

Water Pollution and its effects on human health: A case study of Dehradun City

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Abstract

Water is most important for living organisms. Health of human and other organisms is directly related with safe water other than anything. That is why the safe water resources are very important. In developing countries, it is normally observed that due to the lack of safe drinking water people become ill. Drinking water being transported through distribution networks will be subjected to both chemical and microbial quality changes. The task of efficiently monitoring the hygienic drinking water quality is large but not impossible. With the rapid growth of population, increasing levels of living standards, industrialization and generation of power and other demand of water has increased on the one hand and the contamination of various toxic substances in water bodies have caused deterioration of water quality and level of pollutions increasing continuously on the other hand.

Keywords: Water Pollution | Dissolved oxygen | Biological oxygen demand | Typhoid

Introduction

The water pollution may be defined as “the deterioration in chemical, physical and biological properties of water brought about mainly by human activities”. In other words, substances, bacteria or viruses present in such concentration or number as to impair the quality of water rendering it less suitable or unsuitable for its intended use and presenting a hazard to man or to its environment makes the water polluted.

The water pollution may be caused by any one or more of the following factors. Atmospheric dissolved gases. Decomposition of animal and vegetable materials. Industrial effluents. Sewage disposal. Weathering of soil and rock materials. Disposal of radioactive substances. Huge amount of nutrients eg. Nitrate and phosphate, sewage, pesticide and fertilizers stimulate the growth of micro-organisms which often increase the biological oxygen demand (BOD) of the water and reduce the amount of

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dissolved oxygen (DO) available in aquatic life.

The sewage wastes falling into streams, rivers, lakes and coastal water create various kinds of problems. These wastes may contain pathogenic bacterial and viruses which are threat to the human health. The water borne diseases such as typhoid, bacillary dysentery, amoebic dysentery and hepatitis all represent potential health hazards in sewage contaminated waters (Matta, Gagan, 2014a).

Water is basic for sustaining human life. There is saying in Sanskrit “Jal hi Jeewan Hai”. It is used in domestic, agriculture and industries and transportation and many other forms also. The fresh water reserve for drinking, bathing and other human purpose, is limited. Only 0.9% of the fresh water is found in rivers, lakes, ponds and underground. (Behura, 1981; L’vovitch, 1978; Matta *et al.*, 2015a).

In industries and mining activities, the used water is discharged in the form of effluents mixed with various toxic and non-toxic pollutants along with oil and grease which are harmful and pollute the other sources of water, such as rivers, tanks, reservoirs etc. It adversely affects the aquatic system.

Sources of water pollution in Dehradun City

Water for the city was supplied only from surface sources earlier but later ground water sources also started being used to supplement the surface source. The total water supply to the city is 127.05 mld of which 76% (102.51 mld) is supplied from ground water sources while the remaining 24.54 mld is supplied from surface sources. The average per capita

supply in the city is 124 lpcd at present. The total water losses amount to 30%. The average duration of supply in the city is 4 hours, twice a day. Based on the socio-economic survey of 1160 households it has been examined that about 71% of the population in the city is covered by piped water supply. There are two water treatment plants in the city with a total capacity of 34 mld. The northern part of the city is supplied water through gravity, the central part with gravity and pumping while the southern part is supplied water through pumping.

The water supply is operated and maintained in the city by Uttaranchal Jal Sansthan. Large capital works and overall planning is carried out by Uttaranchal Pey Jal Nigam. Unequal intra-city distribution is one of the problems being faced in the city due to which some localities are facing acute water shortage. Deterioration in the quality of water, inefficient network hydraulics, old and dilapidated networks are some of the other major problems related to water supply in the city. The proportion of water in India in different sectors is estimated as agriculture 96 percent, domestic 3 percent and industrial 1.0 percent. In case of Indian cities and towns, the average daily consumption of water varies from 50 litres/capita/day in small towns to 450 litres/capita/day for large and industrial cities. (Hussain, 1976; Matta, Gagan, 2014b).

Methodology

The data on drinking water was extracted from secondary sources such as pai jal nigam (Water Works Department) Dila Ram chowk. The data constituted of various physical and chemical

characteristics out of which study relevant parameters were derived and used accordingly. There are two water treatment plants in the city with a total capacity of 34 mld. The northern part of the city is supplied water through gravity, the central part with gravity and pumping while the southern part is supplied water through pumping. The water supply is operated and maintained in the city by Uttaranchal Jal Sansthan. Large capital works and overall planning is carried out by Uttaranchal Pey Jal Nigam. The data regarding diseases aggravated through water pollution has been collected from hospitals and discussed with private practioners. The annual incidence rate of water borne diseases has been computed to every 1000 person of the study are reflecting the average incidence of disease.

Impact of water pollution on human health

Man’s physical and mental health depends on the genetic and environmental factors that influence it. To assess the impact of environmental pollution on human health, it is essential to apply approaches to medical geography (Kumra, 1982; Matta, Gagan, 2015). Medical geography deals with the spatial pattern of diseases in study area. For studying the impact of environmental pollution on particular diseases and for this, perception survey is the best technique. It is also necessary to correlate the diseases with concerned pollutants.

Water Pollution may be accidental and sometimes with grave consequences, but it is most often caused by the uncontrolled disposal of sewage and other liquid wastes resulting from domestic use of water, industrial wastes

containing a variety of pollutants, agriculture effluents, from animal husbandry, drainage of irrigation water. The recent advancement in understanding the relation between water pollutants and diseases has been developed as a scheme evolved by in which diseases are classified into four categories: water borne, water washed, water based and diseases with water related insect vectors depending upon the mechanism. .

Dehradun has been a tourist place since long time. More than 80 percent of drinking water supply in Dehradun comes from ground water. After the formation of capital of Uttarakhand many people came here from across the state and country. As per census of 1991, Dehradun city has a total population of 270, 159 which spurred to 426, 674 in 2001 which boomed to 569, 578 in 2011. The study indicates that the incidence of water- borne diseases varies from one area to another depending upon the protection of people health.

Study Sites	Diarrhoea	Gastroen terities	Malaria	Typhoid	Cholera
Vasant Vihar	18	27	17	14	25
Nehru colony	22	31	28	27	27
Patel nagar	16	27	22	19	26
Rajpur	27	42	33	25	23
Dallanwala	39	46	31	33	48
Deepnagar	56	57	27	27	42
Majra	44	61	27	32	55

Source: CMO office and hospitals, Dehradun (U. K)

Table: 1 Annual incidence rate of Diseases (patient per 1000 person) 2001

Diarrhoea is a water borne disease which is caused by food poisoning. Table 1 depicts that total cases registered under Diarrohea from the city were 222 per thousand person and the maximum cases of diarrohea occurs in

Deepnagar (56 per thousand person). Gastro-enteritis is also a water related disease which is caused due to presence of various chemicals in both ground and surface water. Total cases under gastric troubles from the city were 312 per thousand person. However maximum cases under gastric circle were noted in Majra (61 per thousand person). The vector of malaria (anopheles mosquito) is a water borne vector and is responsible for malaria. Total cases registered under malaria were 185 per thousand person. It usually raises in the waters near Rajpur and thus the maximum number of cases are registered from Rajpur (33 per thousand person). Another disease Typhoid is solely spread through contaminated water. The bacterial action is responsible for typhoid. The total city cases were 177 per thousand person under typhoid category and the maximum cases of typhoid are registered from Dallanwala (33 per thousand person). Cholera again is spread due to contaminated water. Total cases were 246 per thousand person from the city overall and maximum cases were from Majra (55 per thousand person).

Study Sites	Diarrhoea	Gastroenteritis	Malaria	Typhoid	Cholera
Vasant Vihar	24	31	21	19	33
Nehru colony	27	39	39	38	32
Patel nagar	26	32	28	27	35
Rajpur	35	49	42	36	29
Dallanwala	47	61	37	46	58
Deepnagar	67	69	38	39	51
Majra	57	77	32	43	68

Source: CMO office and hospitals, Dehradun (U. K)

Table: 2 Annual incidence rate of Diseases (patient per 1000 person) 2006

In 2006 the total cases under diarrhoea were 283 per thousand person and the maximum cases registered from Majra *i.e.* 57 per

thousand person. Table 2 depicts the total gastro-enteritis cases under city 382 per thousand person were registered and the maximum cases from Majra *i.e.* 77 per thousand person. The total cases under Malaria were 237 per thousand person and the maximum cases registered from Rajpur *i.e.* 42 per thousand person. The total Typhoid cases under city 248 per thousand person were registered and the maximum cases were from Dallanwala *i.e.* 46 per thousand person. The total cases under Cholera were 306 per thousand person were registered from the city and the maximum cases were from Majra *i.e.* 68 per thousand person.

Study Sites	Diarrhoea	Gastroenteritis	Malaria	Typhoid	Cholera
Vasant Vihar	34	39	32	30	45
Nehru colony	35	49	56	57	38
Patel nagar	37	42	38	45	44
Rajpur	49	62	58	54	38
Dallanwala	64	82	55	65	73
Deepnagar	86	87	56	62	64
Majra	84	101	44	68	92

Source: CMO office and hospitals, Dehradun (U. K)

Table: 3 Annual incidence rate of Diseases (patient per 1000 person) 2011

In 2011, the total cases registered under diarrhoea and malaria were 389 per thousand person and 339 per thousand person respectively and the maximum cases of both the diseases noted from Deepnagar were 86 per thousand person and 56 per thousand person respectively. (Table 3). The total cases of Gastro-enteritis, typhoid and cholera from the city were 352, 381 and 394 per thousand person and the maximum cases listed under these three diseases were Majra *i.e.* 101 per thousand person, 68 per thousand person and 92 per thousand person respectively.

Study Sites	Diarrhoea	Gastroenteritis	Malaria	Typhoid	Cholera
Vasant Vihar	55	57	55	49	67
Nehru colony	67	66	89	93	53
Patel nagar	54	56	55	77	57
Rajpur	86	88	98	87	53
Dallanwala	89	113	99	99	93
Deepnagar	117	125	85	113	124
Majra	154	137	93	126	154

Source: CMO office and hospitals, Dehradun (U. K)

Table 4 Annual incidence rate of Diseases (patient per 1000 person) 2015

In 2015 the total cases under diarrhoea, gastric disorders, typhoid and cholera were 622 per thousand person, 642 per thousand person, 644 per thousand person and 601 per thousand person from the city and the maximum cases of these four diseases were registered from Majra i.e. 154 per thousand person, 137 per thousand person, 126 per thousand person and 154 per thousand person respectively. (Table 4)

Study Sites	2001	2006	2011	2015
Vasant Vihar	18	24	34	55
Nehru colony	22	27	35	67
Patel nagar	16	26	37	54
Rajpur	27	35	49	86
Dallanwala	39	47	64	89
Deepnagar	56	67	86	117
Majra	44	57	84	154

Source: CMO office and hospitals, Dehradun (U. K)

Table 5: Annual incidence rate of Diarrhoea (patient per 1000 person)

Annual incidence change of diarrhoea was maximum at Patel nagar i.e. 62.5 percent in 2006 from the base year (2001). It followed the same trend in 2011 as well and maintained the maximum rate i.e. 131.3 at Patel Nagar and the minimum change was at Deepnagar 19.6 and 53.6 in 2006 and 2011 respectively. While analyzing the data of 2015 it was figured out that the maximum change of diarrhoea was at Majra i.e. 250 percent and minimum change at

Deepnagar i.e. 108.9 percent from the base year. (Table 5).

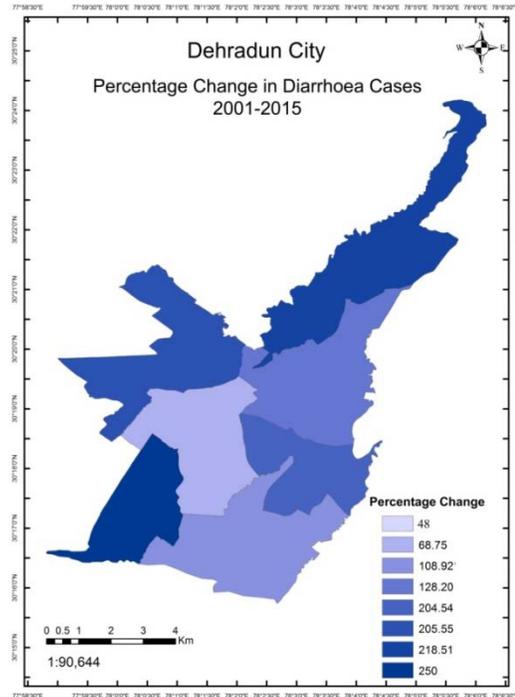


Fig. 1 : Percentage Change in Diarrhoea Cases in Dehradun City from 2001-2015

Study Sites	2001	2006	2011	2015
Vasant vihar	27	31	39	57
Nehru colony	31	39	49	66
Patel nagar	27	32	42	56
Rajpur	42	49	62	88
Dallanwala	46	61	82	113
Deepnagar	57	69	87	125
Majra	61	77	101	137

Source: CMO office and hospitals, Dehradun (U. K)

Table 6: Annual incidence rate of Astroenteritis (patient per 1000 person)

Gastro - enteritis is also a water related disease which is caused due to presence of various chemicals in both ground and surface water. The maximum change in gastric disorders in 2006 was at Majra (26.2 percent). In 2011 and 2015 the maximum change from

the base year at Dallah wala *i.e.* 78.3 percent and 14.7 percent respectively. While analyzing the data regarding the minimum change of gastroenteritis study came across that the minimum value occur continuously at Vasant Vihar *i.e.* 14.8 percent (2006), 44.4 (2011) and 111.1 percent (2015). The Annual occurrence Malaria was maximum at Deepnagar *i.e.* 40.7 percent in 2006 and 107.4 percent in 2011 from the base year (2001). (Table 6).

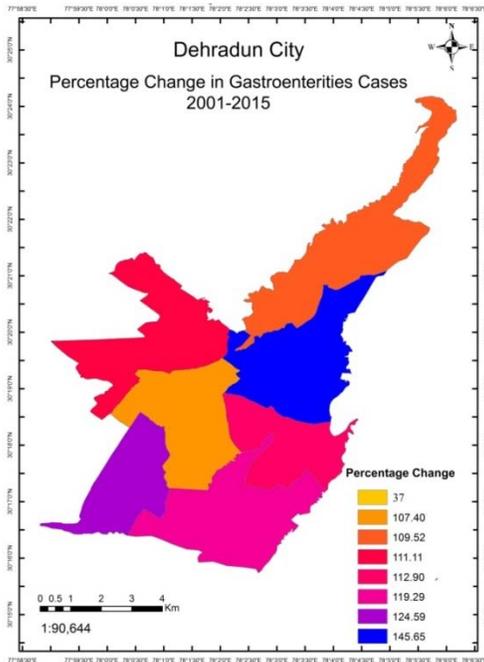


Fig. 2 : Percentage Change in Gastroenteritis Cases in Dehradun City from 2001-2015

Study Sites	2001	2006	2011	2015
Vasant vihar	17	21	32	55
Nehru colony	28	39	56	89
Patel nagar	22	28	38	55
Rajpur	33	42	58	98
Dallahwala	31	37	55	99
Deepnagar	27	38	56	85
Majra	27	32	44	93

Source: CMO office and hospitals, Dehradun (U. K)

Table 7: Annual incidence rate of Malaria (patient per 1000 person)

Table 7 reveals that the minimum rate was at Majra 18.5 and 53.6 in 2001 and 2006 respectively. While analyzing the data of 2015 it was figured out that maximum annual

incident rate of this disease was at Majra *i.e.* 244.4 percent and minimum rate at Patelnagar *i.e.* 150 percent from the base year.

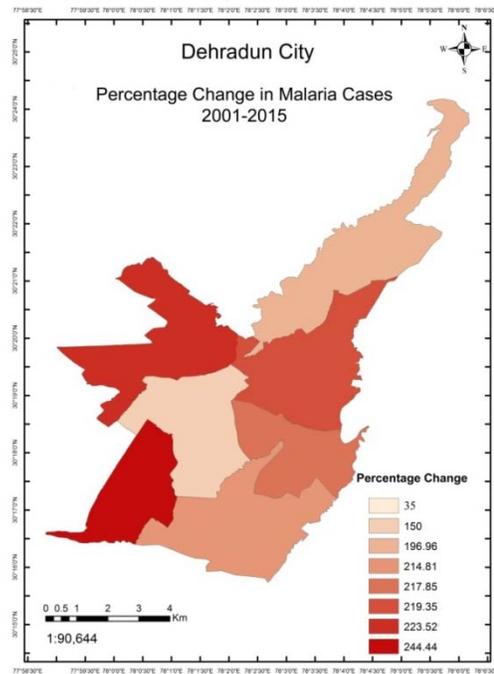


Fig. 3: Percentage Change in Malaria Cases in Dehradun City from 2001-2015

Study Sites	2001	2006	2011	2015
Vasant vihar	14	19	30	49
Nehru colony	27	38	57	93
Patel nagar	19	27	45	77
Rajpur	25	36	54	87
Dallahwala	33	46	65	99
Deepnagar	27	39	62	113
Majra	32	43	68	126

Source: CMO office and hospitals, Dehradun (U. K)

Table 8: Annual incidence rate of Typhoid (patient per 1000 person)

The maximum rate of change of typhoid in 2006 and 2015 from the base year at Deepnagar *i.e.* 44.4 percent and 318.5 percent respectively. In 2011 the maximum rate of change at Patel nagar *i.e.* 136.8 percent. The minimum rate of change in 2006 was at Majra (34.4 percent). In 2011 and 2015 the minimum rate of change recorded at Dallahwala *i.e.* 97 percent and 200 percent respectively (as shown in Table 8).

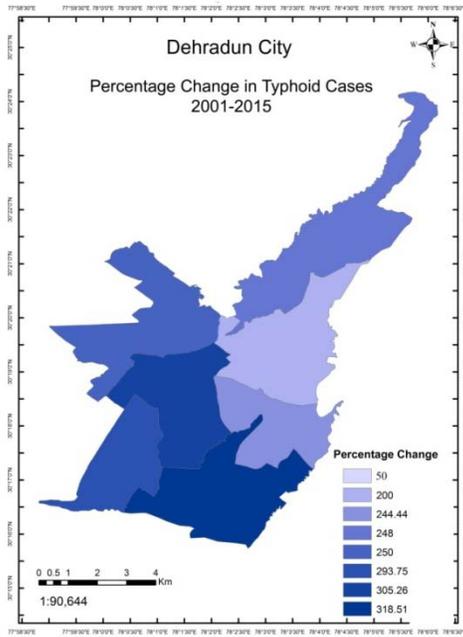


Fig. 3 : Percentage Change in Typhoid Cases in Dehradun City from 2001-2015

Study Sites	2001	2006	2011	2015
Vasant vihar	25	33	45	67
Nehru colony	27	32	38	53
Patel nagar	26	35	44	57
Rajpur	23	29	38	53
Dallanwala	48	58	73	93
Deepnagar	42	51	64	124
Majra	55	68	92	154

Source: CMO office and hospitals, Dehradun (U. K)

Table 9: Annual incidence rate of Cholera (patient per 1000 person)

As shown in Table 9 the annual incident rate of cholera in 2006 was at Patelnagar 34.6 percent, in 2011 at Vasant vihar (80 percent) and in 2015 at Deepnagar (195.2 percent). While analyzing the minimum rate of change of this disease from the base year it was recorded that Nehru colony continuously shows the minimum value i.e. 18.5 percent (2006), 40.7 percent (2011) and 96.3 percent (2015).

Conclusion

The quality of surface water has deteriorated due to discharge of industrial, sewage and domestic effluents directly into water bodies resulting in eutrophication by adding excess

nutrients such as NO₃ and PO₄. The water quality of river has depleted severely at several places along their courses to oceans. Deforestation, urbanization and industrialization have adversely affected hydrological regime and environment of the NW- SE trending intermontane Doon valley in the sub Himalayan region. The rate of the recharge of natural spring is depleting continuously causing lowering of water table. The quality of water has severely deteriorated at various places. The city has witnessed tremendous growth in the last 25 years. After the formation of Uttarakhand state, pace of urbanization, growth of population centers, introduction of industries and employment of auxiliary means of agriculture have increased manifold in Uttarakhand region in general and Dehradun in particular. Pollutants are increasingly added to the surface & groundwater system through various human activities and the natural degradation processes. Untreated disposal of wastes are adding pollutants to the surface and groundwater system and continuous addition accelerates their movement towards production well. Industrial wastes that includes heavy metals and toxic compounds are deteriorating groundwater quality.

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