

# Blue Planet in Peril: The Global Health Crisis of Water Pollution

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## ABSTRACT

Water is an essential resource for living organisms which covers 70 per cent of the Earth's surface and is the foundation of life and health of the ecosystem. It supports all the living organisms to sustain in diverse habitats. Most of the water bodies such as oceans, rivers, lakes, ground water and aquifers are contaminated with industrial effluents which affect aquatic ecosystem and their habitat. Hence, water pollution is a major issue of environment. It is the second most prevalent type of environmental pollution. Understanding the reasons, causes and effects of water pollution is therefore crucial for preserving our planet's most valuable resource.

## INTRODUCTION

Water is an essential source for living organisms for their survival. According to World Water Development Report released by UNESCO, the global usage of fresh water has increased six-fold in the past 100 years and has been growing by about 1 per cent every year since 1980 (1). The quality of water is reduced due to several challenges such as industrialization, agricultural production and urban life resulted in adverse effect on environment, ecosystem and water bodies necessary for life. This ultimately affects sustainable social development and human health (2). Eighty per cent of waste water is discharged directly into the water bodies without prior treatment could

affect oceans, rivers, lakes and ponds. Consuming contaminated water may leads (3) to several diseases in humans and also aquatic ecosystem. This is more in under developed countries, where proper sanitation and wastewater treatment facilities are severely lacking (4). Pollution of water is mainly due to rapid industrialization, natural factors, agricultural activities, insufficient water supply and sewage treatment facilities. Industries include distilleries, pulp and paper, textile, food, iron and steel and so on. Several toxic gases, chemicals, organic and inorganic substances which release from industries enter into the aquatic ecosystem and cause water pollution (5). Arsenic, cadmium and chromium are important pollutants discharged in

to the water bodies and the industrial sector is a significant

contributor to the harmful pollutants (6) Table. 1.

**Table 1: Elements, Sources and their Effect on Humans**

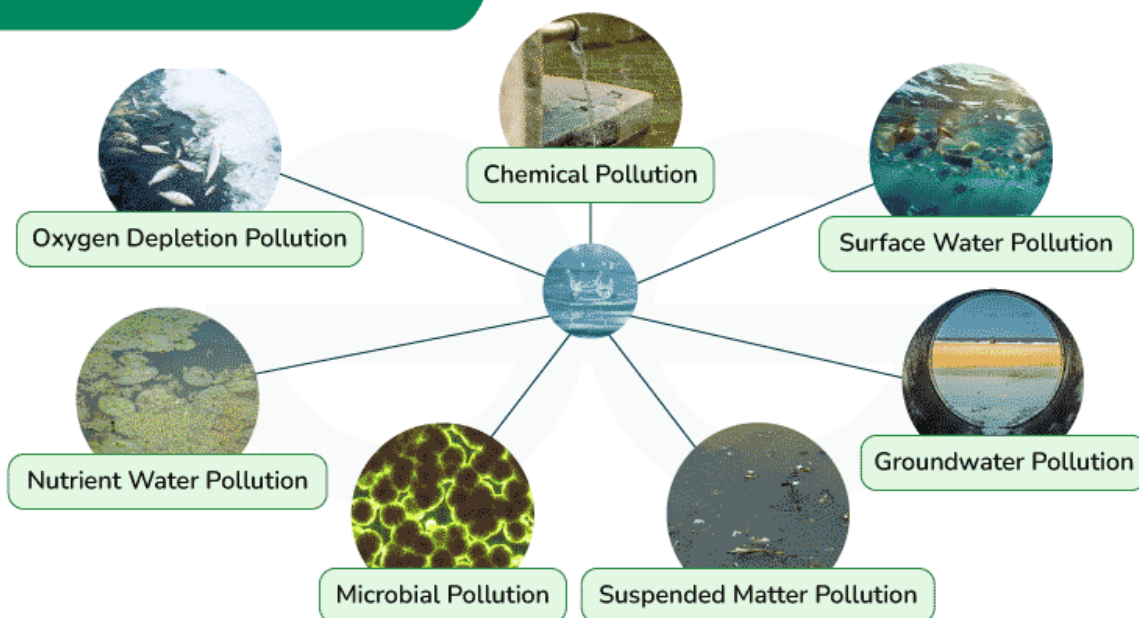
SL. No.	Elements	General Sources	Common effect
1.	Lead	Industry, Coal, Gasoline, mining plumbing	Anemia, colic pain, wrist drop, kidney disease, nerves disorder.
2.	Mercury	Industrial waste, disposed fluorescent light, paints, batteries, pesticides.	Gingivitis, diarrhea, anaemia, tremor of hands and tongues (Minamata disease), paralysis.
3.	Arsenic	Pesticides, chemical waste and mining by-products.	Indigestion, nausea, neurological problems, Carcinogenic
4.	Fluorine	Industrial waste mining	Teeth deformity, skeletal fluorosis (Knock knee syndrome)
5.	Zinc	Industrial waste, metal planting	Abnormal cramps, vomiting, diarrhea.
6.	Chromium	Temporary discharge, metal plating	Malfunctioning of gastrointestinal, urogenital system, central nervous system.
7.	Copper	Metal plating, industrial and domestic waste mineral leaching	Sporadic fever, anemia, coma.
8.	Cadmium	Industrial discharge, mining waste, metal plating	Suppresses kidney activities

Wastewater from industrial production has gradually increased due to rapid urbanization (7). In addition to urbanization, industrialization is also one of the major issues which affect by direct foreign investment. Industrial water pollution in under developed countries is positively correlated with foreign direct investment (8). Agriculture is also one of the major concerns for water pollution like usage of pesticides, fertilizers and organic farm wastes are important causes of water pollution. Agricultural activities will contaminate the water with phosphorus, nitrates, pesticides, soil sediments, salts and pathogens (9).

Furthermore, agriculture has severely damaged all freshwater systems in their pristine state (10). In developing countries such as India and China use partially or untreated wastewater for irrigation. The pollutants in contaminated water lead to potential threat to the atmosphere and environment. This may also affect the quality and quantity of surface water led to serious agricultural land and food pollution, pesticide residues and heavy metal pollution threatening food safety and human health (11). Agriculture significantly contributes to water pollution through the runoff of pesticides, fertilizers, and animal waste, which can contaminate rivers and lakes, causing algae blooms and oxygen deprivation (12). Pesticides have an adverse impact on health through drinking water. Comparing pesticide use with health life Expectancy Longitudinal Survey data, it was found that a 10% increase in pesticide use resulted in a 1% increase in the medical disability index over 65 years of age (13). Indian city of Rishikesh at the gateway to the Himalayas, the river Ganges flow clear and clean water through it. In these mountains, nobody would guess that this water will be transformed into one of the most heavily polluted rivers in the world, with faecal bacteria levels up to 31 million per 100 millilitres. This is according to reports from Sankat Mochan

Foundation, an organisation struggling to restore the Ganges to its former glory (14). These levels mean that the sacred river has become synonymous with water pollution, a worldwide problem affecting one in every three people on the planet, according to the United Nations (UN). The case of the Musi River in India shows a higher incidence of morbidity in wastewater-irrigated villages than normal-water households (15). Hence, regulatory mechanisms should be implemented to manage the pollutants or industrial effluents before they were released into the water bodies. Government, Environmental organizations and authorities should set clear instructions and regulations and to educate the farmers and industrialists about consequences of water contamination. To overcome we need to develop green technologies and suitable farming methods can decrease the contaminants and pollutants that flow into our water bodies. Another crucial approach for water pollution is lack of public awareness and proper education. Hence, necessary measures to be taken such as raising awareness about the importance conserving water sources and pollution and its impact on environment and health of humans. We can also engage or to involve in safe guarding our natural resources and enable them to make necessary preventive steps while discarding the industrial effluents and contaminants into water bodies. Advanced technologies and wastewater treatment systems should implement to decrease pollution of water along with sophisticated filtration systems to eliminate contaminants from water sources, rendering them suitable for consumption and lessening the strain on natural ecosystems (16). Development in research and technology could lead to novel treatment methods and more efficient techniques to filter contaminated water sources and mitigate future pollution. Water pollution and types contamination of water is categorized based on the pollutant, nature of the water body (Fig 1).

## Types of Water Pollution



**Figure 1: Types of Water Pollution from Various Sources and Activities in the Nature**

### 1.1. Types of water pollution

#### 1.1.1. Surface water pollution

Earth's surface water such as lagoons, rivers, lakes, and oceans are contaminated with several pollutants. This could happen when pollutants dissolve in or mix with the water. This pollution can be accidental, like oil spills in the ocean, or intentional, such as industries discharging waste into rivers or seas. Both forms of pollution have significant impacts on the environment, wildlife and human communities (17-19).

#### 1.1.2. Groundwater pollution

Due to hazardous and toxic substances accumulate in the ground water may lead to groundwater pollution due to humans seep into the ground through rainwater. These substances contaminate the ground water sources such as underground waterbeds and rivers. As a result, boreholes and wells would become contaminated. The most common cause of this type of pollution is the use of fertilizers and pesticides on farms (20).

#### 1.1.3. Chemical pollution

Due to rapid urbanization and industrialization, the harmful chemicals without purification are released directly from industries into the water bodies that could affect both underground and surface water bodies. Farming activities such as application of pesticides, insecticides are the leading causes of chemical pollution in water bodies. Metals and solvents used in industries can pollute lakes and rivers, certain chemicals used to control weeds, fungi, bacteria, and insects contribute to contamination of soil. Water sources also contaminate by chemicals due to petroleum spills (21, 22).

#### 1.1.4. Nutrients pollution

Nutrients are essential for living organisms such as plants and aquatic life at limited amounts in their ecosystem but in excess concentrations nutrients could be harmful. Fertilizers and waste water contain high levels of nutrients required for plant growth. When these nutrients are allowed into water bodies, they can cause quick and uncontrolled growth of algae on the surface of the water. This in turn leads to clogging of water filters and contamination of potable water. It also utilizes oxygen leading to marine life destruction (23).

#### 1.1.5. Eutrophication

Excess levels of plant nutrients such as phosphorus and nitrogen in water bodies can lead to algal blooms - massive growth of algae that does not allow sunlight from entering the water streams and deplete oxygen levels. This process of eutrophication can affect aquatic ecosystem resulting in destruction of aquatic flora and fauna. While some algal blooms

could be beneficial for ecosystems, they can also be toxic and harmful to the environment (24-26).

#### 1.1.6. Oxygen depletion pollution

The population of microorganisms increases by consuming on biodegradable substances when they enter in large amounts into the water bodies. They consume all the available oxygen in the water leading to depletion of oxygen, which causes the decrease in aerobic population and subsequently increase in anaerobic microorganisms to survive. Some anaerobic microorganisms produce toxins such as ammonia and sulfides contaminate the water that could be harmful to both aquatic life and humans (27-29).

#### 1.1.7. Microbiological pollution

Pollution of water by naturally occurring harmful microorganisms such as bacteria, protozoa and viruses can contaminate water. Consuming the contaminated water can lead to several diseases. Discharge of effluents without treatment into the water bodies in common areas where people will rely for consumption of water for drinking purpose may affect the health of the people (30-32).

#### 1.1.8. Suspended matter

There are certain contaminants do not soluble in water and are too large to mix with water molecules. These include substances like straws, cans and other large objects. When suspended, they form a layer on the surface of the water, blocking penetration of oxygen and leading to depletion. Particulate matter may settle at the bottom of a lake, ocean or river, impacting the life that exists on the floor of these bodies of water. In some cases, these materials can also contain harmful toxins, further affecting the aquatic ecosystem (33).

#### 1.1.9. Effects of water pollution

Polluted water can affect both aquatic organisms and humans. Most of the cities and urban centers are contaminated by garbage and chemical dumping, whether legally or illegally. Below are some of the most common and severe effects of polluting water bodies (34-36).

#### 1.1.10. Effects on human beings

Polluting water bodies has significantly impacted on human health and the environment. Life is a cycle, and humanity's negligent behavior often returns to haunt it. According to UN World Water Development a report in 2023, 26 per cent of the global population or 2 billion people lack access to drink pure and safe water, and 3.6 billion people, or 46 per cent, do not have access to safely managed sanitation services. One of the

most severe consequences of this is the spread of diseases. In a 2023 assessment, the World Health Organization identified between 21,000 to 143,000 cholera-related deaths worldwide, estimating that there are 1.3 to 4.0 million cases of cholera globally each year. Additionally, events like the Fukushima disaster have led to long-term health consequences, with studies showing a 70 per cent rise in thyroid cancer among infants exposed to radiation (37-39).

#### 1.1.11. Decimation of aquatic life

Animals and plants that rely on water for survival are the most impacted by water pollution. Statistics from the Centre for Biological Diversity on the effects of the Deepwater Horizon spill offer a stark illustration of this impact. The 2010 spill in the Gulf of Mexico harmed over 82,000 birds, 25,900 marine animals, 6,165 sea turtles and an uncounted number of fish and invertebrates (40, 41).

#### 1.1.12. Food chain disruption

Pollution disrupts the food chain by transferring toxins from one level to higher levels. In some cases, there could be imbalance in food chain resulting in wipe out of an entire food chain, further causing imbalances. For instance, if a predator dies, it may lead to excessive growth in prey populations, while the loss of prey can result in the decline of predators (42-44).

#### 1.2. Economic effects

To protect the water bodies from pollution is an expensive endeavour. For instance, in 2019 Japan declared that there is no space to store the contaminated water from the Fukushima disaster, with over a million tonnes stored in tanks. Research indicates that cleaning up the effects of the disaster will cost at least USD 660 billion. Even under normal conditions, the cost of purifying drinking water is high, not to mention the health expenses associated with treating diseases caused by contaminated water (45-47).

#### Future Perspectives of Water Pollution

Future impact of water pollution on the environment and human health is expected to be profound and multifaceted.

Here are some key perspectives:

1. **Increased Health Risks:** As pollutant levels rise, human exposure to toxins will likely increase, leading to a higher incidence of diseases such as cancer, cardiovascular conditions, and gastrointestinal illnesses. The World Health Organization (WHO) predicts that waterborne diseases will continue to be a major health concern, particularly in developing regions.
2. **Ecosystem Disruption:** The extinction of marine species due to pollution will disrupt food chains and ecosystems. This can lead to the collapse of entire ecosystems, affecting biodiversity and the services these ecosystems provide, such as water purification and carbon sequestration.
3. **Economic Burden:** The financial costs associated with water pollution are expected to rise. This includes the costs of cleaning up polluted water bodies, purifying drinking water, and treating health conditions caused by contaminated water. The economic burden will also extend to lost productivity and increased healthcare expenses.
4. **Technological and Policy Innovations:** To combat these challenges, there will be a growing emphasis on developing advanced water treatment technologies and implementing stricter environmental regulations. Innovations in phytoremediation and bioremediation could play a significant role in mitigating pollution.
5. **Climate Change Synergy:** Climate change is expected to exacerbate the effects of water pollution. Increased temperatures and altered precipitation patterns can enhance the spread of pollutants and the frequency of harmful algal blooms. This synergy between climate change and pollution will require integrated approaches to environmental management.

These perspectives highlight the urgent need for comprehensive strategies to address water pollution and protect both human health and the environment.

## CONCLUSION

Water pollution is a significant global problem caused by a several sources such as industrial waste, agricultural runoff and inappropriate disposal of chemicals. Pollution of water bodies leads to serious threat to aquatic ecosystem, human health and the economy. Any reckless actions by humanity negatively impact all other beneficiaries of this resource. Several measures with stringent rules on wastewater treatment systems, industrial waste disposal, sustainable agricultural practices, public awareness, knowledge on waste management is required. It is therefore crucial to protect water bodies from deliberate pollution to ensure the health and sustainability of ecosystems and communities that depend on them. By tackling the underlying reasons for water pollution through a comprehensive strategy that engages government entities, businesses, and local communities, we can strive for a cleaner and more enduring future for everyone.

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