

Adverse Effects of Environmental Pollution with Special Reference to Water

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Introduction to Environmental Pollution

- ▶ **Meaning of environmental pollution**
- ▶ **Types:**
 - ▶ **Air pollution**
 - ▶ **Water pollution**
 - ▶ **Soil pollution**
 - ▶ **Noise pollution**
- ▶ **Why engineers must address pollution**

Why Focus on Water Pollution?

- **Water is essential for life, economy, and ecosystems**
- **Only 2.5% freshwater, less than 1% accessible**
- **Increasing stress due to:**
 - **Urbanisation**
 - **Industrialisation**
 - **Climate change**

What is Water Pollution?

- ▶ Definition
- ▶ Degradation of water quality beyond acceptable limits
- ▶ Makes water:
 - ▶ Unsafe for drinking
 - ▶ Unfit for agriculture
 - ▶ Harmful to aquatic life

Major Sources of Water Pollution

- **Domestic sewage**
- **Industrial effluents**
- **Agricultural runoff**
- **Solid waste dumping**
- **Thermal and radioactive discharges**

Domestic Sewage as a Pollutant

- **Untreated / partially treated sewage**
- **Contains:**
 - **Organic matter**
 - **Pathogens**
 - **Nutrients (N & P)**
- **Situation in Indian cities:**
 - **Gap between sewage generation and treatment**

Industrial Water Pollution

- Key industries:
- Tanneries
- Textiles
- Pulp & paper
- Chemicals
- Pollutants:
- Heavy metals
- Toxic chemicals
- High BOD/COD

Agricultural Runoff

- Excessive use of:
- Fertilisers
- Pesticides
- Leads to:
- Nitrate contamination
- Eutrophication
- Impacts groundwater and surface water

Solid Waste & Plastic Pollution

- Dumping near water bodies
- Leachate from landfills
- Plastic waste:
- Microplastics entering rivers and oceans
- Case examples from Indian rivers

Types of Water Pollutants

- Physical:
- Suspended solids
- Turbidity
- Chemical:
- Heavy metals
- Acids, salts
- Biological:
- Bacteria
- Viruses
- Emerging pollutants:
- Pharmaceuticals
- PFAS (Per- and Polyfluoroalkyl Substances)

Impact on Human Health

- Waterborne diseases:
- Cholera
- Typhoid
- Diarrhoea
- Heavy metal poisoning:
- Arsenic
- Mercury
- Long-term health impacts

Impact on Aquatic Ecosystems

- Oxygen depletion
- Fish mortality
- Loss of biodiversity
- Destruction of wetlands and mangroves

Eutrophication – A Major Concern

- Excess nutrients → algal blooms
- Reduction in dissolved oxygen
- “Dead zones” in water bodies
- Examples: lakes, reservoirs

Groundwater Pollution

- Causes:
- Leaching from septic tanks
- Industrial contamination
- Overuse of chemicals
- Difficult and costly to remediate
- Arsenic & fluoride issues in India

Economic and Social Impacts

- Increased cost of water treatment
- Loss of fisheries and livelihoods
- Impact on tourism
- Public health expenditure

Water Pollution in India – Key Issues

- **Polluted rivers (Ganga, Yamuna, etc.)**
- **Low sewage treatment capacity**
- **Informal industrial clusters**
- **Weak enforcement**

Legal & Institutional Framework

- **Water (Prevention & Control of Pollution) Act, 1974**
- **Role of:**
- **CPCB**
- **SPCBs**
- **Urban Local Bodies**
- **Importance of compliance and monitoring**

Engineering Solutions to Water Pollution

- **Sewage Treatment Plants (STPs)**
- **Effluent Treatment Plants (ETPs)**
- **Zero Liquid Discharge (ZLD)**
- **Nature-based solutions:**
 - **Wetlands**
 - **Phytoremediation**

Role of Engineers & Institutions

- Sustainable design
- Pollution prevention at source
- Adoption of cleaner technologies
- Capacity building & awareness
- Ethical responsibility of engineers

Conclusion & Way Forward

- ▶ Water pollution is a serious environmental and public health issue
- ▶ Integrated approach required:
 - ▶ Technology
 - ▶ Policy
 - ▶ Public participation
- ▶ Engineers as key change-makers
- ▶ **“Protect water today for a secure tomorrow”**

THANK YOU..!!