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# An Overview of Water Pollution and Its Multiple Causes

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**ABSTRACT**
Water pollution is a major problem in every region of the world due to dwindling freshwater reserves and rising wastewater production, which contaminate surface and underground water. Human health, aquatic life, vegetation, and ecological harmony are all seriously threatened by water pollution in India. Despite the proliferation of environmental laws in countries like India that aim to combat this worrying trend, it has only worsened in recent years. In order to present a comprehensive picture and focus the attention of policymakers on the most effective ways to combat water pollution, the authors of this study have used a global perspective with an emphasis on India. The world's fresh water supply is severely threatened by waste water production, which in turn pollutes rivers, lakes, water bodies, and ground water. Human health, aquatic life, vegetation, and ecological equilibrium are all seriously threatened by water pollution in India. Many countries, including India, have passed environmental regulations in an effort to curb this alarming trend, but the problem has only worsened. In order to present a comprehensive picture and focus the attention of policymakers on the most effective ways to combat water pollution, the authors of this study have used a global perspective with an emphasis on India.

***Keywords:*** *water pollution, health, environmental, water quality, natural resource*

## I. INTRODUCTION

Water is generally agreed upon to be the most crucial of all natural resources. With 98% being composed of salt water, our water supply is clearly unsafe for human consumption. Even though glaciers and polar ice caps hold the other 1.6% of the world's water supply, fresh water only accounts for 2% of the total. Aquifers and wells provide the additional 0.36 percent. The water in the world's lakes and rivers only accounts for 0.036 percent of the total. A survey conducted by the World Health Organization and the United Nations Children's Fund found that in 76 percent of households across 45 developing nations, women and children were responsible for collecting water hold the other 1.6% of the world's water supply, fresh water only accounts for 2% of the total. Aquifers and wells provide the additional 0.36 percent. The water in the world's lakes and rivers only accounts for 0.036 percent of the total. A survey conducted by the World Health Organization and the United Nations Children's Fund found that in 76 percent of households across 45 developing nations, women and children were responsible for collecting water. That's time that could be used to get an education, earn a living, or take care of family members. Contamination of water sources is a big problem in every country. Pollution occurs as a result of the spread of toxic effluents through a water system and the subsequent degradation of water quality. Water contamination caused by unrestrained growth in urban, industrial, agricultural, and other infrastructure development around the world is depleting freshwater resources. All manufacturing processes have polluting effects, even if they weren't designed to. Human activities contribute to water pollution in many ways, including the introduction of harmful microorganisms, nutrients that deplete oxygen, heavy metals, pesticides, and oxygen-depleting chemicals, as well as suspended sediments, nutrients, and pesticides. In addition to light and nutrients, heat and other pollutants can elevate the water's temperature and lead to stratification. The quality of water all throughout the world has declined dramatically, and pollution is usually to blame. The most common issue with water quality is eutrophication, which is caused by an excess of nutrients (mainly phosphorous and nitrogen). Sewage that isn't treated causes pollution in waterways and coastal zones in developing nations. Many polluting businesses, such as the leather and chemical manufacturing sectors, are moving from developed to developing nations.

Water pollution has far-reaching effects, damaging not only aquatic ecosystems but also land, agriculture, aquatic life, and human health. In rural and certain suburban areas, the soil acts as a vector for the entry and contamination of partially or wholly untreated household wastes. Domestic wastes are collected and transported through sewage pipelines in urban areas, where they are either treated or dumped untreated into rivers (this is considered the major potential source of water pollution). Sewage management in cities is typically possible due to the presence of well-established government entities in charge of the issue (Boyd and Tucker, 2012). There is a large variety of industrial waste produced by different sectors and regions. Organic wastes, such as those produced by dairies, food processors, and slaughterhouses, can be disposed of using the same methods as municipal solid garbage. When others produce garbage, it tends to be high in toxic metals, acids, or alkalis and low in organic

matter. Chemical and mining plants, as well as textile mills, are among the examples. The contamination of freshwater systems by chemical substances from industry and nature is a global environmental crisis. Water is becoming scarce as a result of fast industrialization and a rising global population; hence, its value is rising rapidly across the board. In some parts of the world, water is scarce and expensive to extract. Reddy claims that 80% of the world's population is in danger of losing access to safe drinking water because of the growing global population and rapid industrialization, which are causing water to become scarcer and more valuable in more and more places. In many parts of the world, water is scarce and expensive to get. According to research recently published in the scientific journal Nature, 80 percent of the world's population is in danger of losing access to clean drinking water, according to Reddy.

## II. WORLDWIDE WATER POLLUTION

Diseases spread through contaminated water are a leading cause of death in many nations. For their own well-being, newborns and young children need regular access to safe drinking water. The World Health Organization estimates that more than 1.8 million individuals lose their lives each year due to diarrhea-related ailments (2005). One's susceptibility to water-borne diseases increases if one's immune system is impaired, as in the case of AIDS patients. Those who partake of water that has been tainted are putting themselves in danger of developing water-borne illnesses. While the percentage of homes in the developing world using contaminated water has reduced, it is extremely unlikely that all residences will have access to a clean water source anytime soon (c.f. Mintz et al., 2001). In 2010, 884 million people around the world used unimproved sources of drinking water, according to UNICEF (2010: 7–9). By 2015, 672 million people, according to UNICEF estimates, will still be using unsanitary water sources. It's important to know why you're treating your water if it comes from a dirty source.

The World Health Organization estimates that at least 5 million individuals each year succumb to water-related illnesses due to a lack of access to clean drinking water. For a long time, it was thought that the world's oceans—which make up more than 70 percent of its surface area—could be used as an infinite rubbish dump. Obviously, this is not true. Over time, the accumulation of pollutants along the world's coastlines has outpaced the oceans' ability to flush them out. As a result of excessive levels of germs from sewage treatment, beaches are being closed around the world, which is having a negative impact on marine life. It appears that pollution does not recognise or respect international boundaries. Sweden held and supported the first major global summit on environmental issues in 1972, when the United Nations (UN) was still in operation. Some poorer nations were hesitant to send representatives to the meeting, which the United States was presiding over, out of concern that the industrialised world would use environmental protection to maintain their economic dominance. The United Nations Environment Program (UNEP) was established as a direct result of the summit.

About forty percent of the rivers in the United States are unsuitable for fishing, swimming, or supporting aquatic life. Almost half of the lakes in the United States are polluted to the point where they are unsafe for swimming or fishing. It is estimated that eutrophication has caused severe or moderate damage to over 50% of the nation's estuaries and bays (nitrogen and phosphorus pollution). An estimated 1.5 million metric tonnes of nitrogen pollution enter the Gulf of Mexico annually via the Mississippi River, which drains 40% of the continental United States, including its farmland heartland, making it unsafe for swimming or fishing. It is estimated that eutrophication has caused severe or moderate damage to over 50% of the nation's estuaries and bays (nitrogen and phosphorus pollution). An estimated 1.5 million metric tonnes of nitrogen pollution enter the Gulf of Mexico annually via the Mississippi River, which drains 40% of the continental United States, including its farmland heartland. Each summer, a hypoxic coastal dead zone the size of Massachusetts forms in the Gulf of Mexico. Untreated sewage, storm water, and industrial waste damage US waters to the tune of 1.2 trillion gallons annually. The United States Environmental Protection Agency (EPA) has issued a warning that sewage pollution in rivers could reach 1970s levels by 2016.

Asia is home to some of the most polluted rivers in the world. There are three times as many bacteria in faeces and twenty times as much lead as there would be in a normal person's body. In 2004, half of the sampled stretches of China's seven largest rivers were deemed unsuitable for human consumption owing to pollution. It has been stated that the percentage of European rivers and lakes that do not meet standards for swimming and other water sports has increased between 2004 and 2005. Just 22.4% of Slovakia's freshwater regions meet EU standards. Thirty percent of Ireland's streams are contaminated by human waste and fertiliser. The Sarno River in Italy is the dirtiest in all of Europe due to its high concentrations of human waste, untreated farm waste, toxic industrial byproducts, and other pollutants. Greece has the cleanest coastlines, followed by Spain and Germany. The ocean water in Estonia and Lithuania is very polluted. The King River in Australia is the most polluted river in the country due to its acidic state, which was brought on by mining. Roughly half of all people on Earth are affected by polluted freshwater supplies. It is believed that between 5 and 10 million individuals per year lose their lives due to water-related ailments. Drinking contaminated water can lead to gastrointestinal disorders such as cholera, typhoid fever, schistosomiasis, and dysentery. Because of this, the country's groundwater is among the most contaminated in the world. The pollutant is arsenic, which occurs naturally in sediments. A million people in Bangladesh have already been poisoned by

drinking arsenic-tainted groundwater, and another million are at risk. As a result of plastic trash ending up in the ocean and near shore areas, more than a million seabirds and countless fish are killed every year.

## III. MULTIFACETED CAUSES OF WATER CONTAMINATION

In this context, "water pollutants" refer to any substances that can change the water's physical, chemical, or biological characteristics. This stuff is toxic to living creatures. When contaminants enter a body of water, such as a stream, river, or lake, the water gets contaminated. Multiple factors contribute to deteriorating water quality. Some categories into which these fall are as follows:

- Information Gathered from Near and Far
- Both nature and humanity provide us with resources.

### 3.1 A Variety of Useful and Useless Sources

Point sources of pollution allow for the efficient monitoring and control of pollutants and effluents from well-defined sources like domestic and industrial wastewater. Conversely, non-point sources of water pollution can be found in a variety of different places. Agricultural fields, construction sites, abandoned mines, and solid waste disposal sites are major contributors to water pollution when contaminated runoff from these areas enters waterways. Non-point-source control is difficult.

### 3.2 Natural and Artificial Energy Production

Increasing concentrations of substances that occur in nature are another definition of pollution. This rising population can be traced back to organic causes. Silt is a type of natural sediment that comes from the erosion of soil, sand, and mineral particles. This occurs frequently in almost any body of water. Random deforestation aerates the ground, which makes it easier for flood flows to deposit silt from the mountains into water bodies like rivers, lakes, and streams. In contrast, human actions can cause what are known as "anthropogenic" or "man-made" sources of water contamination. Anthropogenic sources of water pollution include domestic (sewer and wastewater) and commercial (industrial and agricultural) pollutants dumped into water systems.

## IV. SEVERE WATER POLLUTANTS

Erosion of riverbanks, pesticides, fertilisers, radioactive waste, and agricultural runoff are also major contributors to water contamination.

- Liquid forms of inorganic waste
- Biological waste that cannot be decomposed naturally
- Germs/microorganisms
- Concentrated sources of nutrition
- Inorganic materials
- Elemental Substances
- Gravel and sand
- Steaming $H_2O$

### 4.1 Liquid Forms of Inorganic Waste

Pollutants that are "oxygen-demanding" are decomposed by bacteria and other microorganisms in the presence of dissolved oxygen in the water after being discharged into the ocean or another body of water. Run-off from rainfall and storm events can carry organic waste from the land in addition to sewage and other liquid organic waste. Storms, floods, and precipitation all contribute to this runoff. When the amount of dissolved oxygen in water drops, aquatic organisms like fish and plants might suffer or die.

### 4.2 Biological Waste Decomposed Naturally

Most of the inorganic liquid pollutants that end up in rivers originate from industries, but they are diluted and safe by the time they reach the ocean. It is possible for toxic inorganic waste to build up in the food chain and reach fish at the end of the chain. Many people have died or been seriously hurt because of heavy metals and other inorganic compounds that have been found in fish and crops that people eat. This is because the water is contaminated.

**4.3 Germs/Microorganisms**

Numerous forms of bacteria and viruses are dispersed and contribute to water contamination due to animal waste, debris from sewers and latrines, and other similar sources. Poultry farms, tanneries, and slaughterhouses are all major sources of these microorganisms in our rivers.

**4.4 Concentrated Sources of Nutrition**

Overuse of fertilisers, nitrate-containing minerals, and household pollutants are all contaminating water supplies. This nutritional additive promotes rapid growth in plants that normally wouldn't need it. A foul odour and taste will permeate the water after a few days, when the plants have decomposed. When the growth of aquatic plants becomes unchecked, a process known as eutrophication begins to take place.

**4.5 Inorganic Materials**

Products such as soaps, detergents, pesticides, and other cleaning chemicals fall under this umbrella. Multiple sectors also engage in the production of these compounds.

**4.6 Elemental Substances**

Arsenic, lead, cadmium, and mercury are just a few examples of the inorganic pollutants that can be found in metals.

**4.7 Gravel and Sand**

Due to erosion, silt and sediment end up in rivers and streams. The intensity of soil erosion has increased by a factor of five to ten due to human activities in agriculture and construction.

**4.8 Steaming $H_2O$**

Thermal industries need a lot of cool water to protect their engines from overheating. When this heated water is released into nearby bodies of water, it causes a decrease in dissolved oxygen (DO).

## V. THE EFFECTS OF WASTE WATER DISCHARGE

Polluted water has far-reaching effects on ecosystems everywhere it is released. It has devastating effects on both human beings and the natural world. Pollution is a problem on land and in water, and it can harm a wide variety of organisms. Since this has occurred, output has naturally declined. There will be a decrease in biomass and community diversity when large amounts of harmful compounds are dumped into waterways. The majority of harmful chemicals found in water come from organic waste. There may be an increase in secondary productivity and a change in the makeup of the aquatic community as a result of this garbage. Fish are well-known to be among the most susceptible organisms to pollution, especially those species that are highly sought after by humans as a source of food. The health of human beings can be negatively affected by a polluted water supply. Bacteria and viruses can be carried from one location to another and spread disease when they enter a water source. Our health is in jeopardy because of the contaminated water supply. Human health has been shown to be directly related to plant and animal nutrition. When there is an excess of nitrogen, phosphorus, and other elements that promote plant growth in water, the water turns murky and weeds flourish. This is the reason why some flavourings and colours in water contain artificial ingredients. Eventually, the ecological balance of a body of water is thrown off. The production of carbon dioxide, along with the emissions of sulphur dioxide and nitrogen oxides, can lead to acid rain, which in turn lowers soil pH and acidifies the ocean.

**Table 1:** Effects of water pollution on ecosystems

| S.No | Polluted | Effects |
|---|---|---|
| **1.** | Pathogens | Water's positive health effects (causing a foul odor) (spreading disease through the water supply) |
| **2.** | Detrimental substances that cannot decompose | Consequences for aquatic life include fish deaths, cancer risks, and genetic mutations. Aesthetics and eutrophication |
| **3.** | Dangerous, inorganic pesticides | Algal blooms and eutrophication are the root causes of methemoglobinemia. |
| **4.** | Bases and acids are | This process can be used to disinfect water that is unfit for human consumption, agricultural irrigation, or industrial processes. |
| **5.** | Substances that don't produce nuclear reactions | Cancer and DNA defects |
| **6.** | Heat | That's bad news for aquatic ecosystems because oxygen is being used up. |
| **7.** | Sediment | Because of this, fish populations decline and water quality deteriorates. |

## VI. FOCUS ON INDIA

As cities and individual water usage expand rapidly, so does the volume of graywater and wastewater they produce. It is estimated by CPHEEO that as much as 80% of all domestically used water ends up in the garbage. Seventy-two percent of India's urban population lives in class-I and class-II cities and towns, and they produce roughly 98 LPCD of wastewater per capita. In contrast, only 61% of the wastewater generated in Delhi is treated, while the National Capital Territory generates about 220 LPCD (CPCB, 1999). There are 498 Class I cities in the country and 410 Class II cities, for a combined waste output of 35,558 MLD. Figure 2 shows that only 11,553 MLD of sewage treatment capacity has been added, leaving a gap of 26,468 MLD. The rate at which cities are expanding and the number of people using public water systems have both contributed to an increase in the volume of grey water and wastewater that must be treated and disposed of. CPHEEO estimates that between 70 and 80 percent of all drinking water is lost to leaks and other forms of non-use. Around 98 LPCD of garbage is generated per inhabitant in India's class I and class II cities and towns. About 72% of India's urban population lives in these urban centers. The National Capital Territory of Delhi generates about 220 LPCD of waste, of which only 60% is treated. Class I cities (498 total) and Class II cities (410 total) are expected to produce 35,558 MLD of garbage per year. There is a sewage treatment capacity gap of 26,468 MLD, or 26% of the total installed power capacity, because only 11,553 MLD of sewage treatment capacity has been built (Figure 2). The Series of Waste Stabilization Ponds is used in 28% of the plants despite only accounting for 5.6% of the total capacity. Because land is usually available at a fair opportunity cost and experienced labour is scarce in underdeveloped nations, stabilisation ponds are the best option for wastewater treatment, according to a World Bank report (Shuval et al., 1986).

Although 13468 MLD of wastewater is produced by industries, only 60% is treated. This does not include wastewater produced by households. Because of the high cost of individual wastewater treatment facilities, communities of small businesses have banded together to form Common Effluent Treatment Plants (CETP). Wastewater treatment plants use a variety of treatment procedures to remove sludge, including sludge drying beds, secondary clarifiers, flash mixers, and clarifloculators. Screening, grit removal, and sedimentation are all used to remove coarse material and settable solids from the waste stream before it moves on to secondary treatment. CETPs' industrial wastewater is sent down rivers after being combined with river water. There are a total of ten sewage treatment plants (CETPs) in Delhi, and one of them has a capacity of 133 MLD and discharges its sewage into the Yamuna River. Wastewater treatment using traditional methods is both time-consuming and costly. It is estimated that the total cost of constructing a treatment system for all residential wastewater will be around Rs. 7,560 crore (CPCB, 2005a), which is roughly 10 times the amount that the Indian government plans to spend. In Table 1, we can see a comparison of the costs associated with the various treatment tiers when using the standard metrics. (CPCB, 2007b). Studies of Indian sewage treatment plants (STPs) have revealed that sludge removal, treatment, and handling are frequently overlooked areas of plant management.

wastewater treatment facilities that fail to meet their primary function due to inadequate planning, lax upkeep, power outages, and a shortage of technical staff (CPCB, 2007b). In most cases, sludge digesters and UASB reactors are unable to make good use of the biogas they produce.

## VII. GUIDELINES FOR WATER QUALITY IN INDIA

The Ministry of Environment, Forests, and Climate Change (MoEFCC) is a government agency in New Delhi responsible for enforcing environmental laws and addressing environmental concerns. The fundamental objective of the Water Quality and Pollution Prevention Act is to maintain high standards for water cleanliness and pollution prevention. The Central Pollution Control Board (CPCB) works under the Ministry of Environment and Forestry (MoEF) to ensure that pollution levels are maintained at an acceptable level. India's main groundwater board is called the Central Ground Water Board (CGWA). It was established by the government and is regulated by the Ministry of Water Resources.

**Acts-**

- The Water (Preventing and Controlling Pollution) Act, 1974, as amended in 1988
- The Water (Prevention and Control of Pollution) Act Amendment Act of 2003

**Rules-**

- Amendments to the Rules of the Central Pollution Control Board, 2012
- 2010 Wetlands Regulations

**Policy-**

- The United States' water policy seeks to optimise water use while reducing waste.
- The current water policy in California

## VIII. CONCLUSION

Water pollution is a worldwide issue that requires a comprehensive plan to solve. New, sustainable inventions can't be made without a better research and development system. Development of industrial, urban, agricultural, and other infrastructure in river basins and catchment areas should be restricted to prevent pollution of rivers, lakes, and other bodies of water. It is also crucial to carry out an integrated environmental planning process supported by law and featuring clear simulation models with the intention of safeguarding and restoring water quality.

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