

Water Pollution

Water Pollution

- **Water pollution** occurs when harmful substances—often chemicals or microorganisms—contaminate water bodies such as streams, rivers, lakes, oceans, aquifers, or other bodies of water.
- This contamination degrades water quality, making it toxic to humans and the environment.

Significance

- Water pollution is a major health threat, causing more deaths annually than war and other forms of violence combined.
- Less than 1 percent of the earth's freshwater is accessible for human use.
- By 2050, global demand for freshwater is expected to increase by one-third.

Biochemical Oxygen Demand (BOD)

Definition

- BOD measures the amount of oxygen required by microorganisms to decompose organic matter in water.

Importance

- It indicates the organic pollution level in water. Higher BOD values suggest higher levels of organic pollution, which can deplete oxygen in the water, harming aquatic life.

Measurement

- Typically measured over a 5-day period at 20°C.

Chemical Oxygen Demand (COD)

Definition

- COD measures the total quantity of oxygen required to oxidise both organic and inorganic matter in water.

Importance

- Provides a comprehensive assessment of water pollution by accounting for both biodegradable and non-biodegradable substances.

Measurement

- Involves adding a strong oxidising agent to the water sample and measuring the amount of oxygen consumed.

Comparison

- **BOD** focuses on biologically degradable organic matter.
- **COD** encompasses all oxidisable substances, offering a broader picture of water quality.

Causes of Water Pollution

Agricultural Pollution

- The agricultural sector is the largest consumer of global freshwater resources, using about 70 percent of surface water supplies.
- It is also a leading cause of water degradation, contributing significantly to contamination in rivers, streams, wetlands, lakes, estuaries, and groundwater.
- **Nutrient pollution** from excess nitrogen and phosphorus causes toxic algal blooms, harmful to both humans and wildlife.

Sewage and Wastewater

- Wastewater includes used water from domestic, commercial, industrial, and agricultural activities.
- More than 80 percent of global wastewater is untreated or unreused.

Oil Pollution

- Consumer activities account for the majority of oil pollution, including oil and gasoline from vehicles.

- Nearly half of the oil pollution in marine environments comes from land-based sources like factories, farms, and cities.
- Tanker spills and routine shipping operations also contribute significantly.

Radioactive Substances

- Sources include uranium mining, nuclear power plants, military weapon production, and medical research.
- Radioactive waste persists in the environment for thousands of years, posing long-term disposal challenges.

Categories of Water Pollution

Source-based Classification

Point Source Pollution

- Originates from a single, identifiable source, such as wastewater discharge from factories or oil spills.
- Regulated by the CPCB with specific discharge limits.

Nonpoint Source Pollution

- Comes from diffuse sources like agricultural runoff and stormwater.
- Leading cause of water pollution in India, difficult to regulate due to the lack of a single source.

Transboundary Pollution

- Results from contamination crossing borders, such as oil spills or industrial discharge flowing into another country's waters.

Type of Water Impacted

Groundwater Pollution

- Groundwater, which provides drinking water for nearly 60 percent of the world, gets polluted from pesticides, fertilisers, and waste from landfills and septic systems.

- Contaminated groundwater can be costly and difficult to clean, potentially rendering aquifers unusable for long periods.

Surface Water Pollution

- Includes oceans, lakes, rivers, and streams.
- In India, all rivers and streams and more than two-third of lakes are polluted.
- Leading contaminants include nitrates, phosphates, heavy metals, and random debris from municipal and industrial sources.

Ocean Water Pollution

- 80 percent originates on land, with contaminants carried by rivers and streams into the sea.
- Marine debris, particularly plastic, poses significant threats to marine life.
- Ocean acidification from carbon pollution affects marine organisms' ability to build shells.

Effects of Water Pollution

Human Health

- Water pollution causes 1.8 million deaths annually and sickens about 1 billion people each year.
- Low-income communities are disproportionately affected.
- Diseases spread by contaminated water include cholera, giardia, and typhoid.
- Chemical pollutants, such as lead, arsenic, and mercury, cause various health issues including cancer and hormone disruption.

Environmental Impact

- Algal blooms reduce oxygen levels, causing dead zones devoid of life.
- Contaminants from industrial and municipal waste are toxic to aquatic life and accumulate in the food chain.
- Marine debris harms over 200 species of marine life, while ocean acidification impacts shellfish and coral.

Source of Pollution	Examples	Impact
Agricultural	Fertilisers, pesticides, animal waste	Nutrient pollution, algal blooms
Sewage and Wastewater	Domestic sewage, industrial waste	Pathogens, heavy metals, toxic chemicals
Oil Pollution	Oil spills, vehicle oil	Marine ecosystem damage
Radioactive Substances	Nuclear plants, medical research	Long-term environmental contamination

Type of Water	Pollution Source	Impact
Groundwater	Pesticides, landfill waste	Unsafe drinking water, difficult to clean
Surface Water	Industrial discharge, farm runoff	Unfit for swimming, fishing, drinking
Ocean Water	Land-based contaminants, marine debris	Marine life harm, ocean acidification

Eutrophication

- **Eutrophication** is the process by which a body of water becomes overly enriched with nutrients, leading to excessive growth of algae and other aquatic plants.

Causes

- **Nutrient pollution** from sources such as agricultural runoff, wastewater discharge, and industrial effluents.
- Key nutrients involved are **nitrogen** and **phosphorus**, which are commonly found in fertilisers, detergents, and sewage.

Process

1. **Nutrient Input:** Excessive nutrients enter the water body.
2. **Algal Bloom:** Nutrients promote rapid growth of algae and other aquatic plants. An **algal bloom** is a rapid increase in the population of algae in a water body, often visible as a green, red, or brown layer on the surface.
 - a. **Harmful Algal Blooms (HABs):** Certain species of algae produce toxins harmful to humans, animals, and aquatic life. These are often referred to as **red tides** or **blue-green algae** (cyanobacteria) blooms.

3. **Decomposition:** When algae die, they are decomposed by bacteria, which consume oxygen in the water.
4. **Oxygen Depletion:** Increased decomposition depletes oxygen levels, creating hypoxic conditions (low oxygen).
5. **Dead Zones:** Prolonged oxygen depletion can lead to "dead zones," areas devoid of aquatic life due to lack of oxygen.

Consequences

- **Toxin Production:** Some algal blooms produce toxins that can contaminate drinking water and seafood, posing health risks.
- **Oxygen Depletion:** Similar to eutrophication, the decomposition of algae consumes oxygen, leading to hypoxic conditions.
- **Economic Impact:** Algal blooms can affect fishing, tourism, and water treatment processes.
- **Reduced Biodiversity:** Low oxygen levels can kill fish and other aquatic organisms.
- **Disruption of Ecosystems:** Altered water chemistry and light penetration affect aquatic ecosystems.
- **Water Quality Decline:** Reduced water quality affects drinking water sources and recreational activities.

Water (Prevention and Control of Pollution) Act, 1974

Objective

- The primary objective is to prevent and control water pollution and to maintain or restore the wholesomeness of water in India.

Key Provisions

- Establishes **Central and State Pollution Control Boards** to oversee the implementation of the Act.
- Empowers these boards to set standards for discharge of pollutants into water bodies.
- Requires industries to obtain consent for discharging effluents.
- Provides penalties for non-compliance, including fines and imprisonment.

Central Pollution Control Board (CPCB)

Role and Functions

- **Established under:** The Water Act of 1974.
- **Primary Functions:**
 - Advise the central government on matters related to pollution prevention and control.
 - Coordinate activities of State Pollution Control Boards.
 - Set and enforce pollution control standards.
 - Conduct research and disseminate information on pollution prevention.
 - Monitor water quality and assess the effectiveness of pollution control measures.

Significance

- CPCB plays a crucial role in implementing environmental policies and ensuring compliance with pollution control norms across India.

India's Efforts to Clean River Ganga

1. Ganga Action Plan (GAP)

- **Launched:** 1986
- **Objective:** Reduce pollution levels in the Ganga by treating sewage, industrial effluents, and improving river water quality.
- **Implementation:** Faced challenges due to inadequate infrastructure and poor maintenance.

2. National Ganga River Basin Authority (NGRBA)

- **Established:** 2009
- **Purpose:** Comprehensive planning and management to rejuvenate the Ganga.
- **Strategy:** Adopted a river basin approach to address pollution from various sources.

3. Namami Gange Programme

- **Launched:** 2014

- **Vision:** Integrated conservation mission with a budget of ₹20,000 crore.
- **Slogan:** निर्मल धारा, अविरल धारा
- **Components:**
 - **Sewage Treatment Plants (STPs):** Construction and upgradation to ensure proper sewage management.
 - **River Surface Cleaning:** Deployment of trash skimmers and other equipment.
 - **Industrial Effluent Monitoring:** Enforcement of regulations to control industrial discharge.
 - **Rural Sanitation:** Promotion of open defecation free (ODF) villages along the river.
 - **Public Awareness:** Campaigns to increase community participation and awareness.

4. Recent Initiatives

- **Afforestation:** Planting trees along the river banks to prevent soil erosion.
- **Ganga Task Force:** Deployment of territorial army units for monitoring and enforcement.
- **Clean Ganga Fund:** Encouraging public donations for cleaning efforts.

Challenges

- **Sustained Efforts:** Ensuring long-term maintenance and operation of infrastructure.
- **Coordination:** Effective collaboration among central, state, and local bodies.
- **Funding and Resources:** Adequate allocation and utilisation of financial and technical resources.

India continues to strive towards achieving a cleaner Ganga through these comprehensive and multi-faceted efforts.