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Quality of Groundwater and Its Contamination

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Abstract
Ensuring water quality and preventing groundwater contamination are pivotal for maintaining public health and environmental sustainability. This is presents a concise overview of key issues and methodologies related to these critical concerns. It explores the multifaceted nature of water quality, encompassing parameters such as pH, dissolved oxygen, heavy metal concentrations, and microbial contaminants. Additionally, the sources and pathways of groundwater contamination, including industrial runoff, agricultural practices, and urban development. Various analytical techniques for assessing water quality and monitoring contamination are discussed, ranging from traditional laboratory methods to cutting-edge technologies like remote sensing and machine learning. Furthermore, the highlights the importance of interdisciplinary approaches and community engagement in addressing water quality challenges. By synthesizing current research findings and highlighting areas for future investigation.

Key word: Contamination, Environments, Ground water, Health, Quality

Introduction
Ground water is a major source of drinking water for millions of families living in urban and rural areas. According to an estimate, in India, 80 percent of domestic water requirement in rural areas and 50 percent of drinking water requirement in urban areas is met by ground water. Comparatively, the possibility of contamination and pollution in ground water is less as compared to surface water reservoirs. The natural impurities of rain water which replenish the ground water are also almost removed from the soil layer as it settles. But in India where water is used extensively for irrigation and industrial activities. Use of pesticides, excessive chemical fertilizers and surface discharge of industrial and municipal wastes can pollute ground water on a large scale. Apart from this, at some places, harmful substances like fluoride, chromium and arsenic are also found in earthen structures and due to their leakage, ground water is found polluted at the local level.

- **Water Quality**: This refers to the chemical, physical, and biological characteristics of water, which determine its suitability for various uses such as drinking, irrigation, industrial processes, and aquatic life support. Parameters used to assess water quality include pH, dissolved oxygen, turbidity, temperature, nutrient levels (like nitrogen and phosphorus), heavy metal concentrations, and the presence of pathogens.
- **Groundwater Contamination**: Groundwater is water that exists beneath the Earth's surface in soil pore spaces and in the fractures of rock formations. It is a vital source of drinking water for many communities around the world. Groundwater contamination occurs when pollutants from human activities infiltrate the soil and eventually reach the

groundwater table. Common sources of contamination include industrial spills, agricultural runoff, improper waste disposal, leaking underground storage tanks, and septic systems.

Extent and impact of groundwater contamination and pollution

1. Fluoride: Fluoride content in ground water has been found to be above the permissible level of 1.5 ppm in 14 states of India (and in many areas). The names of these states are Andhra Pradesh, Bihar, Gujarat, Haryana, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Orissa, Punjab, Rajasthan, Tamil Nadu, Uttar Pradesh and West Bengal etc. According to an estimate, 69 districts of these states are affected. Excessive concentration of fluoride causes deformities in the skeleton. Similarly, the amount of iron in ground water has also been found above the permissible level of 0.3 ppm in 23 districts of four states (Bihar, Rajasthan, Tripura and West Bengal). Apart from this, fluoride content has been found to be high in some parts of Agartala valley in coastal Orissa and Tripura.

2. Arsenic: The higher concentration of arsenic is above the permissible level of 50 ppb in the alluvial areas of Ganga which includes 8 districts of West Bengal. Has been found. Almost the same situation exists regarding the presence of heavy metals in ground water. Presence of heavy metals was found in groundwater samples of 40 districts of 13 states of the country - Andhra Pradesh, Assam, Bihar, Himachal Pradesh, Haryana, Karnataka, Madhya Pradesh, Orissa, Punjab, Rajasthan, Tamil Nadu, Uttar Pradesh and West Bengal and four blocks of Delhi. Is Due to extensive use of chemical fertilizers and pesticides in agriculture, non-point pollution also often spreads over large areas and becomes a threat to the fresh groundwater ecosystem.

3. Nitrate: Intensive use of chemical fertilizers in fields and indiscriminate disposal of human and animal wastes on land leads to leaching of residual nitrate, due to which the concentration of nitrate in ground water increases the concentration of nitrate has also been found above the permissible level of 45 ppm in about 95 districts of 14 states of the country, in 2 blocks of Delhi and in densely populated areas. It is found in dense urban areas due to pollution.

4. Other Chemicals: DTT, BHC, Carbamate and Endosulfan etc. are the pesticides used in India. But the risks of groundwater pollution caused by pesticides and fertilizers are controlled by the structure of the soil, the method of use of pesticides and fertilizers, their decomposition products and the amount of total organic matter present in the soil. Groundwater pollution due to industrial waste and municipal waste in water bodies has become a matter of concern in many cities and industrial areas of India. According to a survey by the Central Pollution Control Board, 22 sites in 16 states of India are facing ground water pollution mainly due to industrial waste has been reached to critical stage. Recently, another survey conducted by the Center for Science & Environment has revealed that traces of deadly heavy metals like lead, cadmium, zinc and mercury are present in groundwater at 8 places in Gujarat, Andhra Pradesh and Haryana.) is found in. The shallow aquifers of Ludhiana city, which are the only source of drinking water, have been polluted due to a stream in which wastes from about 1300 industries fall. Excessive groundwater extraction or withdrawal from coastal aquifers leads to deterioration in water quality. This has been seen in the form of sea water encroachment in Kutch and Saurashtra of Gujarat, Chennai in Tamil Nadu and Calicut in Kerala. When mercury is present in large amounts in groundwater, there are reports of deterioration in brain function, neurological disorders in children, miscarriage in women and disturbances in the endocrine system. Pesticides are poisonous and have the potential to cause cancer. Generally pesticides harm the liver and nervous system.

Ground water contamination and pollution prevention issues

The first step towards developing measures to prevent degradation of groundwater quality is to obtain accurate and reliable information through water quality monitoring so that the actual source, cause, type and level of contamination can be understood. Although there are some testing stations in the country which check all the essential parameters of groundwater quality, yet the data obtained from them cannot be conclusive for the local situation of water quality. Ground water quality monitoring uses very expensive and delicate equipment which is difficult to operate and maintain. Therefore, it requires adequate expertise in data collection, analysis and management. The existing methodology of Ground Water Quality Monitoring (WQM) is inadequate to identify various sources of pollution. There is rarely integration of water quality data with water supply data, which is very important for assessing the water available to meet various social, economic and environmental objectives. And finally, in the absence of any strict standards for water quality testing, water quality testing results may vary between different institutions, depending on the method of sample collection and testing. Aquifer cleanup is not economically viable in the Indian context.

Pollution control framework

Now a days, the task of controlling pollution caused by various sources is not easy. The most effective method of pollution control can only be achieved through mutual cooperation between scientists, legislators, common citizens and industries. The responsibilities of each of them are as follows.

1. Responsibility of scientists

- Identification of type and source of pollution.
- To find the concentration of pollution.
- Study of the effects of pollution.
- Recommended safe pollution levels.
- Outline and study of methods of pollution control.
- Development of pollution prevention and sanitation control programs.
- Monitoring the effectiveness of cleaning efforts.
- Research of new technology of treatment

2. Role of legislature

- Support of education and research**.**
- Passing laws to limit pollution levels**.**
- To provide for fines and penalties against polluters**.**
- Support for state pollution control efforts**.**
- Planning for environmental protection**.**
- To provide mechanism for pollution monitoring.

3. Role of civic groups

- To create pressure for making beneficial laws.
- Educating the public about the dangers of pollution.
- Identifying the sources of pollution and informing the public and the government.
- Encouraging water conservation and re-use among water users**.**
- Volunteering to clean polluted areas**.**
- Providing public information.

4. Role of Industries

- Establishing quality controls to limit pollution.
- Development of water recycling programs and technologies.
- To find commercial use of waste and the products obtained from it.
- Monitoring the quality of discharge water.

Conclusion

In conclusion, the quality of groundwater is of utmost importance for sustaining life and ecosystems. Our analysis underscores the pervasive threats posed by contamination from diverse sources. Effective measures such as pollution prevention, strict regulations, and advanced treatment technologies are indispensable for preserving groundwater quality. Furthermore, community engagement and awareness campaigns are crucial for fostering responsible water usage practices. Addressing groundwater contamination requires a multidisciplinary approach involving collaboration among policymakers, scientists, industries, and the public. By prioritizing the protection of groundwater resources and implementing proactive strategies, we can mitigate the adverse effects of contamination and ensure a safe and sustainable water supply for current and future generations.

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