

AIR POLLUTION

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

Air Pollution: It is an atmospheric condition in which certain substances are present in concentrations which can cause undesirable effects on man and his environment.

•These substances include gases, particulate matter, radioactive substances etc.

Classification of Air Pollutants: on the basis of origin of pollutants they can be classified as primary and secondary pollutants.

Primary Pollutants: These are emitted directly from the point source .
•Carbon monoxide, oxides of nitrogen, oxides of sulphur, hydro carbons, radioactive substances.

Secondary Pollutants: These are formed by interaction of primary pollutants with other primary pollutants or with some natural constituents of atmosphere. E.g. Ozone, PAN, Photochemical smog.

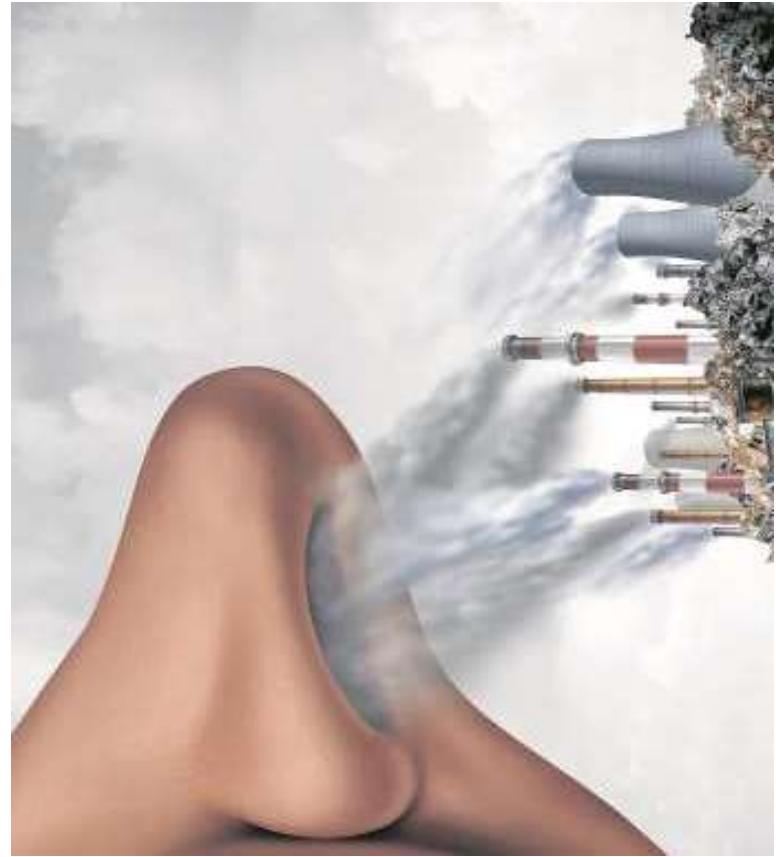
- **Sources of Air Pollutants:** The sources of air pollution are natural and man-made.
 - **Natural Sources:** The natural sources of air pollution are volcanic eruptions, forest fires, sea salt sprays, biological decay, photochemical oxidation of terpenes.
 - **Man-Made:** Man made sources include thermal power plants, industrial units, vehicular emissions, fossil fuel burning, agricultural activities etc.
- **Effects of Air Pollution:** Air pollution has adverse effects on living organisms and materials.
- **Effects on Human Health:** Years of exposure to air pollutants (including cigarette smoke) adversely affect these natural defenses and can result in lung cancer, asthma, chronic bronchitis and emphysema(shortness of breath)
- Suspended particles (SPM) can cause damage to lung tissues and diseases like asthma and bronchitis.
- SO_2 causes constriction of respiratory passage and cause bronchitis.

- Oxides of Nitrogen can irritate the lungs and cause bronchitis and emphysema.
 - CO may cause dizziness, unconsciousness and even death.
 - Many other air pollutants like benzene, formaldehyde and polychlorinated biphenyls, toxic metals and dioxins can cause mutations, reproductive problems or even cancer.
 - Many other hazardous materials like Asbestos, Beryllium, Mercury, Arsenic and radioactive substances cause lung disease and or affect other vital organs like kidney, liver, spleen, brain and some may also cause cancer.
- **Effects on Plants:**
 - SO_2 causes bleaching of leaves, chlorosis, injury and necrosis of leaves.
 - NO_2 increased abscission and suppressed growth.
 - O_3 causes flecks on leaf surface, premature aging , necrosis and bleaching.
 - PAN causes silvering of lower surface of leaf damage to young and more sensitive leaves and suppressed growth. Fluorides cause necrosis of leaf-tip.

- **Effects on aquatic life:** air pollutants mixing up with rain can cause high acidity in fresh water lakes.
 - **Effects on materials:** Because of their corrosiveness, particulates can cause damage to exposed surfaces.
 - Presence of SO_2 and moisture can accelerate corrosion of metallic surfaces due to formation of sulfuric acid.
 - Sulfuric acid formed by the atmospheric SO_2 and water vapors damage leather binding of books.
 - Ozone in the atmosphere can cause crack the rubber.
- Control of Air Pollution:**
- Siting of industries after proper Environmental Impact Assessment Studies.
 - Minimizing activities which cause pollution like transportation and energy production.
 - Modification of process or equipments.
 - Using low sulphur coal in industries.
 - Removing sulphur from coal.
 - Using mass transport system, bicycles etc.

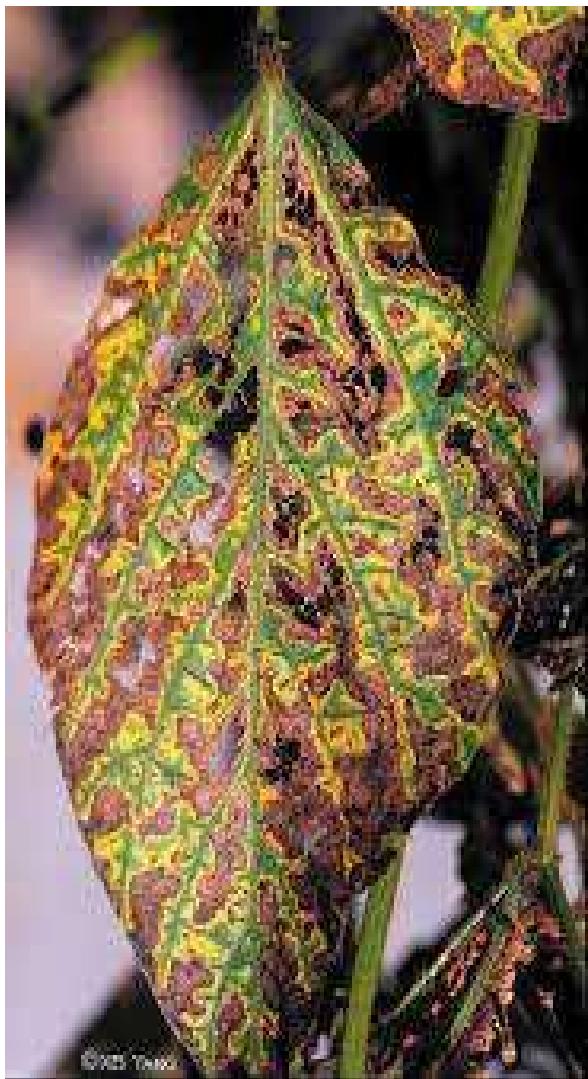
- Using non-conventional sources of energy.
- Using Biological filters and bio-scrubbers.
- Planting more trees.
- Reduction of pollution at source.
- Shifting to less polluting (clean) fuels (Hydrogen gas)
- Replacement of more polluting old vehicles.







Foliage plant heavily damaged by red-spotted caterpillars.



WATER POLLUTION

- Water pollution can be defined as alteration in physical, chemical or biological characteristics of water making it unsuitable for designated use in its natural state.
- **Sources of water pollution:** pollution of water can be caused by point sources and non-point sources.
- Point sources are specific sites near water which directly discharge effluents into them.
- Major **point sources** of water pollution are industries, power plants, underground coal mines, offshore oil wells.
- The discharge from **non-point sources** is not at any particular site rather, these sources are scattered, which individually or collectively pollute water.
- Surface run-off from agricultural fields, overflowing small drains, rain water sweeping roads and fields, atmospheric deposition etc. are the non-point sources.

- **Ground water pollution:** Ground water forms about 6.2% of the total water available on planet earth and is about 30 times more than surface water (streams, lakes and estuaries)
 - Ground water seems to be less prone to pollution. However, there are a number of potential sources of ground water pollution, septic tanks, industry, deep well injection, mining etc. are mainly responsible for ground water pollution, which is irreversible.
 - Ground water pollution with arsenic, fluoride and nitrate are posing serious health hazards.
- **Surface water pollution:** The major sources of surface water pollution are:
 - **Sewage:** Emptying the drains and sewers in fresh water bodies cause water pollution.
 - **Industrial effluents:** Industrial wastes containing toxic chemicals, acids, alkalis, metallic salts, phenols, cyanides, ammonia, radioactive substances are sources of water pollution. They also cause thermal pollution of water.
 - **Synthetic detergents:** these are used in washing and cleaning produce foam and pollute water.

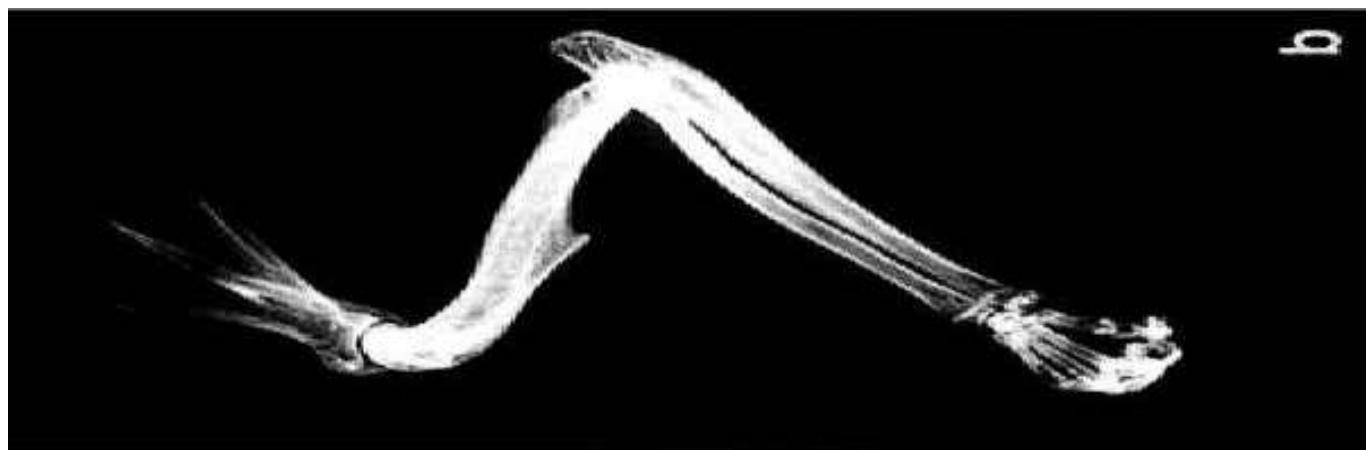
- **Agrochemicals:** Agrochemicals like fertilizers (containing nitrates and phosphates) and pesticides washed by rain-water and surface run-off pollute water.
- **Oil:** Oil spillage into sea-water during drilling and shipment pollute it.
- **Waste heat:** waste heat from industrial discharges increases the temperature of water bodies and affects distribution and survival of sensitive species.
- **Effects of water pollution:** Following are some important effects various types of water pollutants:
 - **Oxygen demanding wastes:** organic matter which reaches water bodies is decomposed by micro-organisms present in water. For this degradation oxygen dissolved in water is consumed.
 - DO is the amount of oxygen dissolved in given quantity of water at a particular temperature and atmospheric pressure.
 - Amount of dissolved oxygen depends on aeration, photosynthetic activity in water, respiration of animals and plants and ambient temperature.
 - Oxygen depletion helps in release of phosphates from bottom sediments and causes eutrophication.

- **Nitrogen and phosphorus compounds:** addition of compounds containing nitrogen and phosphorus helps in the growth of algae and other plants which when die and decay consume oxygen of water.
- **Pathogens:** many wastewaters especially sewage contain many pathogenic and non-pathogenic micro-organisms and many viruses.
- Water born diseases like cholera, dysentery, typhoid, jaundice etc are spread by water contaminated with sewage.
- **Toxic compounds:** Pollutants such as heavy metals, pesticides, cyanides and many other organic and inorganic compounds are harmful to aquatic organisms.
- The demand of DO increases with addition of biodegradable organic matter which is expressed as biological oxygen demand (BOD)
- BOD is defined as the amount of DO required to aerobically decompose biodegradable organic matter of a given volume of water over a period of 5 days 20°C .

- The non-biodegradable toxic compounds biomagnify in the food chain and cause toxic effects at various levels of food chain.
- Substances like DDT are not water soluble and have affinity for body lipids. These substances tend to accumulate in the organisms body. This process is called **bioaccumulation**.
- The concentration of these toxic substances builds up at successive levels of food chain is called **biomagnification**.
- **Minamata Disease** occurred due to consumption of methyl mercury contaminated fish caught from Minamata bay in Japan.
 - In 1953, people in Japan suffered from numbness of body parts, vision and hearing problems and abnormal mental behaviour.
 - Pollution by another heavy metal **cadmium** had caused the disease called **Itai-itai** in the people of Japan.
- The disease was caused by cadmium contaminated rice.
- In this disease bones, liver, kidney, lungs, pancreas and thyroid are affected.
- Arsenic pollution of ground water in Bangladesh and West Bengal is causing various types of abnormalities.

- Nitrate when present in excess in drinking water causes **blue baby syndrome or methaemoglobinemia**.
- Excess of fluoride in drinking water causes defects in teeth and bones called **fluorosis**.
- Pesticides in drinking water ultimately reach humans and are known to cause various health problems. DDT, Aldrin, dieldrin etc. have therefore, been banned.
- Recently, in Andhra Pradesh, people suffered from various abnormalities due to consumption of **endosulphsan** contaminated cashew nuts.
- **Control of water pollution:** It is easy to reduce water pollution from point sources by legislation.
 - Judicious use of agrochemicals like pesticides and fertilizers which will reduce their surface run-off and leaching.
 - Use of nitrogen fixing plants to supplement the use of fertilizers.
 - Adopting integrated pest management to reduce reliance on pesticides.
 - Prevent run-off of manure.

- Separate drainage of sewage and rain water should be provided to prevent overflow of sewage with rain water.
- Planting trees would reduce pollution by sediments and will also prevent soil erosion.
- For controlling water pollution from point sources, treatment of waste water is essential before being discharged.





SOIL POLLUTION

- Soil is the upper layer of the earth crust which is formed by weathering of rocks.
- Organic matter in the soil makes it suitable for living organisms.
- Dumping of various types of materials especially domestic and industrial wastes causes soil pollution.
- **Sources of Soil Pollution:**
 - Industrial wastes are the effluents discharges from chemical industries, paper and pulp mills, tanneries, textile mills, steel industries, distilleries, refineries, pesticides and fertilizer industries, pharmaceutical industries, food processing industries, thermal and nuclear power plants, mining industries etc.
 - Thermal power plants generate a large quantity of 'Fly ash'. Huge quantity of these wastes are dumped on soils, thus contaminating them.
 - Pesticides are used to kill pests that damage crops.
 - The pesticides ultimately reach the soil and persist there for a long time.

- Industrial wastes also contain some organic and inorganic compounds that are refractory and non-biodegradable.
 - Industrial sludge may contain various salts, toxic substances, metals like mercury, lead, cadmium, arsenic etc.
 - Agro chemicals released with the wastes of pesticide and fertilizer factories or during agricultural practices also reach the soil and pollute it.
 - The sources of radioactive substances in soil are explosion of radioactive devices, radioactive waster discharged from industries and laboratories.
- Effects of soil pollution:**
- Sewage and industrial effluents which pollute the soil ultimately affect human health.
 - Industrial discharges affect soil fertility by causing changes in physical, chemical and biological properties.
 - Some of the persistent toxic chemicals inhibit the non-target organisms, soil flora and fauna and reduce soil productivity.
 - These chemicals accumulate in food chain and ultimately affect human health.

- Decomposing organic matter in soil also produce toxic vapours.
- Radioactive fallout on vegetation is the source of radio-isotopes which enter the food chain in the grazing animals.
- Some of these radio isotopes replace essential elements in the body and cause abnormalities e.g. strontium-90 instead of calcium gets deposited in the bones and tissues.
- The bones become brittle and prone to fracture.
- **Control of soil pollution:**
- Effluents should be properly treated before discharging them on the soil.
- Solid wastes should be properly collected and disposed off by appropriate method.
- From the wastes, recovery of useful products should be done.
- Biodegradable organic waste should be used for generation of biogas.
- Cattle dung should be used for methane generation.



Reusing Waste Water in Paper and Pulp Manufacturing Unit





NOISE POLLUTION

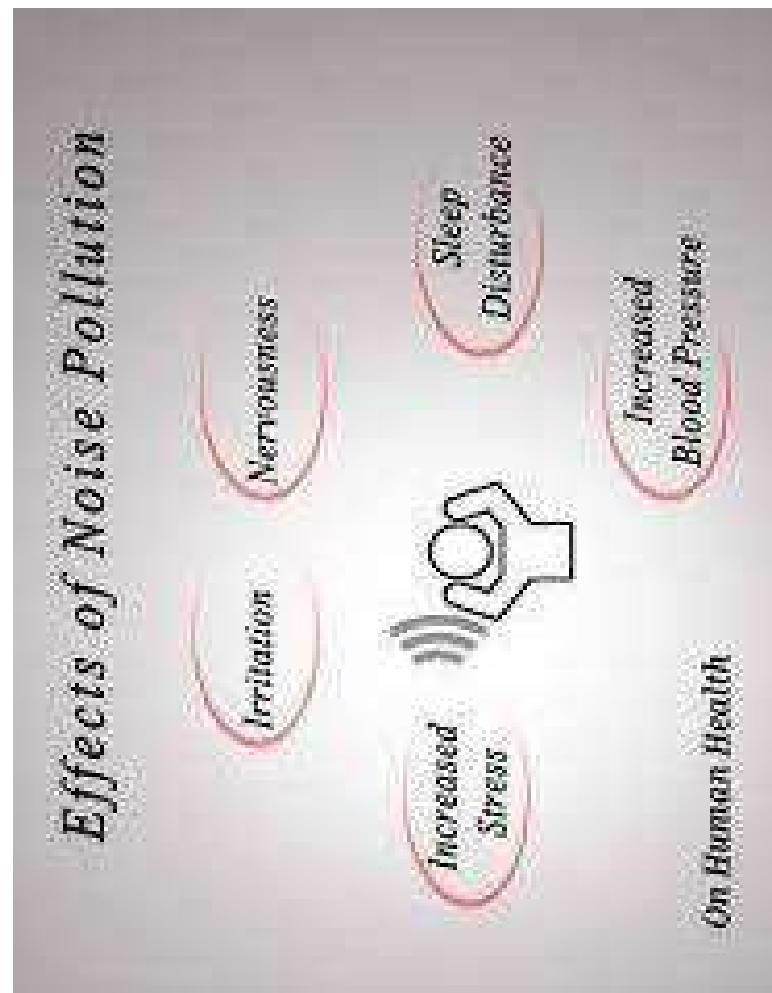
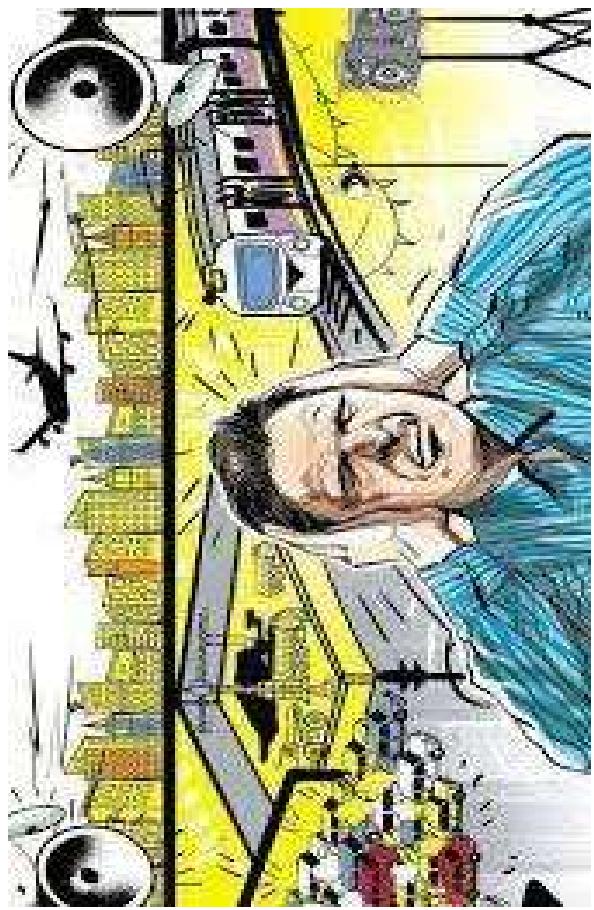
- The unpleasant and unwanted sound is called noise.
- Noise can affect human ear because of its loudness and frequency.
- The Central Pollution Control Board (CPCB) committee has recommended permissible noise levels for different locations as given in table.

S.No	Category Area	Day (Noise levels in db)	Night (Noise levels in db)
1	Industrial	75	70
2	Commercial	65	55
3	Residential	55	45
4	Silence Zone	50	40

- **Sources of Noise Pollution:**

- The main source of noise are various modes of transportation, industrial operations, construction activities and celebrations and electric home appliances.
- **Effects of Noise:** Noise cause the following effects:
 - **Interferes with man's communication:** In a noise area communication is severely affected.
 - **Hearing Damage:** Noise can cause temporary or permanent hearing loss. It depends on intensity and duration of sound level.
 - **Physiological and Psychological changes:** continuous exposure to noise affects the functioning of various systems of the body.
 - It may result in hypertension, insomnia (sleeplessness), gastro intestinal and digestive disorders, peptic ulcers, blood pressure changes, behavioral changes and emotional changes.
- **Control of Noise Pollution:**
 - Reduction in sources of noise: sources of noise pollution like heavy vehicles and old vehicles may not be allowed to ply in the populated areas.

- Noise making machines should be kept in containers with sound absorbing media.
- Proper oiling will reduce the noise from the machinery.
- **Use of sound absorbing silencers:** silencers can reduce noise by absorbing sound. For this purpose various types of fibrous material could be used.
- Planting more trees have broad leaves.
- **Through law:** Legislation can ensure that sound production is minimized at various social functions. Unnecessary horn blowing should be restricted especially in vehicle-congested areas.



MARINE POLLUTION

• **Definition:** Introduction of substances into the marine environment directly or indirectly by humans resulting in adverse effects such as hazards to human health, obstruction of marine activities and lowering of the quality of sea water .

• Causes:

- The most obvious input of waste is through pipes directly discharging waste into the sea.
- Pesticides and fertilizers from agriculture, which are washed off the land by rain, enter water courses and eventually reach the sea.
- Petroleum and oils washed off from roads normally enter the sewage system but storm water overflows carry these materials into rivers and eventually into the seas.
- Ship accidents and accidental spillages at sea can be damaging to the marine environment.
- Offshore oil exploration and extraction also pollute the seawater to a large extent.

- **Control Measures:**

- One way of reducing the pollution load on marine waters is by introducing sewage treatment plants.
- This will reduce the biological oxygen demand of the final product before it is discharged due to the receiving waters.
- Various stages of treatment such as primary, secondary or advanced can be used, depending on the quality of the effluent to be treated.
- Sewage----- Course screening ----- Fine screening ----- Grit Removal (Sand, Gravel) ----- Primary settling tank ----- Chlorination ----- **Effluent.**
- Influent ----- Screening to remove pollutants ----- grit chamber, organic material settles ----- Primary settling tank ----- Chlorination ----- **Effluent.**
- After primary and secondary treatment to remove specific contaminants(chemical treatment) ----- Filtration and Disinfection ----- **Effluent**

- **Effects of Marine Pollution:**

- Phytoplankton blooms or red tides causing a whole area of the water to be discolored as a result of large amount of organic waste.
- Clogging of gills of marine species. This further has an impact on commercially important marine species, reducing the market value of sea food.
- Damaging impacts of oil slicks on marine and bird species, salt marshes and mangrove swamps which tend to trap oil, affecting their flowering, fruiting and germination.

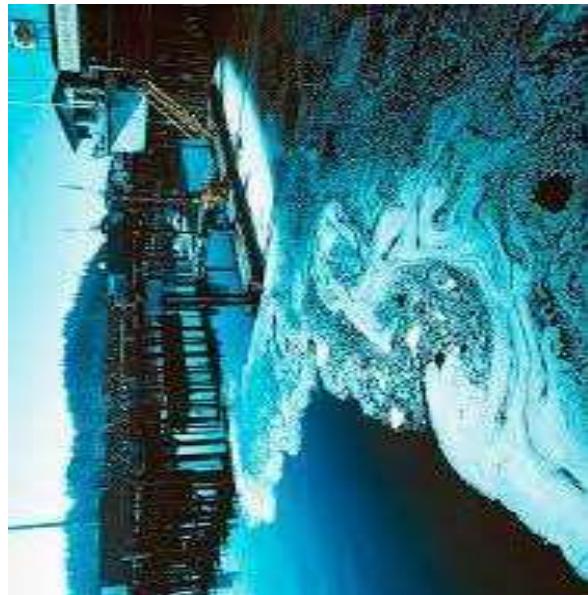


TERMAL POLLUTION

- Thermal pollution refers to degradation of water quality as a result of any process that changes the ambient water temperature.
- It occurs when an industry removes water from a source, uses the water for cooling purposes, and then returns the heated water to its source.
- **Effects:**
- The warmer temperature decreases the solubility of oxygen and increases the metabolism of fish.
- This changes the ecological balance of the river.
- Within certain limits, thermal additions can promote the growth of certain fish and the fish catch may be high in the vicinity of a power plant.
- Tropical marine animals are generally unable to withstand a temperature increase of $2 - 3^{\circ}\text{C}$ and most sponges, mollusks and crustaceans are eliminated at temperatures above 37°C
- This results in a change in the diversity of fauna, as only those species that can live in warmer water will survive and proliferate excessively.

- **Control Measures:**

- Thermal pollution can be controlled by passing the heated water through: a large shallow cooling pond into which hot water is pumped from one end and cooler water is removed from the other (or)
 - A cooling tower after it leaves the condenser.
 - The heat is dissipated into the air and the water can then be discharged into the river or pumped back to the plant to be reused for cooling.



NUCLEAR HAZARDS

- Radioactive substances are present in nature.
 - The isotopes release energy either in the form of gamma rays or ionization particles. i.e. alpha particles and beta particles.
 - The alpha particles are fast moving positively charged particles whereas beta particles are high speed negatively charged electrons.
- **Sources of Radioactivity:**
- **Natural sources:** cosmic rays from outer space, radioactive radon-222, soil, rocks, air, water and food, which contain one or more radioactive substances.
 - **Anthropogenic sources:** these sources are nuclear power plants, nuclear accidents, X-rays, diagnostic kits, test laboratories etc.
 - **Effects of Radiations:** Ionization radiation can affect living organisms by causing harmful changes in the body cells and also changes at genetic level.

- Genetic damage is caused by radiations, which induce mutations in the DNA, thereby affecting genes and chromosomes.
- The damage is often seen in the offsprings and may be transmitted upto several generations.
- Somatic damage includes burns, miscarriages, eye cataract and cancer of bone, thyroid, breast, lungs and skin.
- I^{131} accumulates in thyroid gland and causes cancer.
- Sr^{90} accumulates in the bones and causes leukemia or cancer of bone marrow.
- **Control of Nuclear Pollution:**
 - Siting of nuclear power plants should be carefully done after studying long term and short term effects.
 - Proper disposal of wastes from laboratory involving the use of radioisotopes should be done.





SOLID WASTE MANAGEMENT

- management has become very important in order to minimize the adverse effects of solid wastes.
 - solid waste can be classified as municipal, industrial, agricultural, medical, mining waste and sewage sludge.
- **Sources of Urban Wastes:**
 - Urban waste consists of medical waste from hospitals; municipal solid wastes from homes, offices, markets (commercial waste) small cottage units, and horticultural waste from parks, gardens, orchards, etc.
 - **Waste from homes:** contains a variety of discarded materials like polyethylene bags, empty metal and aluminum cans, scrap metals, glass bottles, waste paper, food waste etc.
 - **Waste from shops:** mainly consist of waste paper, packaging material, cans, bottles, polyethylene bags, pea nut shells, egg shells, tea leaves etc.
 - **Biomedical waste:** includes anatomical wastes, pathological wastes, infectious wastes etc.

- **Construction/demolition waste:** includes debris and rubbles, wood, concrete etc.
- **Horticulture waste and waste from slaughter houses:** include vegetable parts, residues and remains of slaughtered animals, respectively.
- **Industrial waste:** Industrial waste consists of a large number of materials including factory rubbish, packaging material, organic wastes, acids, alkalis and metals etc.
- During some industrial processing large quantities of hazardous and toxic materials are also produced.
- The main sources of industrial wastes are chemical industries, metal and mineral processing industries.
- Radioactive wastes are generated by nuclear power plants.
- Thermal power plants produce fly ash in large quantities.
- e- waste: Discarded electronic materials.

- **Effects of Solid Wastes:**

- Municipal solid wastes heap up on the roads due to improper disposal system.
- People clean their own houses and litter their immediate surroundings which affects the community including themselves.
- This type of dumping allows biodegradable materials to decompose under controlled and unhygienic conditions.
- This produces foul smell and breeds various types of insects and infectious organisms besides spoiling the aesthetics of the site.
- Industrial solid wastes are sources of toxic metals and hazardous wastes, which may spread on land and can cause changes in physico-chemical and biological characteristics thereby affecting productivity of soils.
- Burning of some of these materials produce dioxins, furans and polychlorinated biphenyls, which have the potential to cause various types of ailments including cancer.

- **Management of solid waste:** For waste management we stress on ‘three R ‘s’ – Reduce, reuse and recycle before destruction and safe storage of wastes.
- **Reduction in use of raw materials:** Reduction in the use of raw materials will correspondingly decrease the production of waste.
- **Reuse of waste materials:** The refillable containers which are discarded after use can be reused.
- **Recycling of materials:** Recycling is the reprocessing of discarded materials into new useful products.
- The process of reducing, reusing and recycling saves money, energy, raw materials, land space and also reduces pollution.
- Recycling of paper will reduce cutting of trees for making fresh paper.
- Reuse of metals will reduce mining and melting of ores for recovery of metals from ores and prevent pollution.

- For **discarding wastes** the following methods can be adopted:
- **Sanitary landfill:** In a sanitary landfill, garbage is spread out in thin layers, compacted and covered with clay or plastic foam.
- **Composting:** Due to shortage of space for landfill in bigger cities, the biodegradable yard waste (kept separate from the municipal waste) is allowed to degrade or decompose in an oxygen rich medium.
- A good quality nutrient rich and environmental friendly manure is formed which improves the soil conditions and fertility.
- **Incineration:** Incinerators are burning plants capable of burning a large amount of materials at high temperature.





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DISASTER MANAGEMENT

- The Indian subcontinent is very vulnerable to droughts, floods, cyclones, earthquakes, landslides and forest fires.

Earthquakes and Mitigation Measures:

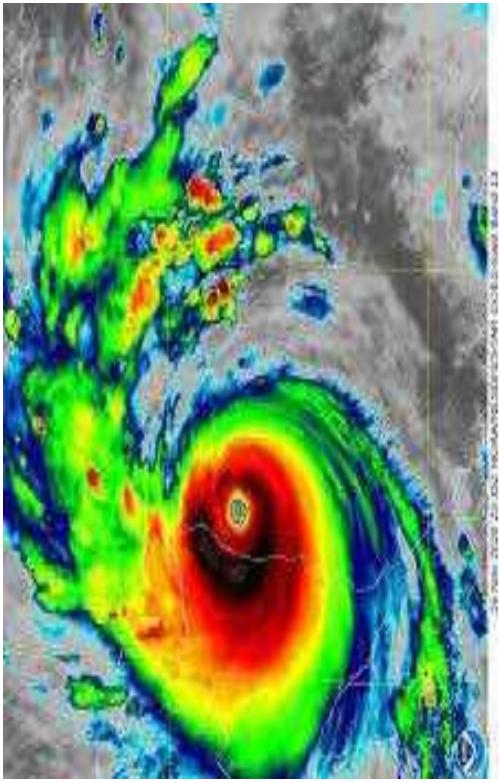
- An earthquake is the shaking of the surface of the Earth resulting from a sudden release of energy in the Earth's lithosphere that creates seismic waves.
- It has been several years since the earthquake struck Gujarat on 26 January 2001.
- In these years, rehabilitation has been undertaken on a massive scale.
- Gujarat's experience has taught that building shelters that are less vulnerable to earthquakes should also take into consideration.
- The role of NGOs in this is very important.
- Their ability and strength lies in their resources and informality in operations.
- The coordination between Government, local NGOs and local community initiatives, both for rescue as well as rehabilitation, needs to be strengthened as this can cause delays, overlaps and waste of relief material and efforts.

- **Mitigation Measures:**

- Detailed studies of the geology on regional and project level scales.
- Applying earthquake-resistant designs on project site.
- Training architects and engineers in seismically-safe building designs.
- Establish revise building codes
- Retrofitting of lifeline buildings.
- Strengthen emergency response in earthquake-prone areas.
- Mainstreaming mitigation in rural development schemes
- Emergency health management in medical education.
- Secure homes/furniture.
- Training public in earthquake-prone areas.



- **Cyclones and Mitigation measures:**
 - Tropical cyclones are the worst natural hazards in the tropics.
 - They are large revolving vortices in the atmosphere extending 150-1000 km horizontally and 12-14 km vertically from the surface.
 - They generally move 300-5000 km per day over the ocean.
 - While moving over the ocean, they pick up energy from the warm water of the ocean.
 - The main dangers from cyclones are very strong winds, torrential rains and high storm tides.
- **Mitigation Measures:**
 - Installation of early warning systems.
 - Developing communication infrastructure.
 - Developing shelter belts.
 - Developing community cyclone shelters.
 - Construction of permanent houses.
 - Training and education.
 - Land use control and settlement planning.

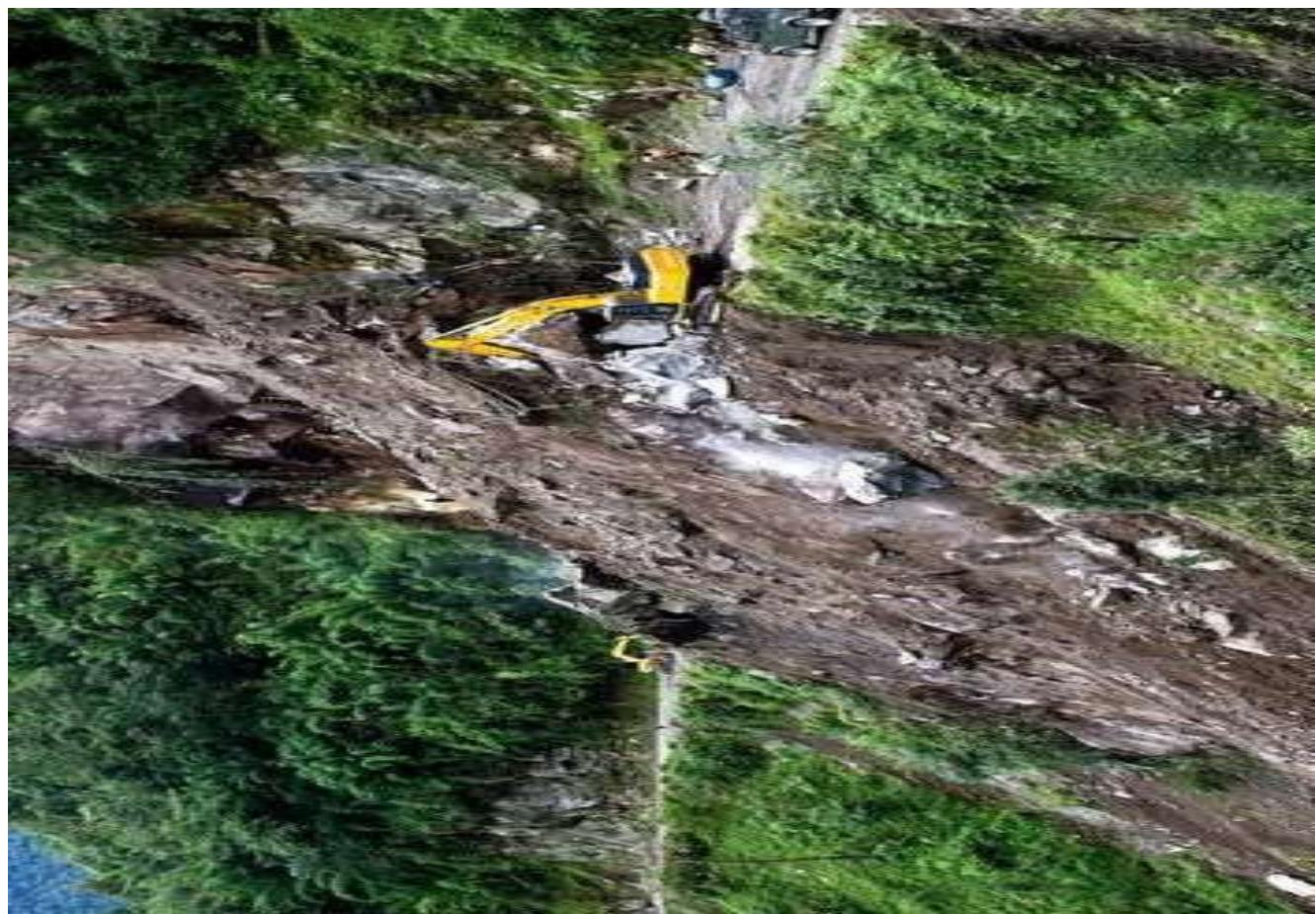


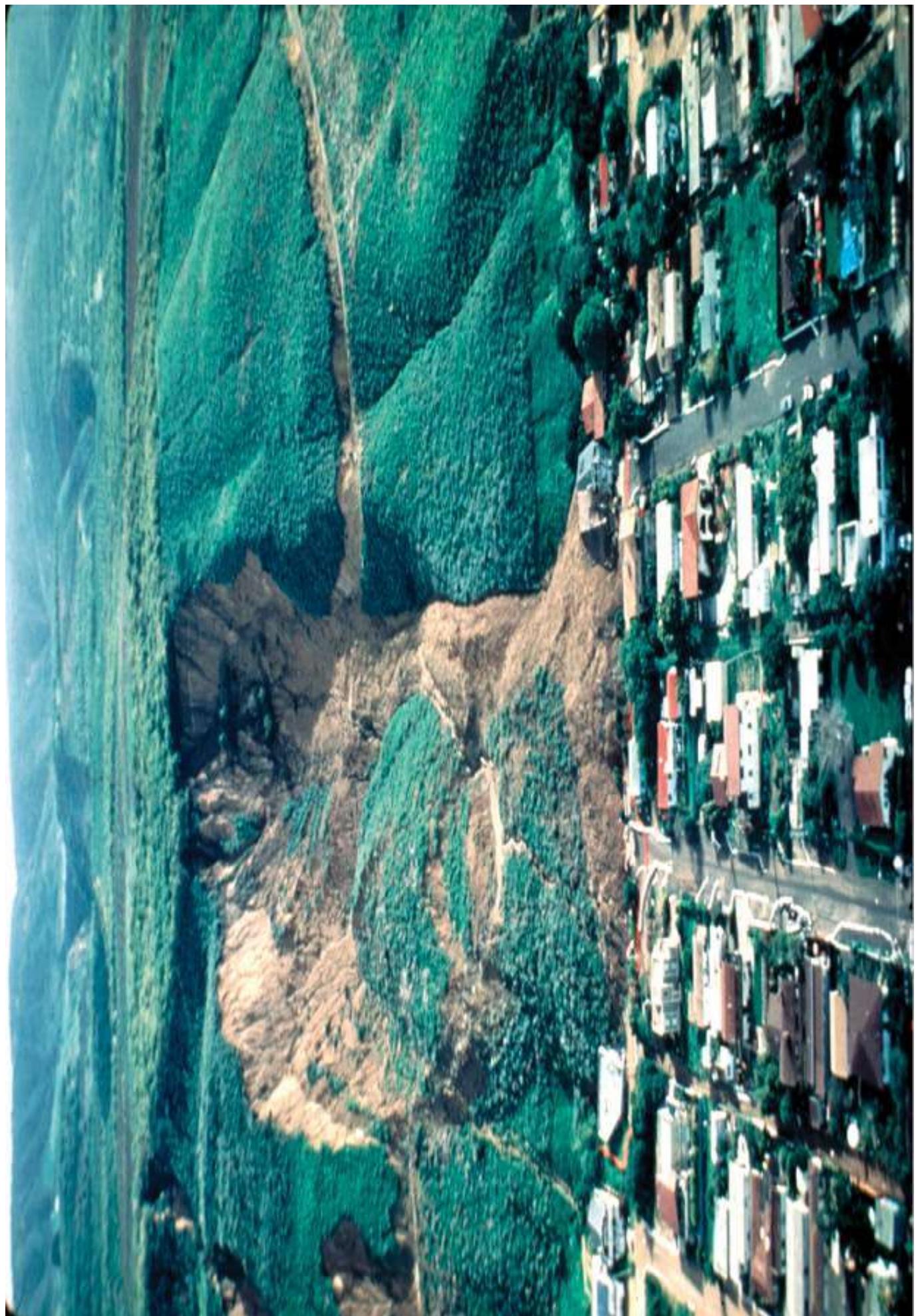
- **Landslides and Mitigation Measures:**

- Landslides are recurring phenomena in the Himalayan region.
- In recent years, intensive construction activity and the destabilising forces of nature have aggravated the problem.
- Landslides occur as a result of changes on a slope, sudden or gradual, either in its composition, structure, hydrology or vegetation.
- The changes can be due to geology, climate, weathering, changing land use and earthquakes.

- **Mitigation Measures:**

- Drainage measures
- Improving afforestation
- Erosion control
- Rock fall control measures
- Preventing exposure of population and facilities
- Implementing strict regulations on developing programs
- Appropriate land use planning and management.







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- **Floods:**
- Among all the disasters, floods are the most frequently occurring natural disasters, due to the irregular Indian monsoon.
- About 75% of the annual rainfall in India is concentrated in three to four months of the monsoon season.
- As a result there is heavy discharge from the rivers during this period, causing widespread floods.
- In some countries like India and Bangladesh rainfall does not occur throughout the year, rather, 90% of it is concentrated into a few months.
- Heavy rainfall often causes floods in the low lying coastal areas.
- Prolonged downpour can also cause the over-flowing of lakes and rivers resulting into floods.
- Deforestation, overgrazing, mining, rapid industrialization, global warming etc. have also contributed largely to a sharp rise in the incidence of floods, which otherwise is a natural disaster.
- Floods have been regular features of some parts of India and Bangladesh causing huge economic loss as well as loss of life.
- People of Bangladesh are accustomed to moderate flooding during monsoon and they utilize the flood water for raising paddy.
- Networking of rivers is being proposed at national level to deal with the problems of floods.

