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Assessment of water quality of River Ganges during Kumbh mela 2010

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Abstract

In the present study the water quality of Ganga River was assessed during Maha Kumbh-2010. River water samples were collected from five sites. Various Physico-Chemical and microbiological parameters were analysed. It was observed that all parameters were within the permissible limit according to WHO (2009) and BIS (2004) except most probable number that is the indication of low sanitary condition and it can further lead to the outbreak of diseases. During this mass bathing two sites were found to be more affected than the other three sites. These were noted to Har-ki-pauri and Mayapur ghat at Haridwar, at these sites parameters are observed to be slightly raised in comparison to other three sites.

Keywords*: Mass bathing; water quality, physicochemical parameters, microbiological parameters*.

Introduction

Water is the most precise thing in this world, which we can not live without. Water is super abundant on the planet as a whole, but fresh potable water is not always available at the right time or the right place for human or ecosystem use. The water being an important part of environment occurs as solid, liquid and gas forms on the earth. As a liquid, it forms hydrosphere, which covers approximately three-fourth of the earth's surface. About 97% of the total available water on earth is saline, and hardly 3% is fresh. A small portion of this fresh water fulfills the fresh water requirements of human beings (Sharma, 2006). Rivers play a significant role in fulfilling the fresh water requirements in the world. In spite of their wide-ranging role, presently rivers are under severe threat due to various anthropogenic pressures (Singh *et al.* 2007). Humans frequently exert rapid, large scale influence on their immediate environment, including modification of water courses, pollution, hunting and fishing (Ehrlich *et al.* 1973). Biologists consider pollution as a change in aquatic environment which brings about a reduction in the diversity of aquatic life and eventually destroy the balance of life in a stream. So far as our country is concerned, plight of surface water is not hidden. Last Maha Kumbh mela in Haridwar was held in 1998. Three other places where Kumbh appears time to time are Nashik, Ujjain, and Allahabad. Maha Kumbh mela 2010 was the first of the century and the first at Haridwar after the creation of the Uttarakhand state (Source: Times of India 26-07-10).

Bathing Days: The main bathing dates at the Haridwar Kumbh were: January 14th 2010- Makar Sakranti, January 15th – Mouni Amavasya, (Solar eclipse), January 20th- Basant Panchami, January 30th-Magh Poornima, February 12th–Mahashivratri (First Sahi snan), March 15th–Somwati Amavasya (Second Sahi snan), March 16th–Nav Samvatharambh Snan. March 24th– Ramnavmi Snan, March 30th –Chaitra Poornima Snan (Third Sahi snan), April 13th–Baishakhi, April 14th – Mesh Sakranti (Fourth Sahi snan) (Source: The Tribune 15-01-10).

Material and Methods

During this study period various physico-chemical and microbiological parameters of river Ganges were studied. The water samples were collected

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from five sites "Triveni ghat", "Pashulok barrage", "Dhudhiya Dam", "Har-ki-Pauri" and "Mayapur". First site, that is Triveni ghat is situated in the city Rishikesh, second site, Pashulok barrage is located 5 Km Southward from the first one. Third site, Dhudhiya Dam is 17-18 Km far from the second site. Har-ki-Pauri the fourth site is approximately 1-2 Km distant from the third site. This site has the maximum anthropogenic activities happening throughout the year. There is a distance of 2 Km in between fourth and fifth site, later one is Mayapur. All these five sites are located in Haridwar-Rishikesh region. This region is situated in the western part of Uttarakhand state of India. Its latitude and longitude are 29°58' to 30° 7' 0''degree north and 78°13' to 78° 19'02'' degree east respectively. The height from the sea level is 249.7 mt. The parameters which were analysed during course of study includes temperature (°C), turbidity (N.T.U), total dissolved solids (mg/l),total suspended solids (mg/l), total solids (mg/l), pH, conductivity (siemens/cm), free CO_2 (mg/l), alkalinity (mg/l), dissolved oxygen(mg/l), chemical oxygen demand COD (mg/l), biochemical oxygen demand BOD (mg/l), most probable number (MPN). The physico-chemical and microbiological parameters were determined according to procedures outlined in Trivedi and Goel (1986), APHA (1998), Khanna and Bhutiani (2008).

Results and Discussion

The mean values of all the physico-chemical and microbiological parameters obtained during course of study are shown in the table number 1. Whenever the values of any parameter go beyond the permissible limit it adversely affects the aquatic ecosystem and organism by making other corresponding parameters fluctuate up to a fatal level. Thus increasing pollution causes ecological balance of the system to spoil. As water temperature increases, the rate of chemical reactions generally increases together The minimum value of temperature during Kumbh Mela was noted to be 17.11±2.09 °C at site 4th and the maximum value of temperature was noted to be 17.38±2.20°C at site 3rd. Average value was found to be 17.26±2.16 °C during whole study period. Turbidity in water is caused by suspended and colloidal matter such as clay, silt, finely divided organic and inorganic matter and plankton and other microscopic organisms. During Kumbh Mela the minimum value of turbidity was noted to be. 8.45 ± 4.13 NTU at Ist site and the maximum value of Turbidity was noted to be 10.00±3.71 NTU at site 4th. Average value of turbidity was found to be 9.32±3.68 NTU. Bhatt *et al.* (1984) reported the similar trend in the river Kosi. Turbidity was found to be more than permissible limit at few sites that is 5 NTU according to BIS (2004). High turbidity can leads to decrease photosynthetic activities and dissolved oxygen affecting the aquatic organism. The minimum value of total solids during Kumbh Mela was noted to be 169.40±24.00 mg/l at site 2nd and the maximum value of total solids was noted to be 191.16±22.74 mg/l at site 5th. Average value was found to be 182.87±10.70 mg/l. (Semwal *et al*. 2006) found the same pattern while working on the rivers of Uttarakhand. In natural waters, the major contributors to total dissolved solids are carbonate, bicarbonate, chloride, sulfate, phosphate, and nitrate salts. The minimum value of total dissolved solids during Kumbh Mela was noted to be 30.03 mg/l at 2nd site and the maximum value of total dissolved solids was noted to be 44.45 mg/l at site. Average value of total dissolved solids was found to be 39.17±9.51 mg/l which was well within permissible limit (500 mg/l). More or less similar results were observed by Khanna and Bhutiani (2006) in River Suswa. The minimum value of total suspended solids during Kumbh Mela was noted to be 138.57±22.34 mg/l at site 1st and the maximum value of total suspended solids was noted to be 147.88±28.77 mg/l at site 3rd. Average value was found to be 143.85±11.32 mg/l. Khanna and Bhutiani (2003) noted the similar trend in river Ganges at Haridwar. During Kumbh Mela the minimum observed value of pH was noted to be 7.42±0.12 at site 1st and the maximum value was noted to be 7.58±0.14 at site 2nd. Average value of pH was found to be 7.53±0.09, it was well within the permissible limit (6.5-9.2) according to WHO (2009). Deshmukh *et al*. (1964) in Kanhan River and Badola (1981) in Alaknanada River noted the matching results. Alkalinity in waters is beneficial because it minimizes pH changes, reduces the toxicity of many metals by forming complexes with

them and provides nutrient carbon for aquatic plants. It is mostly taken as an indication of the concentration of carbonate, bicarbonate and hydroxide, but may include contributions from borate, phosphates, the minimum value of Alkalinity during Maha Kumbh was observed to be 121.09±15.82 mg/l at site 4th and the maximum value of Alkalinity was noted to be 125.54±20.23 mg/l at site 2nd.

Tabel 1: Showing values of various water quality parameters during Kumbh mela 2010

Sampling sites / Parameters	Sampling site 1st	Sampling site 2nd	Sampling site 3rd	Sampling site 4th	Sampling site 5th	Average±SD
Temperature (°C)	17.19±2.23	17.25±2.13	17.38±2.20	17.11±2.09	17.36±2.33	17.26±2.16
Turbidity (N.T.U)	8.45±4.13	9.00±3.43	9.90±4.82	10.00±3.71	9.27±3.92	9.32±3.68
TDS (mg/l)	37.01±16.18	30.03±12.26	41.79±14.82	42.56±14.34	44.45±13.19	39.17±9.51
TSS (mg/l)	138.57±22.34	139.37±21.08	147.88±28.77	146.75±20.34	146.70±18.47	143.85±11.329
TS (mg/l)	175.59±24.14	169.40±24.00	189.67±27.54	188.57±24.02	191.16±22.74	182.87±10.70
Conductivity (siemens/Cm)	182.03±27.18	177.05±33.53	179.07±31.68	179.21±16.19	178.81±17.60	179.24±19.58
pH	7.42±0.12	7.58±0.14	7.55±0.16	7.57±0.16	7.55±0.13	7.53±0.09
Free CO_2 (mg/l)	2.75±1.19	3.49±0.91	3.70±1.39	2.98±0.99	3.44±0.89	3.27±0.83
Alkalinity (mg/l)	124.81±21.60	125.54±20.23	121.90±15.94	121.09±15.82	124.00±21.76	123.47±15.88
DO (mg/l)	9.36±0.94	9.74±0.73	9.49±1.00	9.60±1.07	9.48±1.07	9.53±0.87
BOD (mg/l)	1.67±0.87	1.62±0.68	1.70±0.78	1.86±0.81	1.90±0.64	1.75±0.31
COD (mg/l)	6.72±2.24	7.09±2.07	6.36±1.96	6.72±2.24	5.81±1.40	6.54±1.28
Total hardness (mg/l)	131.24±26.97	131.46±19.78	124.14±20.58	130.94±33.91	128.70±23.34	129.30±21.20
Chloride (mg/l)	33.12±6.10	33.40±6.11	32.25±7.65	32.87±7.79	31.80±6.46	32.68±6.18
Fluoride (mg/l)	0.10±0.01	0.11±0.01	0.09±0.01	0.09±0.01	0.10±0.01	0.10±0.00
Nitrate (ppm)	0.079±0.0250	0.052±0.0231	0.055±0.02049	0.09±0.0690	0.07±0.0261	0.07±0.0274
Phosphate (ppm)	0.07±0.0317	0.06±0.0206	0.06±0.01857	0.07±0.0261	0.05±0.0203	0.06±0.0172
Sulphate (ppm)	21.51±2.0907	20.26±2.9563	20.79±2.71044	23.54±2.3786	20.77±2.1041	21.37±1.9541
MPN/100 ml	1163.63±478.06	1181.81±501.63	1145.45±550.20	1363.63±651.57	1272.72±596.80	1225.45±530.96

Average value was found to be 123.47±15.88 mg/l. Same observation were also made by Holden and Green (1960) and Venkateswarlu and Jayanti (1968). During Kumbh Mela the minimum value of dissolved oxygen was noted to be 9.36±0.94 mg/l at site 1st and the maximum value was observed to be 9.74±0.73 mg/l at site 2nd. Average value of dissolved oxygen was found to be 9.53±0.87 mg/l it was far more than the minimum permissible limit (6.00 mg/l). Semwal *et al*. (2006) worked on the rivers of Uttaranchal and found dissolved oxygen in between 9.53 mg/l and 0.87 mg/l. The minimum observed value of biochemical oxygen demand during Maha Kumbh was noted to be 1.62±0.68 mg/l at site 2nd and the maximum value was found to be 1.90±0.64 mg/l at site 5th. Average value of biochemical oxygen demand was observed to be 1.75±0.31 mg/l, far lesser than the maximum permissible limit according to BIS (2004). During Maha Kumbh the minimum observed value of Chemical oxygen demand was noted to be 5.81±1.40 mg/l at site 5th and the maximum value of chemical oxygen demand was found to be 7.09±2.07 mg/l at site 2nd. Average value was observed to be 6.54±1.28 mg/l. Singh et al. (2006) while working on river Ganges concluded the same thing.Abdo (2005) reported almost equivalent trend. The minimum value of total hardness was noticed to be 124.14±20.58 mg/l at site 3rd during Kumbh Mela and the maximum value was noted to be 131.46 ± 19.78 mg/l at site first site. Average value of total hardness was found to be 129.30±21.20 mg/l. During Kumbh Mela the minimum value of Chloride was found to be 31.80±6.46 mg/l at site 5th and the maximum value was noted to be 33.40±6.11 mg/l at site 2nd.

Average value of Chloride was found to be 32.68±6.18 mg/l which was far lesser than the maximum permissible limit (250 mg/l) according to WHO (2009). (Khanna *et al*. 2007) found average value of Chloride around 7.39 mg/l in the river Ganges. Mishra and Saxena, (1984) while working on Kshipra River and Sengar et al (1985) working on river Yamuna reached to the similar results. During Kumbh Mela the minimum value of fluoride was noted to be 0.09±0.01 mg/l at site 4th and 5th and the maximum value was noted to be 0.11±0.01 mg/l at site 2nd. Average value of Fluoride was found to be 0.10±0.00 mg/l which is far lesser than the maximum permissible limit for fluoride according to WHO (2009). During Kumbh Mela the minimum observed values of ions (nitrate, phosphate and sulphate) were noted to be 0.07±0.02, 0.05±0.02 and 20.26±2.95 ppm at fifth, fifth and second sites respectively and the maximum values were noted to be 0.09±0.06, 0.07±0.03 and 23.54±2.37 ppm at fourth, first and fourth sites respectively. Average value of these ions during Kumbh Mela were found to be 0.07±0.02, 0.06±0.01 and 21.37±1.95 ppm. All these three ions were observed well within the permissible limits according to WHO (2009) for these above mentioned ions.It is customary to report results of the coliform test by the multiple-tube fermentation procedure as a Most Probable Number (MPN) index. This is an index of the number of bacteria. Faecal contamination of water is routinely detected by microbiological analysis. The minimum observed value of most probable number during Kumbh Mela was noted to be 1145.45±550.20 MPN/100ml at site and the maximum value was noted to be 1363.63±651.57 MPN/100ml at site. Average value of most probable number (MPN) was found to be 1225.45±530.96 MPN/100ml; it was far beyond the minimum permissible limit (50 MPN/100ml).

Conclusion

The present study is aimed to assess the water quality during the Maha Kumbh, 2010 at the five located stations. The physico-chemical, microbiological characteristics during this Maha Kumbh were analysed. It has been revealed that Mass bathing exerts some spoiling effects on the water quality but it is constrained to few parameters, namely total solids, total suspended solids, hardness, dissolved oxygen and chemical oxygen demand etc. These above mentioned parameters were observed to be slightly increased during the Bathing days. Other parameters are also disturbed temporarily but that too negligible. The average values of all the parameters were found to be in the permissible limit during whole occasion except microbial parameters. So it can be concluded that this Mass bathing has not an alarming effect on the water quality of river Ganges but it should be considered seriously so far as microbiological parameters and disesase outbreak is concerened. Finally it can be concluded that during this mass bathing two sites were found to be more affected than the other three sites. These were noted to Har-ki-pauri and Mayapur ghat at Haridwar, at these sites parameters are observed to be slightly raised in comparison to other three sites. The main reason behind this is huge influx of all sorts of waste and organic matter during the holy occasion at these vary sites as these are the sites where mainly bathing and other customs were performed. Regular monitoring at times should be performed and appropriate mitigation measures and sanitation strategies must be practically implemented.

References

Agarwal, T.R., Singh, K.N. and Gupta, A. K. 2000. Impact of Sewage Containing domestic wastes and Heavy Metals on the Chemistry of Varuna River. ***Poll. Res.***, 19(3):491-494.

Alley, K.D., 2002. *On the Banks of the Ganga: When Wastewater Meets a Sacred River.* University of Michigan Press, Michigan.

Alter, S., 2001. *Sacred Waters: A pilgrimage up the Ganges River to the source of Hindu culture.* Harcourt, London.

APHA, AWWA, WEF, 1998. *Standards Methods for the Examination of Water and Wastewater*, 20th edition, American Public, Health Association, American Water Works Association and Water Environmental Federation, Washington, DC 2005- 2605.

Badola, S.P. and Singh, H.R., 1981. Hydrobiology of the river Alaknanda of Garhwal Himalaya. ***Ind. J. Eco.***, 8(2):269-276.

Bhargava, D.S. and Ram Tirath., 1982. Water quality in Gomti River at Lucknow (U.P). ***Journal of the Indian water works association,*** 14(4):299-304.

Bhatt, S.D., Bist, Y. and Negi, U., 1984. *Limnology of the Limnoflora in river Koshi of the Kumaon Himalaya* (U.K.) *Proc. Indian.*, 50(4):395-405.

Bilgrami, K.S. and Datta Munshi, J.S., 1985. *Ecology of river Ganga, Impacts of Human activities and conservation of aquatic biota (Patna to Farakka)*. Final Technical report of MAB Project, Bhagalpur University, Bhagalpur.

Bilgrami, K.S. and Duttamunshi, J.S., 1985. *Ecolgy of River Ganges (Patna-Farakka). Technical report, CSIR.*

CPCP, 2002:g. Annual Report 2001-2002, Central Pollution Control Board http:// www.cpcb.nic. In/ar2002/ ar12content.htm.

Deshmukh, S.B., and Phadke, N.S. and Kothandaraman, V., 1964. Physico-Chemical characteristic of Kanhan river Water (Nagpur). ***Indian J. Environ. Hlth.***, 6(3):181-186.

Ehrlich, A. and Holdren, J.P., 1973. *Human ecology:problems and solutions. San Francisco.* W.H. Freeman and Company.

Flood, G., 2003. *The Blackwell Companion to Hinduism.* Blackwell, Malden Massachusetts.

Garrels, R. M., Mackenzie, F. T. and Hunt, C., 1975. *Chemical Cycle and the Global Environment*, William Kaufman, New York, 260.

Gaur, V. K., Gupta, S. K., Pandey, S. D., Gopal, K. and Misra, V., 2005. Tribution of heavy metals in sediment and water of river Gomti. ***Environ. Monit. Assess***, 102:1–3.

Holden, J.M. and Green, J., 1960. Hydrobiology and Plankton of the river Sokoto. ***J. Anim. Ecol.***, 29(1):65-84.

Horowitz, A. J., 1995. *The use of suspended sediment and associated trace elements in water quality studies.* IAHS Special Publication, IAHS Press, Wallingford, UK, 58.

Horowitz, A. J., 1997. Some thoughts on problems associated with various sampling media used for environmental monitoring. ***Analyst,*** 122: 1193–1200.

Khanna, D.R., Pathak, S.K., Bhutiani, R. and Chandra, K.S., 2006. Study of water quality of river Suswa near Raiwala, Uttaranchal. ***Env. Con. J.***, 7(3):79-84.

Kudesia, V.P. and Verma, S.P., 1985. A study of industrial pollution on Kali River. ***J. Env. Sci.***, 1(2):41-49.

MPCB, 2004a. Annual Reports, Maharashtra Pollution Control Board, 2003-2004, http://mpcb. Mah.nic.in/.

Report of Ardh Kumbh Mela, 2004. published by GoU.

Semwal, N. and Akolkar, P., 2006. Water quality assessment of sacred Himalayan Rivers of Uttaranchal, ***Current Science***, 91(4):25.

Sharma, P.D., 2006. *Ecology and Environment*. Rastogi Publication, Meerut.

Singh, M. and Singh, A. K., 2007. Bibliography of environmental studies in natural characteristics and anthropogenic influences on the Ganga river. ***Environ. Monit. Assess.,*** 129:421–432.

Singh, T.V., 1989a. On Developing Himalayan Tourism Ecologically. In *Studies in Himalayan Ecology and Development Strategies* edited by T.V. Singh, and J. Kaur, second edition. Himalayan Books, New Delhi.

The Tribune, 2010. *Pilgrim rush less than expected*, January 15th 2010, Haridwar

TOI, 2010: *Kumbh, a fair deal*, Times of India, July 26th, 2010, Haridwar.

TOI, 2010. *Fair deal for foreigners*,Times of India, April 18th 2010, Haridwar.

TOI, 2010. *Of faith and fear*, Times of India, April 25th 2010 ,Haridwar.

UNESCO, Impact, 2004. *The Effects of Tourism on Culture and the Environment in Asia and the Pacific: Tourism and Heritage Site Management in Luang Prabang, Lao PDR.* UNESCO World Heritage Centre, Bangkok.

Venkateswarlu, T. and Jayanti, T.V., 1968. Hydrobiological studies of river Sabarmati to evaluate water quality. ***Hydrobiologia***, 33(3-4):442-448.