

Chapter III Environmental Pollution and Laws

Environmental Pollution — Introduction

Definition: Environmental pollution is the addition of any substance or form of energy (such as heat, light, or sound) to the environment at a rate faster than the environment can disperse, dilute, decompose, recycle, or store it harmlessly.

Pollutant: A pollutant is any substance or energy that causes pollution.

- **Biodegradable pollutants** — These break down naturally through biological processes, e.g., domestic sewage and paper waste.
- **Non-biodegradable pollutants** — These do not break down easily and remain in the environment for long periods, e.g., plastics, DDT, and heavy metals.

Types of pollution:

1. **Air pollution** — contamination of the atmosphere by harmful gases and particles.
2. **Water pollution** — contamination of water bodies making them unsafe.
3. **Soil pollution** — contamination of land reducing its fertility.
4. **Noise pollution** — excessive/unwanted sound harmful to health.
5. **Thermal pollution** — rise in water temperature due to industrial discharge.
6. **Radioactive pollution** — contamination from radioactive substances.

Causes (in general):

1. Industrialization and urbanization — factories and cities generate large amounts of waste and emissions.
2. Population growth — more people means more consumption and more waste.
3. Deforestation — removes natural pollution-absorbing cover.
4. Burning of fossil fuels — releases smoke and harmful gases.
5. Improper waste disposal — untreated waste contaminates land, air, and water.
6. Overuse of chemical fertilizers and pesticides — pollutes soil and water.

Effects (in general):

1. Human health problems — respiratory and waterborne diseases increase.
2. Damage to plants and animals — disturbs ecosystems.
3. Global warming — due to accumulation of greenhouse gases.

4. Depletion of natural resources — clean air, water, and soil become scarce.
5. Loss of biodiversity — species decline due to habitat destruction.
6. Damage to monuments — acid rain corrodes historic structures.

Control measures (in general):

1. Use of eco-friendly and renewable technology — reduces dependence on polluting sources.
 2. Treating waste before disposal — prevents contamination of environment.
 3. Afforestation — trees absorb pollutants and restore ecological balance.
 4. Strict implementation of environmental laws — ensures accountability of polluters.
 5. Public awareness programs — encourages responsible behaviour.
 6. Following the 3 R's (Reduce, Reuse, Recycle) — minimizes waste generation.
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Air Pollution

Definition: Air pollution is the presence of undesirable solid, liquid, or gaseous substances in the atmosphere in amounts harmful to humans, animals, plants, and property.

Causes:

1. **Natural sources** — volcanic eruptions, forest fires, and dust storms release pollutants without human involvement.
2. **Vehicular emissions** — burning of petrol and diesel releases CO, hydrocarbons, and lead.
3. **Industrial emissions** — factory chimneys release smoke, SO₂, and NO_x.
4. **Thermal power plants** — burn coal, releasing large quantities of smoke and ash.
5. **Crop residue burning** — common in agricultural regions, adds particulate matter.
6. **CFCs from aerosols/refrigerants** — deplete the ozone layer.

Major pollutants: CO, CO₂, SO₂, NO_x, SPM (PM_{2.5}, PM₁₀), CFCs, hydrocarbons, and lead — each contributes differently to health and environmental damage.

Effects:

1. Respiratory diseases — asthma, bronchitis, and lung cancer caused by inhaling polluted air.
2. Global warming — greenhouse gases trap heat, raising global temperatures.

3. Ozone layer depletion — CFCs break down ozone molecules, increasing UV radiation reaching Earth.
4. Acid rain — SO₂ and NO_x react with atmospheric moisture, damaging crops, forests, and buildings (e.g., yellowing of the Taj Mahal).
5. Smog formation — mixture of smoke and fog reduces visibility and worsens air quality in cities.
6. Reduced plant growth — pollutants damage leaves and hinder photosynthesis.

Control measures:

1. Catalytic converters — installed in vehicles to reduce harmful exhaust emissions.
 2. Promoting CNG/electric vehicles — cleaner fuel alternatives reduce pollution.
 3. Electrostatic precipitators and scrubbers — used in industries to trap pollutants before release.
 4. Afforestation and green belts — plants absorb CO₂ and filter pollutants.
 5. Renewable energy sources — solar and wind power reduce fossil fuel dependence.
 6. Emission standards (e.g., Bharat Stage norms) — legally enforce pollution limits for vehicles.
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Water Pollution

Definition: Water pollution is the contamination of water bodies such as rivers, lakes, oceans, and groundwater by harmful substances, making the water unfit for use and harmful to aquatic life.

Causes:

1. Untreated domestic sewage — directly discharged into rivers, introducing pathogens and organic waste.
2. Industrial effluents — contain toxic chemicals and heavy metals harmful to aquatic organisms.
3. Agricultural runoff — pesticides and fertilizers wash into nearby water bodies.
4. Oil spills — from ships and offshore drilling, causing large-scale marine contamination.
5. Religious/social practices — idol immersion and waste dumping add pollutants to rivers.

6. Thermal pollution — heated water discharged from power plants raises water temperature, harming aquatic life.

Effects:

1. Waterborne diseases — cholera, typhoid, diarrhea, and jaundice spread through contaminated water.
2. Death of aquatic organisms — reduced dissolved oxygen suffocates fish and other species.
3. Eutrophication — excess nutrients cause algae to overgrow, blocking sunlight and depleting oxygen.
4. Bioaccumulation and biomagnification — toxins accumulate in organisms and increase in concentration up the food chain.
5. Loss of aquatic biodiversity — sensitive species die out, disrupting ecosystems.
6. Groundwater contamination — pollutants seep underground, affecting drinking water sources.

Control measures:

1. Effluent Treatment Plants (ETPs) — treat industrial waste before releasing it into water bodies.
2. Rainwater harvesting — recharges groundwater and reduces pressure on existing water sources.
3. Organic farming — reduces the use of chemical fertilizers and pesticides that pollute water.
4. Enforcement of the Water (Prevention & Control of Pollution) Act — legally regulates discharge into water bodies.
5. Public awareness campaigns — educate people about responsible water use and disposal.
6. Common Effluent Treatment Plants (CETPs) — provide shared treatment facilities for small-scale industries.

Soil Pollution

Definition: Soil pollution is the contamination of soil with harmful chemicals, pollutants, or waste materials that reduce its fertility and quality.

Causes:

1. Excessive use of chemical fertilizers and pesticides — alters soil chemistry and kills beneficial organisms.
2. Improper disposal of industrial/municipal waste — dumping directly on land contaminates soil.
3. Mining activities — disturb land structure and release harmful substances.
4. Deforestation — removes vegetation cover, leading to soil erosion.
5. Plastic and non-biodegradable waste — remains in soil for years, affecting fertility.
6. Acid rain — increases soil acidity, harming plant growth.

Effects:

1. Loss of soil fertility — reduces the soil's ability to support plant growth.
2. Death of soil microorganisms — disrupts natural nutrient cycling.
3. Groundwater contamination — pollutants leach down into underground water sources.
4. Entry of toxins into the food chain — crops absorb harmful substances from contaminated soil.
5. Desertification — fertile land gradually turns barren.
6. Reduced agricultural productivity — lowers crop yield, affecting food supply.

Control measures:

1. Organic farming and biofertilizers — reduce dependence on harmful chemicals.
2. Proper solid waste disposal — prevents waste from directly contaminating soil.
3. Afforestation — plant roots bind soil and prevent erosion.
4. Crop rotation and contour farming — maintain soil fertility and prevent erosion on slopes.
5. Recycling — reduces the volume of waste dumped on land.
6. Reducing plastic use — limits accumulation of non-biodegradable material in soil.

Noise Pollution

Definition: Noise pollution is unwanted or excessive sound that causes discomfort, disturbance, or harm to humans and animals. It is measured in decibels (dB).

Causes:

1. Traffic and vehicle horns — constant honking in cities is a major noise source.
2. Industrial machinery — factories generate continuous loud operational noise.
3. Loudspeakers — used during festivals and public events, exceeding safe limits.
4. Construction activities — drilling and heavy machinery create high noise levels.
5. Aircraft and railways — generate intense noise near airports and railway tracks.
6. Firecrackers — produce sudden loud bursts of sound, especially during festivals.

Effects:

1. Hearing impairment — prolonged exposure can cause permanent deafness.
2. Psychological stress — leads to anxiety, irritability, and disturbed sleep.
3. Cardiovascular problems — chronic noise exposure is linked to high blood pressure.
4. Reduced concentration — affects productivity at work and study.
5. Disturbance to wildlife — interferes with breeding and communication among animals and birds.

Control measures:

1. Silencers — fitted in vehicles and machinery to reduce noise output.
2. Trees along roads — act as natural sound barriers, absorbing noise.
3. Restrictions on loudspeakers — especially enforced during night hours.
4. Soundproofing — applied to buildings and industries near residential areas.
5. Enforced decibel limits — different noise standards for residential, commercial, industrial, and silence zones.
6. Noise-reducing technology — ongoing innovations help lower noise at the source.

Solid Waste Management

Definition: Solid waste management is the systematic collection, transportation, processing, and disposal of solid waste in a manner safe for the environment and public health.

Types of waste:

1. Municipal/urban waste — household garbage, plastics, paper, and food waste.
2. Industrial waste — generated by factories, sometimes hazardous in nature.
3. Biomedical waste — from hospitals, e.g., needles, bandages, expired medicines.

4. E-waste — discarded electronic items like phones and computers.

Control measures — Urban waste:

1. Segregation at source — separating biodegradable and non-biodegradable waste at the household level makes further processing easier.
2. Composting — converts biodegradable waste into useful manure.
3. Sanitary landfills — a scientifically engineered method of disposing waste in low-lying areas without contaminating surroundings.
4. Incineration — burning waste at high temperature reduces its volume significantly.
5. Recycling — materials like paper, plastic, glass, and metal are reused instead of discarded.
6. 3 R Principle — Reduce, Reuse, Recycle helps minimize the overall waste generated.
7. Public awareness and collection systems — campaigns like Swachh Bharat Abhiyan promote door-to-door waste collection.

Control measures — Industrial waste:

1. Treatment before disposal — hazardous waste must be treated to reduce toxicity before release.
2. ETPs and Common TSDFs — Effluent Treatment Plants and Treatment, Storage & Disposal Facilities handle waste safely.
3. Cleaner production technologies — industries adopt methods that generate less waste in the first place.
4. Proper labelling, storage, and transport — as per government rules, to prevent accidental exposure or leakage.
5. Recycling/recovery — useful materials are extracted and reused from industrial waste.
6. Compliance with Hazardous Waste Management Rules — ensures industries follow safe and legal disposal practices.

Environmental Laws (India)

(a) Environment (Protection) Act, 1986

- Enacted after the **Bhopal Gas Tragedy (1984)** — India's worst industrial disaster prompted a comprehensive law.

- Known as an "umbrella legislation" because it covers all aspects of environmental protection.
- Key provisions:
 1. Sets standards for emission and discharge of pollutants.
 2. Regulates the location where industries can be set up.
 3. Controls the handling and storage of hazardous substances.
 4. Lays down procedures for dealing with environmental emergencies.
 5. Penalty — imprisonment up to 5 years and/or fine for violations.

(b) Air (Prevention and Control of Pollution) Act, 1981

- Enacted to control and prevent air pollution across the country.
- Key provisions:
 1. Led to the establishment of the Central Pollution Control Board (CPCB) and State Pollution Control Boards (SPCBs).
 2. Allows state governments to declare "air pollution control areas."
 3. Requires industries to obtain consent from the SPCB before operating.
 4. Empowers Boards to inspect industries and collect emission samples.
 5. Penalty — imprisonment and/or fine for non-compliance.

(c) Water (Prevention and Control of Pollution) Act, 1974

- Enacted to prevent and control water pollution and restore the wholesomeness of water bodies.
- Key provisions:
 1. Established Central and State Pollution Control Boards to oversee enforcement.
 2. Prohibits discharge of pollutants into streams, wells, or sewers without treatment.
 3. Requires industries to obtain consent before establishing or operating.
 4. Gives Boards power to collect water samples for testing.
 5. Penalty — fines and legal action for polluting water bodies.

(d) Wildlife Protection Act, 1972

- Enacted to protect wild animals, birds, and plants for ecological security.
- Key provisions:
 1. Prohibits hunting of specified wild animals — species in Schedule I and Part II of Schedule II receive the highest protection.
 2. Provides for setting up National Parks, Wildlife Sanctuaries, and Biosphere Reserves.
 3. Regulates trade in wildlife products to prevent exploitation.
 4. Establishes Wildlife Advisory Boards to guide conservation policy.
 5. Prescribes strict punishment for poaching and illegal wildlife trade.

(e) Forest Conservation Act, 1980

- Enacted to check deforestation and regulate diversion of forest land for non-forest use.
- Key provisions:
 1. Requires prior approval of the Central Government before de-reserving forest land or using it for mining/industry.
 2. Restricts state governments from reducing forest area without central approval.
 3. Mandates compensatory afforestation whenever forest land is diverted.
 4. Aims to maintain overall ecological balance in the country.

International Agreements, Policies and Treaties

1. **Stockholm Conference (1972)** — The first major international conference declaring the human environment a global concern.
2. **Ramsar Convention (1971)** — Focused on the conservation and wise use of wetlands worldwide.
3. **CITES (1973)** — Regulates international trade in endangered plants and animals to prevent their exploitation.
4. **Vienna Convention (1985)** — Created a framework for international cooperation to protect the ozone layer.
5. **Montreal Protocol (1987)** — Committed nations to phase out substances (like CFCs) responsible for ozone depletion.

6. **Basel Convention (1989)** — Controls the transboundary movement and disposal of hazardous wastes.
7. **Rio Earth Summit / UNCED (1992)** — Adopted Agenda 21 and introduced the concept of sustainable development.
8. **Convention on Biological Diversity, CBD (1992)** — Aims at conserving biodiversity and ensuring fair sharing of benefits from genetic resources.
9. **Kyoto Protocol (1997)** — Set binding targets for industrialized nations to reduce greenhouse gas emissions.
10. **Paris Agreement (2015)** — A global commitment to limit temperature rise to well below 2°C, preferably 1.5°C, above pre-industrial levels.

Important National Policies:

1. **National Environment Policy, 2006** — Guides the conservation of critical environmental resources in India.
2. **National Forest Policy, 1988** — Sets a target of maintaining 33% of land area under forest cover.
3. **Swachh Bharat Abhiyan (2014)** — A national campaign promoting cleanliness and proper waste management.