

Water Quality and Waterborne Diseases in India: A Review

Jasdeep Kaur



Abstract: Climate change is seriously impacting human lives and human health in varied ways. Environmental pollution, including air and water pollution, is having a significant impact on human health. The increasing demand of water lead to its over exploitation and pollution and inefficient water use policies and methods are due to unchecked population growth and expansion of economic activities. Water quality problems are increasing, and so are the waterborne diseases. Governments have initiated various laws, policies, and programs; however, the quality of water continues to deteriorate daily.

Keywords: Water, Diseases, Quality, Policies, Programmes.

I. INTRODUCTION

A healthy population is essential for economic development. The poorest people on the planet suffer the most from the health effects of exposure to environmental hazards, such as air pollution and contaminated water. Consequently, these diseases hinder economic development. Ensuring the supply of safe drinking water in India is a constitutional provision under Article 47, which states that clean drinking water should be provided to all citizens. The world's water is increasingly becoming degraded in quality, raising the cost of treatment and threatening human and ecosystem health (Palaniappan et. al., 2010, [1]). At least 780 million people do not have access to potable water, nearly 2.5 billion people, mainly children, die due to waterborne diseases every year (Gleick 2002 [2] (UN 2009, [3]) (WHO and UNICEF 2012, [4]).

In developing countries, nearly 80% of illnesses are linked to inadequate water and sanitation conditions. Non-potable water, insufficient sanitation and poor hygiene is a leading cause of cholera and many infectious diseases in the African Region (WHO, 2015, [5]). Nearly 1 out of every five deaths under the age of 5 worldwide is due to a water-related disease (WHO and UNICEF, 2009 [6]). An estimated 1.8 billion people drink water contaminated with Escherichia coli, an indicator of faecal contamination (Bain et. al., 2014 [7]).

Many studies observed water quality deterioration during its collection and/or storage in the home (Rajasekaran et. al., 1977 [8]) (Shiffman et. al., 1978 [9]) (El Attar et. al., 1982 [10]) 9Kirchhoff et. al., 1985 [11]) (Heinanen et. al., 1988, [12]) (Molbak et. al., 1989 [13]) (Morin et. al., 1990 [14])

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(Verweij et. al., 1991 [15]) (Simango et. al., 1992 [16]) (Swerdlow et. al., 1992 [17]) (Shears et. al., 1995 [18]) (Kaltenthaler et. al., 1996 [19]) (Genthe et. al., 1997; [20]).

II. REVIEW OF LITERATURE

Bedi et. al., (2015 [21]) in their paper on, "Health and economic impacts of unsafe drinking water in Ludhiana city of Punjab", highlighted that millions of people in country do not have access to safe potable water. The poor and weaker sections of society bear the brunt of water-related diseases and suffer the loss of income. The incidence of waterborne diseases and their economic impact on households are pretty significant.

Jalan et. al., (2009 [22]) in their study on, "Awareness and the demand for environmental quality: Survey evidence on drinking water in urban India", highlighted that the demand for environmental quality is often presumed to be low in developing countries due to poverty. Less attention has been paid to the possibility that a lack of awareness about the adverse health effects of environmental pollution may also contribute to low demand.

Raju et. al., (2007 [23]) in their working paper on, "Increasing groundwater dependency and declining water quality in urban water supply", examined that the extent of groundwater dependency and quality status in Hubli, Dharwad, Belgaum and Kolar cities has been increasing. The household survey indicated dependencies of 30, 51, 37, and 100 per cent, while the quality analysis showed 45, 42, 22, and 97 per cent as non-potable in the above cities, respectively.

Ramachandriah (2001[24]) in his paper on, "Drinking water as a fundamental right" highlighted the recent landmark judgement by the Supreme Court, placing drinking water in the list of fundamental rights. The study emphasizes that the concern of the judiciary should serve as a stern warning to the politician-bureaucrats nexus that have, in recent years, disregarded the growing pollution in Indian rivers.

Ruet et. al., (2002 [25]) in their paper on, "The water and sanitation scenario in Indian metropolitan cities: Resources and Management in Delhi, Calcutta, Chennai, Mumbai", justified that like other infrastructure in India, the urban water supply and sanitation sector (UWSS) is not on right track. Faced with increasing demand and growing pollution problems, Indian cities struggle to provide essential services to their residents. Trevett et. al., (2004 [26]) in their paper on, "Water quality deterioration: A study of household drinking water quality in rural households highlighted that there is growing awareness that drinking-water can become contaminated following its collection from communal sources such as wells and tap-stands, as well as during its storage in the home.



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III. LAWS AND ACTS ON WATER QUALITY MANAGEMENT

At the national and state levels, several policies and regulations have been established to improve the water quality of aquatic resources and prevent water resource contamination. The following laws and acts have been passed on water quality management:

- The Water (Prevention & Control of Pollution) Act, 1974
- Water Cess Act, 1977
- Environment (Protection) Act, 1986

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- Executive Guidelines for Implementation of Water Quality Testing Laboratories (1990
- Bureau of Indian Standards (BIS) IS: 10500 Drinking Water Specification (1991)
- National Rural Drinking Water Quality Monitoring and Surveillance Programme (NRDWQMSP) (2006)
 - National Rural Drinking Water Programme (NRDWP)

(2009)

- Modified National Rural Drinking Water Quality Monitoring and Surveillance Programme (2009)
- The National Green Tribunal Act (2010)

IV. NATIONAL WATER POLICIES ADDRESSING POLLUTION ISSUES

The Government of India drafted national water policies in 1987, 2002, and 2012. Each policy was considered as an effort to improve the previous policies to meet the contemporary challenges and to apply modern technology and management techniques to manage the country's water resources. However, there are still many issues on which there is no unanimity among professionals, and a few open-ended questions still exist. The main elements concerning water pollution of each of the national water policies/drafts, starting from 1987, have been given in Table 1.

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ble: 1 Mai	n element (concerning	water	pollution in	NWP 1987,	, 2002 and 2012	

Elements	NWP 1987	NWP 2002	NWP 2012
Water Quality	Both surface and groundwater should be regularly monitored for quality. A phased program should be implemented to improve water quality. Water should be free from contamination. Potable water should be made available to all by the government.	In addition, effluents should be treated to acceptable levels and standards before discharging them into rivers. A minimum flow should be maintained in perennial rivers to ensure ecological balance and address social considerations. The principle of "Polluter Pays" should be followed. With these additions, water quality can be assured, as contaminated water leads to profound health implications.	Sources of water and water bodies should not be allowed to get polluted. A system of third-party periodic inspection should be implemented, and heavy penalties must be imposed based on the "Polluter Pays" principle. Quality conservation and improvements are more important, as cleaning up groundwater is a challenging task. Fines in the form of pollution fines will help increase revenue and further strengthen water infrastructure.
Water Conservation	The efficiency of water utilisation in all its diverse applications should be improved, and awareness of water as a scarce resource should be promoted. Conservation consciousness should be promoted through education, regulation, incentives and disincentives. Conservation of water through various alternatives will enhance water availability in water- stressed regions.	In addition, resources should be conserved and availability be augmented by maximizing retention, eliminating pollution and minimizing losses. For this, selective linings in the conveyance systems and other measures should be promoted. Awareness programme titled 'water as a scarce resource' will help in conserving water and enhancing the drinking water availability in urban areas.	In addition, the community should be sensitised and encouraged to adapt to the utilisation of water according to local water availability. Community- based water management should be institutionalised and strengthened. A system to evolve benchmarks for water uses for different purposes i.e. water footprints and water auditing should be developed to promote and incentivize efficient use of water. An institutional arrangement is needed at the national level to promote, regulate, and control the efficient use of water.

Note: The review of National Water Policies of 1987 and 2002 was done by K.S. Murty in 2003, and it was, by and large, reproduced as such, while the author reviews National Water Policy 2012 to have a comparative view of various policies. Source: Bedi (2013 [13]); Murty (2003 [27]).

A. Punjab Water Policy 1987

The State shall endeavour to develop and manage its river systems by the internationally accepted riparian principles. The needs of riparian/basin states should be the basis for the sharing/distribution of river waters. Riparian Water Rights calls for the right for water to flow onto your land in its natural quantity and quality, and the right to protect property from flooding, and land from erosion.

Retrieval Number:100.1/ijssl.D1062062423 DOI: <u>10.54105/ijssl.D1062.062423</u> Journal Website: <u>www.ijssl.latticescipub.com</u> Riparian Water Duties remind us to pass on the flow of water without obstruction, pollution or diversion affecting the rights of others, to maintain the bed and banks of the watercourse and to clear any debris, whether natural or artificial, and to

keep any culverts, trash screens, weirs and mill gates clear of debris.





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B. Incidence of Waterborne Diseases in States of India

When the networks are empty and unpressurized for prolonged periods, contaminants can enter the pipes through leaks in the supply lines. The situation is dire in cities with unhygienic excreta disposal, where sewage flows in open ditches close to water distribution pipes. In Delhi, an intermittent supply and the proximity of water and sewage pipelines were the prime suspects of a paratyphoid fever outbreak in 1996 (Yepes et. al., 2000 [28]). In four Indian town districts, between 27 percent and 76 percent of samples tested positive for faecal coliforms under intermittent supply (NEERI, 1994 [29]).

Waterborne diseases in India have been occurring over the years, despite various water quality management plans implemented by the Government of India. Regardless of the initial water quality, unhygienic practices during collection, storage, and consumption led to diarrhoea, causing germs and other water-related diseases (Montgomery A and Elimlech M, 2007 [30]). The incidence of waterborne diseases in some

selected states of India is presented in Table 3. There is a wide range of waterborne diseases, including diarrhoea, cholera, malaria, Japanese encephalitis, hepatitis, dengue, and enteric fever. However, due to certain constraints, comparative data on some water-related diseases were not available.

Diarrhoea is one of the most common diseases in most states of India. There were 8,501 thousand diarrhoea incidents in various states in 1998, which decreased to 8,414 thousand incidents and then increased to 11,701 thousand in 2012 (Table 3). The central states affected by diarrhoea were Andhra Pradesh, Delhi, Gujarat, Haryana, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Odisha, Punjab, Rajasthan, Tamil Nadu, Uttar Pradesh, and West Bengal. Malaria had 1,661,000 incidents in 2001, which decreased to 1,537,000 in 2005, and then further decreased to 880,000 in 2013. The states affected by malaria were Andhra Pradesh, Assam, Bihar, Delhi, Gujarat, Haryana, Jharkhand, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Orissa, Punjab, Rajasthan, Tamil Nadu, Uttar Pradesh, West Bengal and Uttarakhand.

Parameter	Maximum Permissible limit	Health impact	Affected States		
Fluoride	1.5 mg/l	Digestive disorders, skin diseases, and dental fluorosis	Andhra Pradesh, Assam, Bihar, Gujarat, Chhattisgarh, Haryana, Jharkhand, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Orissa, Punjab, Rajasthan, Tamil Nadu, Tripura, Uttar Pradesh, West Bengal		
Arsenic	0.05 mg/l	Vomiting, abdominal pain and bloody rice water diarrhoea	Assam, Bihar, Chhattisgarh, Jharkhand, Tripura, West Bengal, Uttar Pradesh		
Iron	l mg/l	Digestive disorders, skin diseases and dental problems	Arunachal Pradesh, Assam, Bihar, Chhattisgarh, Jharkhand, Jammu & Kashmir, Karnataka, Kerala, Manipur, Meghalaya, Mizoram, Madhya Pradesh, Maharashtra, Nagaland, Orissa, Punjab, Rajasthan, Sikkim, Tripura, Tamil Nadu, Uttar Pradesh, West Bengal, Andaman and Nicobar Islands, Pondicherry		
Nitrate	100 mg/l	Causes Methanmoglobinemia (Blue body disease) where the skin of infant becomes blue due to decreased efficiency of hemoglobin to combine with oxygen. It may also increase the risk of cancer.	Bihar, Gujarat, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Punjab, Rajasthan, Tamil Nadu and Uttar Pradesh		
Salinity	2000 mg/l	Objectionable taste to water may affect osmotic flow and the movement of fluids	Andhra Pradesh, Chhattisgarh, Gujarat, Haryana, Kerala, Madhya Pradesh, Maharashtra, Orissa, Punjab, Rajasthan, Tamil Nadu, Uttar Pradesh, West Bengal, Pondicherry		
Heavy metals	Cadmium-0.01; zinc-15 mg/l; Mercury-0.001 mg/l	Damage to the nervous system, kidneys and other metabolic disruptions	Gujarat, Andhra Pradesh, Delhi, Haryana, Kerala		
Persistent organic pollutants (POPs)	None	High blood pressure, hormonal dysfunction and growth retardation	Delhi, Himachal Pradesh, West Bengal, Jharkhand		

Table 2: States affected by various water quality problems

Source: (BIS Standards: IS 10500: 1991 [31])

(http://www.ddws.nic/in/popups/submissionfunds-200607-195.pd [32])

(www.cseindia.org/programme/health/pdf/conf2006/a69industrydelhi.pdf. [33])

(Khurana and Sen, Water aid, 2005 [34])

Hepatitis is also one of the water-related diseases. It was reported that there were 140,000 incidents in 2000-01, which fell to 129,000 incidents of hepatitis in 2006, and further declined to 118,000 in 2012. The states affected by this particular disease were Andhra Pradesh, Gujarat, Haryana, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Orissa, Punjab, Rajasthan, Tamil Nadu, Uttar Pradesh and West Bengal.

Governments of various states were successful in reducing hepatitis incidences, with an 8.52 per cent decline in the country as a whole. Table 3 presents a comprehensive overview of disease incidences across various years in

different states, and Table 4 provides the incidence of waterborne diseases in specific states over other years.



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Water Quality and Water Borne Diseases in India: A Review

Disease	Incidence (in thousands)			States affected
Diarrhea	8501 (1998)	8414 (2006)	11701 (2012)	Andhra Pradesh, Delhi, Gujarat, Haryana, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Orissa, Punjab, Rajasthan, Tamil Nadu, Uttar Pradesh, West Bengal
Malaria	1668 (2001)	1537 (2005)	880 (2013)	Andhra Pradesh, Assam, Bihar, Delhi, Gujarat, Haryana, Jharkhand, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Orissa, Punjab, Rajasthan, Tamil Nadu, Uttar Pradesh, Uttarakhand, West Bengal
Hepatitis	140 (2000- 01)	129 (2006)	118 (2012)	Andhra Pradesh, Gujarat, Haryana, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Orissa, Punjab, Rajasthan, Tamil Nadu, Uttar Pradesh, West Bengal

Table 3: Trends in the incidence of waterborne diseases inselected states of India

Note: Figures in brackets show the years of study.

Source: 1. MoHFW, GOI, 2006, 2013 [35].

2. National Health Profile 2006, CBHI, DGHS - MoHFW [36]

Table 4 highlights that Andhra Pradesh reported 18, 52,642 incidences of diarrhoea in 1998, which decreased to 12, 15,659 in 2006. Malaria cases decreased from 57,735 in 2001 to 39,099 in 2005, and hepatitis cases also declined from 27,595 in 2000-01 to 17,846 in 2006. This indicates that, despite the presence of various water-related diseases in Andhra Pradesh, the government has been successful in reducing their incidence over the years.

Diarrhoea cases had decreased in 2006 compared to 1998 in Andhra Pradesh, Delhi, Haryana, Kerala, Madhya Pradesh, Maharashtra, Odisha, Punjab, and Uttar Pradesh, while the incidence had increased in Gujarat, Karnataka, Rajasthan, Tamil Nadu, and West Bengal. West Bengal had a different case, with 7,20,352 diarrhoea incidences in 1998, which increased to an astonishing figure of 26,22,968 incidences in 2006. Malaria incidences too had risen in West Bengal. Other states in which malaria incidences had increased from 2001 to 2005 were Gujarat, Haryana, Jharkhand, Kerala, Punjab, Tamil Nadu, Uttar Pradesh, and Uttarakhand. While the states of Andhra Pradesh, Assam, Bihar, Delhi, Karnataka, Madhya Pradesh, Maharashtra, Orissa, and Rajasthan reportedly had fewer incidences of Malaria in 2005 compared to 2001.

Diarrhea		Malaria			Hepatitis				
States	1998	2008	Percentage change	2001	2005	Percentage change	2000-01	2006	Percentage change
Andhra Pradesh	18,52,642	12,15,659	-34.38	57,735	39,099	-32.27	27,595	17,846	-35.32
Assam	5,96,176	_	—	95,142	67,885	-28.64	-	-	-
Bihar	N.R.	_	_	4,108	2,733	-33.47	-	-	-
Delhi	1,33,089	94,398	-29.07	1,484	1,133	-23.65	4,007	4,080	1.82
Gujarat	2,07,027	3,82,056	84.54	81,347	1,79,023	120.07	3,982	9,396	135.96
Haryana	3,75,113	2,85,342	-23.93	1,202	33,262	2667.22	1,086	3,983	266.76
Jharkhand	-	14,752		1,30,784	1,93,144	47.68	-	51	
Karnataka	6,74,805	9,39,221	39.18	1,97,625	83,181	-57.90	24,571	14,980	-39.03
Kerala	5,50,768	4,75,510	-13.67	2,289	2,554	11.57	5,521	7,018	27.11
Madhya Pradesh	4,79,073	3,18,935	-33.42	1,83,118	1,04,317	-43.03	6,620	2,499	-62.25
Maharashtra	10,98,750	6,95,723	-36.67	56,043	47,608	-15.05	40,962	43,215	5.5
Orissa	7,93,442	3,73,748	-52.89	4,54,541	3,96,573	-12.75	14,011	2,687	-80.82
Punjab	1,96,398	1,82,451	-7.10	604	1,883	211.75	1,796	3,829	113.19
Rajasthan	2,11,710	3,18,169	50.28	1,29,233	52,286	-59.54	1,601	3,869	141.66
Tamil Nadu	47,367	1,16,062	145.02	31,551	39,678	25.75	1,740	4,523	159.94
Uttar Pradesh	5,64,587	2,84,709	-49.57	94,524	1,05,303	11.4	988	3,716	276.11
Uttarakhand	-	94,746	-	1,196	1,242	3.84	-	3,381	-
West Bengal	7,20,352	26,22,968	264.12	1,45,053	1,85,964	28.2	5,831	7,433	27.47

Table 4: Incidence of waterborne diseases in central states of India

NR: Not reported.

Source: 1. Ministry of Health and Family Welfare, GOI, 2006.[37]

National Health Profile 2006, CBHI, DGHS-MoHFW.[38]

MoHFW, GOI, Annual Report 2002-03.[39]

Hepatitis cases also declined from 2000-01 to 2006 in the states of Andhra Pradesh, Karnataka, Madhya Pradesh, and Orissa. In contrast, the incidence of hepatitis increased in most states in 2006 compared to 2000-01.

Retrieval Number:100.1/ijssl.D1062062423 DOI: <u>10.54105/ijssl.D1062.062423</u> Journal Website: <u>www.ijssl.latticescipub.com</u> Apart from these diseases, the incidence of cancer deaths in Punjab is much higher than the accepted national and international averages. World Health Organisation (WHO)

reference regarding incidences of Cancer affected 80 persons from a population of one lakh, while Punjab's survey





revealed this figure to be 90 affected persons from the same population (The Indian Express, Chandigarh, Tuesday, January 29, 2013, 2:03 hrs [40]). Punjab Government conducted a survey in 2012 wherein it was revealed that 33,318 cancer deaths had occurred during the last 5 years, out of which 14,682 were in the Malwa region alone. As many as 4,000 of these deaths happened in Ludhiana.

C. Waterborne Diseases in Ludhiana District

Waterborne diseases are spreading at an alarming rate in both rural and urban areas. It is of great concern for the governments of different States/UTs. Mostly diarrhoea, cholera, enteric fever and hepatitis A and E occur due to nonpotable water. In 2008, around 4948 diarrhoea, 2474 enteric fever, 335 hepatitis A and E and 17 cases of cholera were reported. In 2009, the number of diarrheal cases increased to 9,498, and 3,633 cases of enteric fever were reported. The same situation prevailed in 2010 and 2011. In 2012, cases of enteric fever and hepatitis A and E decreased to 3,415 and 261, respectively. In 2013, cases of diarrhoea, enteric fever, cholera, hepatitis A, and hepatitis E fell to 18,861, 2,844, 4, and 5, respectively. No case of hepatitis A or E was reported in September 2014.

Period	Acute Diarrhea	Enteric fever	Hepatitis A and E	Cholera
2008	4948	2474	335	17
2009	9498	3633	356	13
2010	9527	4710	200	01
2011	18258	4545	420	07
2012	23738	3415	261	03
2013	18861	2844	05	04
From 2014 to September	7691	1282	00	02

Table 5: Waterborne diseases in Ludhiana district

Source: Integrated Disease Surveillance Programme Office, Ludhiana, 2012, CGWB (2014).[41]

V. CONCLUSION

In brief, water quality problems are due to pollution of surface or groundwater. The overexploitation of groundwater leads to water contamination, resulting in serious health problems. Unsafe water causes various waterborne diseases, including diarrhoea, malaria, cholera, skin infections, and tuberculosis. These incidences have been increasing year by year, thus putting great stress on the health of the masses. Still, many states suffer from a lack of clean water, and this has led to the spread of waterborne diseases. To provide safe drinking water to the public, various government institutions and departments are in place to monitor and ensure the quality of water. However, the investment in the water supply and sanitation sector, as well as various pollution control boards, does not coexist with the health benefits. Therefore, there is a need to invest more resources in supplying drinking water in urban areas, with a special emphasis on the most vulnerable sections of society.

Despite the numerous policies and programmes initiated by the government, the supply of safe drinking water in urban areas is far from satisfactory. Therefore, the supply of safe drinking water and wastewater disposal should remain a priority area under the five-year plans.

A special programme to provide safe drinking water in low-income localities and slums should be initiated and closely monitored to achieve the 100% target.

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DECLARATION

	presents evidence that is not subject to interpretation.
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