



Safe Drinking Water-Threats of Pollution to Potable Water For The Community

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Abstract

Clean drinking water is not merely a convenience, it is a fundamental human need and a cornerstone of public health. However, millions of people around the globe still lack access to safe water sources, leading to severe consequences for their health, livelihoods, and overall well-being. Understanding the gravity of this issue is pivotal, as is the urgent need to address it effectively. The ramifications of inadequate access to clean drinking water are profound and far-reaching. According to recent data from the World Health Organization (WHO) and UNICEF, approximately 785 million people worldwide still lack even a basic drinking-water service, with many more consuming water that is contaminated or unsafe. This precarious situation exposes individuals and communities to a myriad of health risks, including waterborne diseases such as cholera, typhoid fever, and diarrhea, which claim the lives of over 2 million people annually, predominantly children under the age of five.

Moreover, the absence of clean water perpetuates a cycle of poverty, hindering economic development and exacerbating inequalities. Without access to safe water for drinking, cooking, and sanitation, communities struggle to maintain good health, attend school regularly, or pursue livelihood opportunities, trapping them in a cycle of poverty and deprivation.

Ensuring universal access to clean drinking water is not just a matter of basic necessity: it is a fundamental human right. Clean water is indispensable for maintaining health, sanitation, and dignity. It serves as a cornerstone for sustainable development, empowering individuals and communities to thrive economically and socially. Additionally, adequate water access is crucial for achieving various Sustainable Development Goals (SDGs), including those related to health, education, gender equality, and poverty eradication.

Key Words: Clean, Consequences, Gender, Community, Livelihood, Drinking, Contaminated, Economic, Health

Introduction

Safe drinking water is a basic necessity. Water is a subject of the state, and rural water supply has been included in the Eleventh Schedule of the Constitution among the subjects that may be entrusted to panchayats by the states. Considering the magnitude of the problem, the central government has been supplementing the efforts of the state governments through various programs from time to time. Access to clean drinking water remains a significant problem in India, with millions lacking access to safely managed sources. While government initiatives like the Swachh Bharat Mission aim to improve sanitation and water access, challenges persist, including groundwater depletion and contamination, open defecation, and inadequate hygiene practices. Access to affordable and improved Water, Sanitation, and Hygiene (WASH) facilities is essential for people's daily lives, and it is the primary goal of Sustainable Development Goal 6 (SDG-6). However, achieving this goal is a significant challenge for many countries, including India. The aim of this study is to assess the progress made towards achieving SDG-6 targets in Indian districts, states, and Union Territories (UTs) and to identify clusters by measuring spatial inequality of WASH coverage in India. India has made tremendous progress in increasing the coverage of the drinking water supply infrastructure in rural areas. As per the joint monitoring programme of the United Nations Children's Fund and World Health Organization, by 2020, 89 per cent of the rural population in India was covered with at least basic drinking water services, i.e., they had access to an improved water source within a round trip of 30 minutes. Further, as per the latest information reported by the Department of Drinking Water and Sanitation, Ministry of Jal Shakti, Government of India, as of 31 May 2022, 50 per cent of rural households had a tap connection within the dwelling or premises. However, there is a dearth of information on whether the progress in creating the physical infrastructure has translated into an improvement in the reliability and safety of drinking water services in rural households.

With this background, our issue brief focuses on ascertaining the extent to which data on safely managed drinking water services are reported in India and makes recommendations to strengthen the existing data and information system. These services are characterised by access to the improved source of drinking water that is located on the premises, available when needed, and free from faecal and priority chemical contamination (refer to Figure ES 1). For this purpose, the four main national government sources that report data and information on rural drinking water services in India were reviewed. These include the *Census of India*, *National Sample Survey (NSS)*, *National Family Health Survey (NFHS)*, and the Integrated Management Information System (IMIS) dashboard maintained by the Department of Drinking Water and Sanitation (DDWS), Ministry of Jal Shakti, Government of India. These sources were reviewed concerning the data and information they report on rural drinking water services, various terminologies used, and the possibility of using them to make reliable inferences on the progress made in providing safely managed drinking water services.

Specific Challenges:

Groundwater Depletion: Over-extraction of groundwater for irrigation and other uses is causing a decline in water tables, particularly in rural areas and contamination by industrial and agricultural runoff, as well as improper sanitation practices, contaminate water sources, leading to waterborne diseases. **Open Defecation:**-despite the Swachh Bharat Mission, open defecation remains a problem in some areas, contributing to water contamination. **Hygiene Practices** -lack of handwashing with soap and inadequate sanitation facilities contribute to the spread of waterborne diseases. **Infrastructure Gaps**-inadequate water treatment facilities and distribution networks, especially in rural areas, hinder access to safe drinking water. **Gender Disparities**-women and girls often bear the burden of collecting water from distant sources, limiting their access to education and economic opportunities. **Socio-Cultural Factors**-traditional beliefs, casteism, and illiteracy can hinder the adoption of improved sanitation and hygiene practices. **Economic Disparities**-the cost of water and sanitation services can be prohibitive for low-income households, further exacerbating the problem. **Examples of Case Studies:** -Nongpok Sekmai and Surrounding Villages-This area faces water scarcity due to traditional water sources like open wells being contaminated and a drying river due to illegal activities. Kurukshetra District-Research in this area found that while many households had access to government borewells, a significant percentage still reported experiencing waterborne diseases and some preferred open defecation. Pasur Village:A study in this village revealed high water consumption, poor water quality due to leakages and sewage contamination, and the need for improved sanitation facilities.

Government Initiatives and Solutions: **Swachh Bharat Abhiyan**-The "Clean India Mission" aims to eliminate open defecation and promote cleanliness and hygiene, **Drinking Water Schemes**-Government initiatives are focused on providing access to improved water sources within a reasonable distance, **Water Treatment Technologies**-Efforts are underway to improve water treatment and disinfection technologies, **Hygiene and Sanitation Campaigns**-Public awareness campaigns aim to promote better hygiene practices and sanitation, **Community Participation**-Engaging communities in water management and sanitation initiatives is crucial for sustainability, **Government Support**-Financial and technical assistance from the government is crucial for implementing and maintaining water infrastructure, **NGO Involvement**-Non-governmental organizations play a vital role in providing support and implementing innovative solutions.

Sources of Drinking Water Pollution

Microorganisms-bacteria, viruses, and parasites from sewage and animal waste can contaminate water sources, **chemicals**-Industrial discharges, agricultural runoff (pesticides, fertilizers), and natural sources like arsenic can introduce harmful chemicals, **Heavy Metals**-Lead and other heavy metals can leach from pipes and other materials into drinking water, **Disinfection Byproducts**-Chemicals used to disinfect water, such as trihalomethanes, can pose health risks, **Health Effects of Drinking Water Pollution**, **Infectious Diseases**-Contaminated water can transmit diseases like diarrhea, cholera, dysentery, typhoid, and hepatitis A., **Chronic Diseases**-Long-term exposure to contaminants can cause kidney damage, liver failure, and even cancer, **Reproductive Issues**-Some chemicals in polluted water can affect reproductive health, causing fertility problems and birth defects.

Examples of Drinking Water Contaminants: **Arsenic**-A naturally occurring heavy metal that can cause cancer and other health problems, **Lead**- Leaching from pipes can lead to lead poisoning, especially in children, **Perfluorooctanesulfonic acid (PFOS)**- A persistent chemical used in various industrial products that can contaminate water, **Nitrates**-High levels of nitrates can cause "blue baby syndrome" in infants.

Preventing Drinking Water Pollution

Proper Waste Management-Effective sewage treatment and disposal can prevent microbial contamination, **Industrial Regulations**-Strict regulations on industrial discharges can minimize the release of harmful chemicals, **Agricultural Practices**-Sustainable agricultural practices can reduce the use of pesticides and fertilizers, preventing runoff, **Water Treatment**-Advanced water treatment technologies can remove or reduce the levels of many contaminants, **Public Education**-Educating the public about the risks of water pollution and the importance of safe water practices.

Health Risks: Pollution in drinking water can lead to severe health risks for humans. Contaminants such as heavy metals, chemicals, bacteria, and viruses can cause diseases like gastrointestinal illnesses, neurological disorders, reproductive problems, and even cancer.

Certainly, here are some health risks associated with water pollution:

1. Gastrointestinal Illnesses: Contaminated water often contains pathogens like bacteria, viruses, and parasites, which can cause gastrointestinal infections. Symptoms may include diarrhea, vomiting, stomach cramps, and dehydration. Common waterborne diseases include cholera, dysentery, and gastroenteritis.

2. Waterborne Diseases: Various pathogens present in polluted water can lead to waterborne diseases. For example:

- **Cholera:** Caused by the bacterium *Vibrio cholerae*, cholera can cause severe diarrhea and dehydration, leading to rapid health deterioration and, if untreated, death.
- **Typhoid Fever:** Caused by the bacterium *Salmonella typhi*, typhoid fever is characterized by high fever, weakness, abdominal pain, and sometimes rash. It can be fatal if not treated promptly.

- **Hepatitis A:** This viral infection affects the liver and can cause symptoms like jaundice, fatigue, nausea, and abdominal pain.
- 3. Chemical Contamination:** Pollutants such as heavy metals (e.g., lead, mercury, arsenic), industrial chemicals (e.g., PCBs, dioxins), pesticides, and pharmaceuticals can contaminate water sources. Prolonged exposure to these chemicals through drinking water can lead to various health issues, including:
 - **Neurological Disorders:** Heavy metals like lead and mercury can impair brain development in children and cause cognitive and behavioral problems in adults.
 - **Cancer:** Some chemicals found in polluted water are known or suspected carcinogens, increasing the risk of cancer development over time.
 - **Reproductive Problems:** Exposure to certain chemicals in water can affect reproductive health, leading to infertility, birth defects, and hormonal imbalances.
- 4. Skin Irritation and Allergic Reactions:** Polluted water can cause skin problems such as rashes, itching, and irritation. Allergic reactions may also occur due to contaminants like chlorine, which is commonly used for water disinfection.
- 5. Respiratory Issues:** Inhalation of contaminated water droplets, such as through showering or steam inhalation, can lead to respiratory problems, particularly for individuals with pre-existing conditions like asthma or allergies.
- 6. Long-term Health Effects:** Chronic exposure to polluted drinking water can have long-term health effects, including organ damage, compromised immune function, and an increased risk of chronic diseases such as cardiovascular disease, kidney disease, and liver disease.

These health risks underscore the critical importance of ensuring access to clean and safe drinking water for public health and well-being. Efforts to prevent water pollution, improve water treatment infrastructure, and enforce regulations are essential for mitigating these risks and protecting human health.

Waterborne diseases

Waterborne diseases are illnesses caused by germs (like bacteria, viruses, and parasites) that are found in contaminated water. When people consume or come into contact with this polluted water, these germs can enter their bodies, leading to various health problems. Waterborne diseases can affect the digestive system, causing symptoms like diarrhea, vomiting, and stomach cramps. They can also impact other parts of the body, leading to conditions such as skin infections, respiratory issues, and even serious diseases like cholera, typhoid fever, and hepatitis. Preventing waterborne diseases involves ensuring access to clean and safe drinking water, improving sanitation and hygiene practices, and treating water to remove harmful contaminants.

Preventing common waterborne diseases involves several key strategies:

- 1. Access to Clean Water:** Ensuring access to clean and safe drinking water is essential. This can be achieved through measures such as proper treatment of drinking water, regular testing to monitor water quality, and maintaining water distribution systems to prevent contamination.
- 2. Sanitation and Hygiene Practices:** Promoting good sanitation and hygiene practices can help prevent the spread of waterborne diseases. This includes proper disposal of human waste, handwashing with soap and clean water, and safe handling and storage of food and water.
- 3. Water Treatment:** Implementing effective water treatment methods is crucial for removing or killing harmful germs in water. Common water treatment processes include filtration, chlorination, and UV disinfection, which help to remove or inactivate pathogens and make water safe for consumption.
- 4. Proper Waste Management:** Proper disposal of sewage and other wastes helps prevent contamination of water sources. Implementing wastewater treatment systems and enforcing regulations on waste disposal can significantly reduce the risk of waterborne diseases.
- 5. Boiling or Purifying Water:** In areas where access to clean water is limited, boiling water before drinking can help kill harmful germs. Alternatively, water purification methods such as using water filters, chemical disinfectants, or water purification tablets can be used to make water safe for consumption.
- 6. Educational Programs:** Public awareness campaigns and educational programs play a crucial role in promoting preventive measures against waterborne diseases. These programs can inform communities about the importance of clean water, proper sanitation practices, and hygiene behaviors to prevent the spread of infections.
- 7. Community Engagement:** Engaging communities in water management and sanitation initiatives encourages participation and ownership of preventive measures. Community-based approaches, such as setting up clean water committees or promoting community-led sanitation projects, can help sustainably improve water quality and reduce the risk of waterborne diseases.
- 8. Monitoring and Surveillance:** Regular monitoring and surveillance of water sources, as well as surveillance of waterborne disease outbreaks, help identify potential risks and implement timely interventions to prevent further transmission of diseases.

By implementing these preventive measures and promoting a holistic approach to water management and sanitation, the risk of common waterborne diseases can be significantly reduced, leading to improved public health and well-being.

Chemical contamination

Refers to the presence of harmful chemicals in the environment, including water sources, soil, air, and food. These chemicals can come from various sources such as industrial activities, agricultural practices, household products, and waste disposal. Chemical contaminants can be classified into different categories, including heavy metals, pesticides, industrial chemicals, pharmaceuticals, and household chemicals.

Here's an overview of some common sources and types of chemical contamination:

1. **Heavy Metals:** Heavy metals like lead, mercury, arsenic, cadmium, and chromium are naturally occurring elements that can also be released into the environment through human activities such as mining, industrial processes, and improper waste disposal. These metals can accumulate in soil and water, posing serious health risks to humans and ecosystems. Long-term exposure to heavy metals can lead to neurological disorders, kidney damage, developmental delays in children, and increased risk of cancer.

2. **Pesticides:** Pesticides are chemicals used to control pests in agriculture, landscaping, and public health. While pesticides can effectively manage pests, they can also contaminate soil and water sources through runoff, leaching, and spray drift. Exposure to pesticides has been linked to various health problems, including neurological disorders, reproductive issues, hormone disruption, and increased risk of certain cancers.

3. **Industrial Chemicals:** Industrial activities such as manufacturing, mining, and chemical processing can release a wide range of hazardous chemicals into the environment. These industrial chemicals include solvents, heavy metals, volatile organic compounds (VOCs), and persistent organic pollutants (POPs). Industrial contamination can occur through spills, leaks, emissions, and improper disposal practices, leading to soil and water pollution. Chronic exposure to industrial chemicals can cause respiratory problems, skin irritations, liver damage, and reproductive disorders.

4. **Pharmaceuticals:** Pharmaceuticals are medications used to treat various health conditions in humans and animals. However, pharmaceuticals can enter the environment through improper disposal of unused medications, excretion by humans and animals, and discharge from pharmaceutical manufacturing facilities and healthcare facilities. While the environmental impact of pharmaceutical contamination is still being studied, there is concern about the potential effects on aquatic ecosystems and human health.

5. **Household Chemicals:** Household products such as cleaning agents, personal care products, paints, and pesticides contain chemicals that can be harmful to human health and the environment. Improper use, storage, and disposal of these household chemicals can lead to contamination of soil and water sources. Exposure to household chemicals can cause respiratory problems, skin irritations, allergic reactions, and other health issues.

Overall, chemical contamination poses significant risks to human health, wildlife, and ecosystems. Preventing and mitigating chemical contamination require implementing measures to reduce chemical use, improving waste management practices, enforcing regulations on chemical safety, and promoting sustainable alternatives and technologies. Additionally, regular monitoring and testing of environmental samples are essential for detecting chemical contaminants and protecting public health and environmental quality.

Ecological Impact

The ecological impact of pollution, including water pollution, is profound and wide-ranging, affecting various aspects of ecosystems and biodiversity. Here's an overview of some key ecological impacts:

1. **Biodiversity Loss:** Pollution can degrade habitats and directly harm plant and animal species, leading to declines in biodiversity. Aquatic ecosystems, in particular, are vulnerable to pollution from sources such as industrial discharge, agricultural runoff, and urban sewage, which can disrupt aquatic habitats, decrease oxygen levels, and alter water chemistry. As a result, sensitive species may be unable to survive or reproduce in polluted environments, leading to population declines and even extinctions.

2. **Water Quality Degradation:** Pollution introduces contaminants such as heavy metals, pesticides, nutrients, and pathogens into water bodies, leading to degraded water quality. Excessive nutrient runoff, for example, can cause eutrophication, where algae blooms proliferate and deplete oxygen levels, leading to fish kills and ecosystem imbalances. Poor water quality can also impair the health of aquatic organisms, including fish, amphibians, and invertebrates, and disrupt food webs and nutrient cycling processes.

3. **Habitat Degradation:** Pollution can degrade terrestrial and aquatic habitats, reducing the availability of suitable habitat for plant and animal species. Habitat destruction and fragmentation due to pollution can disrupt migration routes, breeding

sites, and foraging areas, leading to habitat loss and isolation for many species. This can result in population declines and reduced genetic diversity, making species more vulnerable to environmental stressors and disturbances.

4. **Bioaccumulation and Biomagnification:** Some pollutants, such as persistent organic pollutants (POPs) and heavy metals, can bioaccumulate in the tissues of organisms and biomagnify through food chains. This means that as pollutants move up the food chain, they become increasingly concentrated in predators at the top, posing health risks to apex predators and other organisms in the ecosystem. Bioaccumulation and biomagnification can have cascading effects on ecosystem health and function, leading to population declines and ecosystem disruption.

5. **Impaired Ecosystem Services:** Pollution can impair the delivery of ecosystem services, such as clean water, air purification, and pollination, which are essential for human well-being and ecological functioning. Degraded ecosystems may be less resilient to environmental changes and less capable of providing the services upon which humans depend. This can have socio-economic implications, including reduced food security, increased health risks, and decreased livelihood opportunities for communities dependent on ecosystem services.

6. **Loss of Cultural and Recreational Values:** Pollution can degrade natural landscapes and recreational areas, reducing their aesthetic and cultural values. Contaminated water bodies may become unsuitable for swimming, fishing, boating, and other recreational activities, impacting local economies and community well-being. Additionally, pollution can erode cultural connections to the land and water, diminishing traditional practices and cultural heritage.

Addressing the ecological impacts of pollution requires comprehensive strategies to reduce pollution sources, restore degraded ecosystems, and promote sustainable management practices. This may include implementing pollution prevention measures, restoring riparian buffers and wetlands, enforcing regulations on pollution discharge, and fostering community engagement and stewardship of natural resources. By safeguarding ecosystems from pollution, we can protect biodiversity, ensure the provision of ecosystem services, and promote the health and resilience of ecosystems for future generations.

Conclusion:

While India has made progress in improving access to water and sanitation, significant challenges remain. Addressing these challenges requires a multi-pronged approach that involves government initiatives, community participation, technological innovations, and addressing socio-cultural factors. Water pollution is a global crisis that threatens the health and well-being of both humans and the environment. As individuals become more aware of the devastating consequences of water pollution, many are taking action by conducting research projects to better understand the problem and find solutions. One crucial aspect of any research project or essay on water pollution is the conclusion. The conclusion is the final opportunity for researchers to summarize their findings, evaluate the significance of their results, and provide recommendations for future action. It serves as a powerful tool to communicate the importance of the project and its potential impact on addressing water pollution issues. A well-crafted conclusion can inspire others to join the fight against water pollution, as it highlights the urgency and need for immediate action. Furthermore, a comprehensive conclusion can also guide policymakers and stakeholders in implementing effective strategies to mitigate and prevent water pollution.

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