c) Encephalitis
(b) Minamata
(d) Fluorosis
7. In Japan, pollution by heavy metal, cadmium, caused the disease called _____.
(a) Itai-itai
(b) Minamata
(c) Encephalitis
(d) Fluorosis
8. Which disease causes discolouring of dental enamel and black and brown stains on the teeth?
(a) Itai-itai
(b) Minamata
(c) Encephalitis
(d) Fluorosis
9. The Municipal Corporation of your city has banned all construction activities from 5 pm to 9 am. Why?
(a) To enable people to sleep.
(b) To reduce the noise produced by the activity.
(c) To reduce the physiological effects of noise pollution.
(d) All of the above.

II. Short Answer Questions

1. How does noise pollution affect animals?
2. What major harm is done to human beings by air pollution?
3. How are animals affected by air pollution?
4. What is the effect of oil spills on marine life?
5. What causes waterborne diseases? Name two waterborne diseases.
6. In what way does soil pollution affect human beings?
7. A landfill was reclaimed and sturdy plants were grown on it instead of crops or fruit trees. Why?
8. Give the impact of radiations on human body.
9. Why are nuclear radiations more dangerous than other forms of pollution?
10. Crude oil from a refinery has leaked into the Kosasthalaiyar river (north of Chennai), the biodiverse Ennore creek (where many migratory birds come) and the Bay of Bengal. This has caused pollution. List what all could have been impacted and how?

III. Structured Questions

1. (a) State briefly how noise pollution is detrimental to human health.
(b) How does air pollution affect human beings?
(c) Explain how the accumulation of nutrients and chemicals in the water prove fatal for the marine organisms.
(d) With the help of a well labelled diagram explain how the accumulation of toxic substances increases as we move up the food chain.
2. (a) State any two effects each of soil pollution on human beings and environment.
(b) Name three common air pollutants and their effects on human health.
(c) What are pathogens? How do they enter human body? Name any three diseases caused by these pathogens.
(d) State with examples the effects of radiations on the human beings and environment.

IV. Thinking Skills

1. The apparent lack of concern for the effects of pollution seems to be the reason for not implementing plans to prevent pollution. Justify this statement with examples.
2. Which is the most visible effect of pollution on human beings in your city? What are the causes and possible remedies?
3. Northern India is enveloped in smog in the month of November. List the causes for the same.