

Water Pollution

By: Prof.Meera Singh

Introduction

Water pollution is one of the most serious environmental problems affecting the world today. It occurs when harmful substances such as chemicals, waste materials, plastics, microorganisms, and toxic compounds contaminate rivers, lakes, oceans, ponds, groundwater, and other water bodies. Clean water is essential for human survival, agriculture, industries, and ecosystems. However, increasing population growth, industrialization, urbanization, and modern agricultural practices have greatly increased water contamination across the globe.

Water pollution not only affects aquatic organisms but also threatens human health and economic development. Polluted water becomes unsafe for drinking, cooking, bathing, irrigation, and industrial use. Millions of people worldwide suffer from diseases caused by contaminated water every year. Water pollution also damages biodiversity, disrupts food chains, and reduces the availability of freshwater resources.



Definition of Water Pollution

Water pollution can be defined as the contamination of water bodies by harmful substances that adversely affect living organisms and reduce water quality. Pollutants may be natural or man-made and may enter water bodies directly or indirectly.

Sources of Water Pollution

1. Domestic Sewage

Domestic sewage is one of the major causes of water pollution. Wastewater from homes contains soaps, detergents, food waste, human excreta, and harmful microorganisms. In many developing countries, untreated sewage is directly discharged into rivers and lakes.

Effects:

- Spread of waterborne diseases
- Reduction in dissolved oxygen
- Foul smell and unpleasant appearance



2. Industrial Waste

Industries release toxic chemicals, dyes, acids, oils, and heavy metals into nearby water bodies. Industries such as textile, paper, leather, pharmaceutical, and chemical manufacturing are major contributors to water pollution.

Harmful industrial pollutants:

- Mercury
- Lead
- Cadmium
- Chromium
- Arsenic

These substances are toxic to both humans and aquatic organisms.



3. Agricultural Runoff

Modern agriculture uses fertilizers, pesticides, herbicides, and insecticides to improve crop production. During rainfall, these chemicals are washed into rivers, lakes, and groundwater.

Consequences:

- Eutrophication
 - Algal blooms
 - Fish mortality
 - Groundwater contamination
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4. Plastic Waste

Plastic pollution has become a major environmental concern. Plastic bags, bottles, packaging materials, and microplastics accumulate in oceans and freshwater bodies.

Impacts:

- Marine animal deaths
 - Blockage of waterways
 - Microplastic entry into the food chain
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5. Oil Spills

Oil spills from ships, pipelines, and offshore drilling contaminate oceans and coastal areas. Oil forms a thin layer on water surfaces that blocks oxygen exchange.

Effects:

- Death of marine birds and fish
 - Damage to coral reefs
 - Economic loss to fisheries and tourism
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Types of Water Pollution

1. Surface Water Pollution

Contamination of rivers, lakes, ponds, and oceans due to pollutants entering from industries, sewage, and agricultural runoff.

2. Groundwater Pollution

Occurs when pollutants seep into underground aquifers through soil.

3. Chemical Pollution

Caused by harmful chemicals such as pesticides, acids, fertilizers, and industrial toxins.

4. Biological Pollution

Caused by bacteria, viruses, algae, fungi, and parasites.

5. Thermal Pollution

Occurs when industries discharge hot water into rivers and lakes, increasing water temperature.

Major Water Pollutants

Pollutant	Source	Effects
Heavy metals	Industries	Toxicity and organ damage
Pesticides	Agriculture	Harm aquatic life
Plastics	Domestic waste	Marine pollution
Pathogens	Sewage	Waterborne diseases
Fertilizers	Farming	Eutrophication
Oil	Shipping	Marine ecosystem damage

Effects of Water Pollution on Human Health

Water pollution has severe impacts on human health. Contaminated water spreads many infectious diseases.

Waterborne Diseases

- Cholera
- Typhoid
- Dysentery
- Hepatitis
- Diarrhea

Heavy Metal Toxicity

- Mercury damages the nervous system

- Lead affects brain development
- Arsenic causes skin diseases and cancer

Long-term Effects

- Kidney damage
- Liver disorders
- Cancer risk
- Reproductive problems

Millions of deaths occur annually due to unsafe drinking water and poor sanitation.

Effects on Aquatic Ecosystems

1. Oxygen Depletion

Organic waste increases microbial activity, reducing dissolved oxygen in water. Fish and aquatic organisms die due to lack of oxygen.

2. Eutrophication

Excess nutrients such as nitrogen and phosphorus promote algal growth.

Consequences:

- Dense algal blooms
- Reduced sunlight penetration
- Fish kills
- Bad odor

3. Bioaccumulation and Biomagnification

Toxic chemicals accumulate in aquatic organisms and move through the food chain.

Example:

Mercury accumulates in fish and eventually affects humans consuming contaminated fish.

Plastic Pollution in Oceans

Plastic pollution is increasing rapidly worldwide. Oceans contain millions of tons of plastic waste.

Sources:

- Plastic bags
- Bottles
- Fishing nets
- Packaging waste

Microplastics

Small plastic particles called microplastics enter aquatic ecosystems and food chains.

Harmful Effects:

- Ingestion by marine organisms
- Reduced reproductive ability
- Human health risks

Groundwater Pollution

Groundwater is an important source of drinking water. Pollution occurs due to:

- Landfill leakage
- Septic tanks
- Industrial waste
- Agricultural chemicals

Problems:

- Difficult to detect
- Expensive to treat
- Long-term contamination

Water Pollution and Climate Change

Climate change worsens water pollution problems.

Floods

Floods carry pollutants into rivers and lakes.

Droughts

Reduced water levels increase pollutant concentration.

Rising Temperature

Warmer water promotes algal blooms and decreases dissolved oxygen.

Water Pollution in India

India faces serious water pollution challenges due to rapid urbanization and industrial growth.

Major Polluted Rivers

- Ganga
- Yamuna
- Gomti
- Sabarmati

Main Causes:

- Untreated sewage
- Industrial discharge
- Religious waste
- Agricultural runoff

The pollution of rivers affects millions of people who depend on them for drinking and irrigation.

Control and Prevention of Water Pollution

1. Wastewater Treatment

Sewage and industrial wastewater should be treated before discharge.

Treatment Stages:

- Primary treatment
 - Secondary treatment
 - Tertiary treatment
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2. Proper Waste Disposal

Solid waste and plastics should be disposed of properly to prevent contamination.

3. Sustainable Agriculture

Farmers should reduce excessive use of fertilizers and pesticides.

Eco-friendly Practices:

- Organic farming
 - Biofertilizers
 - Integrated pest management
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4. Industrial Regulations

Governments should enforce strict environmental laws and pollution control measures.

5. Public Awareness

Public participation is essential for water conservation and pollution prevention.

Awareness Activities:

- Educational campaigns
- Community clean-up programs
- School awareness drives

Wastewater Treatment Process

Primary Treatment

Removal of large solid particles through screening and sedimentation.

Secondary Treatment

Microorganisms decompose organic matter biologically.

Tertiary Treatment

Advanced treatment removes nutrients, chemicals, and pathogens.

Government Policies and Laws

Governments worldwide have implemented laws to control water pollution.

In India:

Water (Prevention and Control of Pollution) Act, 1974

- Regulates industrial discharge
- Protects water quality
- Establishes pollution control boards

International Efforts

Organizations promote sustainable water management and pollution control globally.

Importance of Clean Water

Clean water is essential for:

- Human survival

- Agriculture
- Industrial development
- Aquatic biodiversity
- Public health

Water conservation and pollution control are necessary for sustainable development.