

Impact of Water Quality on Human Health: An Indian Scenario

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Abstract - Water is one of the most important element for sustaining life and maintaining ecological. It is of paramount importance to assess, preserve, maintain, and sustain quality of water as human lives depend on it. There is disparity in the access to safe drinking water across the various sections of society. The study tries to understand the relationship between water quality and human health, causes of water quality deterioration and its consequences. The study also tries to find out the number of people facing health risks due to lack of safe drinking water. Various parameters like pH value, Fluoride concentration, BOD and TDS have been used to assess the quality of water. The result of the study shows that the quality of water has degraded drastically in some states. Some states like West Bengal, Madhya Pradesh, Uttar Pradesh, Rajasthan, Kerala etc. which are facing degradation in the quality of water. The result of the study also highlights the success of the Indian Government in its efforts to provide quality and safe water to its population as several states in which 100 percent of the population has access to safe drinking water.

Keywords: sustaining life, preserve, access, deterioration, degraded, efforts.

I. INTRODUCTION

Water is one of the most important resources for life and plays a fundamental role in maintaining the ecosystem and supporting human well-being. It is of paramount importance to preserve the quality of water as it significantly influences public health outcomes, emphasizing the need to understand the intricate relationship between water quality and human health. Water is important for all the living and non-living phenomena on the earth's surface. So it becomes utmost important to highlight the quality of water which is a very dynamic and complex attribute that depends on various human and natural factors. Water of optimum quality is essential to human life, and water of acceptable quality is essential for agricultural, industrial, domestic, and commercial uses; in addition, water is also used for recreational activities (Mawari, G. et al., 2022). The population growth, urbanization, and industrialization accelerate the demand for water resources, intensifying issues about the potential impact on human health. Population explosion, over-exploitation and inappropriate uses of chemicals in different sectors continuously threaten the precious natural resource. Once groundwater (GW) was the purest form of water resource, but today, the quality is being deteriorated day by day and exposed to human health risk due to improper knowledge and management (Chakraborty, B. et al., 2022). To provide sufficient and safe drinking water to more than 1,300 million Indians is a significant challenge as water demand is increasing rapidly day by day due to population growth, industrialization and urbanization (V. P. Katekar et al.,

2021). Water sources are polluted with pollutants such as heavy metals, pathogens, pesticides, waste disposal, industrial waste water, sewage emerging contaminants pose a significant threat to public health worldwide. Infiltration of this rainwater contributes to the recharge of the shallow aquifers in the region. Groundwater levels decline during the post-monsoon period (Karunanidhi, D., et al., 2021). A growing number of bodies of water in India are unfit for human use and in the River Ganga, holy to the country's 82 percent Hindu majority, is dying slowly due to unchecked pollution. Water pollution is a major problem in India (Kumar, S. et al., 2017). The effects of water pollution on human health are severe. The consequences of poor water quality on human health are diverse, ranging from acute gastrointestinal illnesses to chronic conditions and even contributing to the spread of waterborne diseases. Water pollution, open defecation and poor hygiene practices are the main hindrances to achieving good health. Therefore, safe and readily available water is essential for public health whether used for drinking, domestic use, food production or recreational purposes (Kumar, P. et al., 2022). It is important to understand the routes and pathways through which contaminants reach the water supply and subsequently affect human health is crucial for developing effective preventive measures and intervention strategies. Various types of infectious diseases are caused by water pollution and waterborne infections can also be caused by pathogens. In the last three decades, groundwater fecal pathogen and associated acute diarrhoea cases generally improved in most areas of India, and has been mostly caused by sanitation

development, urbanization and related-land use changes (Mukherjee, A., et al., 2019). Metals in industrial wastewaters such as lead, zinc, arsenic, copper, mercury, and cadmium harm humans and other creatures. The impact of these factors on water quality can be seen in the form of increased levels of pollutants and contaminants in water bodies. The presence of these pollutants and contaminants can have serious implications for human health and the environment (Babuji, P. et al., 2023). Improper disposal of sewage and solid waste, excessive use of pesticides and fertilizers, and deteriorating pipeline networks are the main causes of drinking water pollution (Lin, L. et al., 2022). The presence of arsenics in the water can cause arsenic accumulation in body parts such as blood, nails, and hair, resulting in skin lesions, rough skin, dry and thickened skin, and eventually skin cancer A strong relationship between contaminated drinking water with trace elements and the incidence of chronic diseases such as renal failure, liver cirrhosis, hair loss, and chronic anaemia has been documented (Mandour, R.A., 2012). The existence on bacteria in water mercury molecules in wastewater to extremely poisonous methyl mercury, which can induce numbness in the limbs, lips, and tongue, hearing, blurred eyesight, and mental instability Only 60% fertilizers are used in the soil other chemicals leached in to soils polluting the water, cyanobacteria are rich in polluted water and excess phosphate run off leads to eutrophication. Residues of chemicals mix with river water due to flooding, heavy rainfall, excess irrigation and enter in the food chain. (Haseena, M., et al., 2017).

India may not be the only country that is suffering from decline in quality of water but certainly it is at a critical stage than other countries. India is agrarian economy and for irrigation government is providing subsidies for pumping the ground water, the reduction of water table and quality of water was bound to happen. The need for user involvement in maintaining water quality and looking at other aspects like hygiene, environment sanitation, storage and disposal are critical elements to maintain the quality of water resources (Khurana, I. and Sen, R., 1998). The fast growing population and particularly the middle class has increased the pressure on water sources.

II. OBJECTIVES OF THE STUDY

This paper aims to delve into the multifaceted aspects of this relationship, examining the potential risks, consequences, and mitigation strategies associated with waterborne contaminants. The study will highlight links between water quality and human health. This paper will also try find out the number of people facing health problems due to lack of availability of good quality of water. The synthesis of available research will contribute to a comprehensive understanding of the risks associated with compromised water quality and the need for robust water management policies. Moreover, the paper aims to highlight the

importance of interdisciplinary collaboration among scientists, policymakers, and public health professionals to address the complexities of water quality and its impact on human health.

III. DISCUSSION AND DATA ANALYSIS

Water is the very basis of life and safe and clean water supply is one of the most important factor for good health of human beings. It is well known fact that majority of population of India lives in rural areas where tap water supply is not well provided. So millions of India are not having safe drinking water because tap water is a source of safe drinking water. Table 1 highlights the availability of tap water in India in different states. The table shows that 71.37 percent households in India have tap water supply. At regional level Goa, Andaman and Nicobar islands, Dadra and Nagar Haveli, Daman and Diu, Haryana, Telangana, Puducherry, Gujarat, Punjab and Himachal Pradesh have 100 percent availability of tap water while West Bengal have tap water supply for only 39.37 percent households. There some states where various factors have caused hindrances in providing reliable tap water supply like geographic, economic, and infrastructural conditions of each state. States having areas with limited water resources, such as arid regions or regions prone to drought, may find it difficult to establish and maintain a sustainable tap water supply for example Rajasthan. Many states may lack the necessary pipelines, treatment plants, and distribution networks to provide clean and reliable water to all residents like West Bengal, Jharkhand and Bihar. The table also shows that households in states like Kerala, Meghalaya, Assam, Madhya Pradesh have comparatively less supply of tap water. Contamination from industrial discharges, agricultural runoff, or inadequate wastewater treatment can compromise the quality of water supplied through taps. Addressing these challenges requires a comprehensive approach involving investments in infrastructure, sustainable water management practices, awareness campaigns, and effective governance at both the state and national levels. Collaborative efforts between the government, private sector, and communities are crucial to overcoming these obstacles and ensuring access to clean and reliable tap water for all residents.

Table 1 Status of households with tap water connection

State/ UT	Total households	Households with tap water supply	Households with tap water supply (%)
Goa	2,63,013	2,63,013	100
A & N Islands	62,037	62,037	100
D&NH and D&D	85,156	85,156	100
Haryana	30,41,314	30,41,314	100
Telangana	53,98,219	53,98,219	100
Puducherry	1,14,969	1,14,969	100
Gujarat	91,18,449	91,18,449	100
Punjab	34,25,723	34,25,723	100

Himachal Pradesh	17,08,727	17,08,727	100
Mizoram	1,33,060	1,29,655	97.44
Bihar	16630250	16033673	96.41
Arunachal Pradesh	2,28,921	2,19,784	96.01
Ladakh	41,962	37,392	89.11
Sikkim	1,31,880	1,16,651	88.45
Uttarakhand	14,54,129	12,62,922	86.85
Maharashtra	1454129	1262922	81.98
Nagaland	3,69,204	3,00,586	81.41
Manipur	4,51,566	3,50,457	77.61
Tamil Nadu	12531229	96,60,500	77.09
Jammu & Kashmir	18,70,347	14,06,407	75.19
Tripura	7,46,313	5,42,228	72.65
Andhra Pradesh	95,53,983	68,78,199	71.99
Karnataka	10116807	71,68,887	70.86
Uttar Pradesh	2,63,20,933	1,85,76,743	70.58
Chhattisgarh	49,96,175	35,14,089	70.34
Odisha	88,63,758	60,47,973	68.23
Assam	69,14,350	45,45,269	65.74
Meghalaya	6,51,529	4,25,427	65.3
Madhya Pradesh	11185837	66,10,639	59.1
Kerala	70,78,418	36,59,910	51.71
Jharkhand	61,78,048	28,56,732	46.24
Rajasthan	10663650	47,93,154	44.95
Lakshadweep	13,370	5,931	44.36
West Bengal	17398660	69,36,972	39.87
Total	192415353	137327413	71.37

Source: Jal Jeevan Mission-Har Ghar Jal, 2023

Ground Water Quality in India: Several factors contribute to the poor groundwater quality in certain states of India. These factors vary across regions and can result from a combination of natural and anthropogenic influences. Areas with certain geological formations, such as those with high levels of fluoride, arsenic, or heavy metals, may naturally have poor groundwater quality. Agricultural runoff carries these chemicals into the groundwater, affecting its quality and posing risks to human health. Rapid urbanization also causing more sewage and inadequate sewage water treatment and disposal. Overexploitation of ground water is major cause of contamination of ground water because after a certain level presence of heavy metal increases in the ground water. In the coastal regions salt water intrusion happens in aquifers due to overexploitation of ground water. Table 2 explains various presence of various elements in ground water in various states of India. It shows that Meghalaya has highest pH value while Assam has lowest pH value of ground water. Kerala has highest Biochemical Oxygen Demand (BOD) in ground water while states like Chhattisgarh, Daman & Diu, Dadra & Nagar Haveli, Haryana, Jammu and Kashmir, Madhya Pradesh, Nagaland, Orissa, Puducherry, Punjab, Tamilnadu, Tripura, and Uttar Pradesh. The

concentration of Total Dissolved Solids (TDS) in ground water is found in Gujarat (3444 mg/L) while lowest proportion of TDS is found lowest in Tripura (62 mg/L). Fluoride is also found in ground water and its presence above defined limit can cause severe health problems. Its highest concentration is found in Odisha (5.14 mg/L) while there several states like Karnataka, Madhya Pradesh, Maharashtra, Meghalaya, Nagaland, Punjab, Tripura and Uttar Pradesh where it is found in below detection limits (BDL). Arsenic is also found in the various states particularly in those states where excessive ground water consumption has lowered the water table. The increased concentration of TDS in the water is a clear indicator of contamination of ground water. It indicates the various salts like calcium, magnesium, sodium, potassium and bicarbonates are dissolved in the water. Their concentration above permissible limit are causing health problems, particularly of poor and deprived sections of society who can not afford clean water.

Table 2 WATER QUALITY DATA OF GROUND WATER UNDER NWMP – 2022

S. No.	Sate	pH	Biochemical Oxygen Demand (BOD) (mg/L)	Total Dissolved Solids (mg/L)	Fluoride (mg/L)	Arsenic (mg/L)
1	Andhra Pradesh	7.5	BDL	2041	1.7	BDL
2	Assam	6.8	2.4	208	0.31	0.01
3	Bihar	7.3	-	648	0.29	-
4	Chandigarh	7.4	1.2	466	0.54	BDL
5	Chhattisgarh	7.26	BDL	162	-	-
6	Daman & Diu, Dadra & Nagar Haveli	7.81	BDL	2941	0.27	0.01
7	Delhi	7.6	-	911	-	-
8	Goa	7.4	1.2	451	0.4	0.01
9	Gujarat	7.55	1.2	3444	1.18	BDL
10	Haryana	7.8	BDL	2670	1.1	-
11	Himachal Pradesh	7.94	3	896	0.35	-
12	Jammu and Kashmir	7.95	BDL	282	-	-
13	Jharkhand	7.6	1.6	276	-	-
14	Karnataka	7.3	3	120	BDL	-
15	Kerala	8.4	10.7	559	0.48	0.008
16	Lkshadwep	7.44	-	1245	-	-
17	Madhya Pradesh	6.97	BDL	790	BDL	BDL
18	Maharashtra	7.3	3.6	2789	BDL	-
19	Manipur	7.4	-	175	-	-
20	Meghalaya	9.1	1.2	215	BDL	-
21	Mizoram	7.6	-	-	-	-
22	Nagaland	7.9	BDL	465	BDL	BDL
23	Odisha	7.8	BDL	-	5.14	-
24	Puducherry	6.82	BDL	1150	-	BDL

25	Punjab	7.4	BDL	184	BDL	BDL
26	Rajasthan	7.48	-	1320	0.61	-
27	Tamil Nadu	7.75	BDL	2856	0.42	BDL
28	Telangana	7.69	-	1235	0.33	0.01
29	Tripura	5.69	BDL	62	BDL	-
30	Uttar Pradesh	7.8	BDL	376	BDL	0.018
31	Uttarakhand	7.5	-	241	0.4	BDL
32	West Bengal	8.34	BDL	572	0.67	0.035

(i) BDL value under NWMP are : - pH – (2.0), BOD (mg/L) – (1), Dissolved Solids (mg/L)-(10), Fluoride (mg/L)-(0.2) & Arsenic (mg/L)-(0.01).

(ii) Data downloaded from EWQDES portal on 21.06.2023.

IV. HEALTH IMPACTS OF WATER QUALITY IN INDIA

India is a country of more than 1 billion people and all the people do not have access to safe drinking water which is important for good health and tap water is an important source of water. Water quality and accessibility vary regionally, several health issues may arise due to inadequate or contaminated water sources. Water borne diseases are one of the major health problems in India and millions of people suffer from these diseases because still in rural India these are millions of households where clean water supply is not assured. Cholera a bacterial infection that causes severe diarrhoea and dehydration and Water contaminated with the bacterium Salmonella typhi can lead to typhoid fever, characterized by high fever, abdominal pain, and gastrointestinal issues. Contaminated water is a common cause of diarrheal diseases, especially among children. Persistent diarrhoea can lead to dehydration and malnutrition. Infections like amoebic dysentery can result from consuming water contaminated with amoebic cysts. The Giardia parasite, often found in contaminated water, can cause gastrointestinal problems such as diarrhoea and stomach cramps. Contamination of water with arsenic and heavy metals can lead to poisoning, causing a range of health issues, including skin problems, neurological disorders, and organ damage. Table 3 highlights major diseases caused by pollutes water like Diarrhoea, Typhoid, Viral Hepatitis and Acute Encephalitis Syndrome (AES) in India. There are 10762500 Diarrhoeal, 1537118 Typhoid, 208290 Viral Hepatitis and 104145 cases of AES reported in 2016. At state level Andhra Pradesh (1721050) recorded highest cases while Lakshdweep (7496) recorded lowest cases of Diarrhoeal infections. Highest number of cases of Typhoid recorded in Uttar Pradesh (223066) while Lakshadweep recorded lowest only 3 cases of Typhoid. In India 208290 cases of Viral Hepatitis have been reported but at state level 14055 have been reported in Madhya Pradesh while Lakshadweep recorded only 5 cases of viral hepatitis.

Table 3 State-wise Number of Cases of Water Borne Diseases in India in 2013

S.No.	State /U.T	Diarrhoeal Cases	Typhoid Cases	Viral Hepatitis Cases
1	Andhra Pradesh	1721050	233212	8325
2	Arunachal Pradesh	27659	6154	525
3	Assam	105876	6521	466
4	Bihar	550281	261791	6736
5	Chhattisgarh	104966	27457	670
6	Goa	16485	355	173
7	Gujarat	427523	22962	3676
8	Haryana	166882	27182	1307
9	Himachal Pradesh	355104	38572	2114
10	Jammu & Kashmir	591231	70859	6307
11	Jharkhand	78292	24806	1211
12	Karnataka	139819	13457	1327
13	Kerala	375122	4329	7034
14	Madhya Pradesh	535012	114578	14055
15	Maharashtra	527047	82852	5934
16	Manipur	25333	10927	258
17	Meghalaya	186023	9134	518
18	Mizoram	13127	2766	419
19	Nagaland	21376	12520	110
20	Odisha	593207	53743	3119
21	Punjab	183531	35136	3099
22	Rajasthan	506638	31615	1837
23	Sikkim	42410	186	692
24	Tamil Nadu	278407	31440	1868
25	Tripura	92826	12849	205
26	Uttarakhand	84792	25956	8619
27	Uttar Pradesh	826246	223066	9078
28	West Bengal	1830310	108695	4967
29	A & N Islands	27413	1363	216
30	Chandigarh	44664	3251	424
31	D & N Haveli	62259	4323	90
32	Daman & Diu	8615	888	184
33	Delhi	125727	31579	8130
34	Lakshadweep	7496	3	5
35	Puducherry	79751	2591	447
Total		10762500	1537118	208290

Source:- ‘National Health Profile’ published by Central Bureau of Health Investigation, Directorate General of Health Services, Ministry of Health and Family Welfare, Government of India

V. CONCLUSION AND SUGGESTIONS

It becomes essential to preserve the quality of water for the better health of present and future generations. By elucidating the intricate connections between water quality and human health, this study attempts to provide a basis for informed decision-making, sustainable water resource management, and the protection of public health in the face of evolving environmental challenges. The study also highlights that poor and underprivileged people of the society are more affected from waterborne diseases because their economic condition does not allow them to afford water

purifiers and supply of filtered water from other sources. It is most important to preserve and assess the quality of water to maintain well-being of both human populations and ecosystems. The study has presented various factors ranging from natural to human which affect the quality of water. Understanding these factors is essential for effective water management strategies that safeguard public health and environmental sustainability. Various parameters like physical, chemical and biological have been explored which measure the quality of water. These indicators provide a comprehensive understanding of the condition of water sources and help identify potential contaminants. The discussion delved into access to clean water, prevalence of pollution in the water and effects of deteriorating water quality on human health. The government of India has initiated various programmes to supply the tap water in rural areas also. The Jal Jeevan Mission has been launched, Har Ghar Nal has also been initiated to provide tap water in every household in India by 2024. Various labs have established to test and monitor the quality of water in almost every state.

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