Assessment of Quality of Ground Water Body of Neelangarai and Triplicane Area in Chennai, Tamil Nadu in the Post Inundation Circumstances

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Abstract

Although flood hit the entire part of Chennai, Tamil Nadu some three years ago, the quality of water is still found to be worse because of major inundation in these areas. The current inspection deals with the physico-chemical analysis of the ground water samples collected from ten locations in Neelangarai and Triplicane area in Chennai, Tamil Nadu and assessed using Heber Water Quality Index (HWQI) in the post tsunami circumstances. The factors examined were pH, fecal coliform, total dissolved solids (TDS), dissolved oxygen (DO), temperature biochemical oxygen demand (BOD) and turbidity. In addition to these parameters, pointers like electrical conductivity and salinity were also taken into consideration. The overall HWQI outcomes for all the trials in Neelangarai area were determined between 65.02 and 72.25 and Triplicane area was 66.64 - 70.71, which suggest that all the samples are medium to good in quality and could use for human consumption.

Introduction

All life depends on the fresh water. At the same time as stringently speaking, absolutely pure water does not exist for any considerable span of time in nature (Almeida and Quintar 2008). Pure water is believed to be the one that has less suspended or floating solids and intolerable gases as well little in natural life (Trivedi 1984). Such high class water may be essential only for consumption reasons while for other utilizations like industry and agriculture, the superiority of water can be reasonably bendable and water contaminated up to assured degree in common sense can be stared as pure (Gorde and Jadhav 2013). Regular water quality examine of the water assets are enormously indispensable to evaluate the quality of water for hygiene, agricultural, industrial use ecosystem health and hygiene and domestic use. Chennai always faces a severe trouble of innate resource paucity, particularly that of water in sight of population explosion and financial improvement. Heavy rainstorm hit the entire part of Chennai city and it's out skirts in the month of December, 2015 which shook the entire state. Though it caused so much of economic and financial losses, the impact of it on the quality of ground water body is really very large (Kumaraperumal et al. 2007). Examining of water quality can be a intricate procedure undertaking several factors capable of causing different pressure on by and large aquatic quality (Bharti and Katyal 2011). To assess water quality from a large quantity of specimens, each having concentrations for several factor is complicated (Almeida et al. 2008). Usual approaches to understanding the quality of water are based on the association of experimentation with the accessible guiding principle (Debels et al. 2005). As a result, water quality indices are such approaches which minimize the information to a large degree and make simpler the appearance of water health. These indices are framed on the basis of the comparison of water quality pointers to dogmatic values and provide a distinct quantity to the quality of water of a particular source (Tirkey et al. 2015). In this present paper, to assess the quality of earth water taken from ten places of Neelangarai and Triplicane which were the worst affected areas in the rainstorm, Heber Water quality index was exploited

Experimental

Study area

Chennai is located along the Coramandel coast; a province bordered by the Bay of Bengal and is enclosed inland by the districts of Kanchipuram and Thiruvallur. The sampling stations namely Neelangarai and Triplicane are one of the thickly populated areas and were majorly hit areas in the recent floods. Water samples were collected from Ten locations namely, Habeeba Street, Begum Street, Sivan koil street, First North cross street and Second North Cross Street of Neelangarai area and Rajahanumantha Street, Venkataraghavan Street, Easwara Doss Street, Nallathambi Street and Muthukalathi Street of Triplicane area of Chennai, Tamilnadu, India (Fig. 1).

Materials And Methods

Experimental

Water samples were collected from the bore wells at 15 feet depth during on an ordinary day in the morning hours between 9 am to 12 noon in a previously washed and dried plastic container. The containers were rinsed thoroughly with sample water in each sampling stations. After the collection of samples, containers were labeled with the information like time, date and area, temperature and pH. All the samples were preserved to resist changes that occur during transportation to the laboratory and the time lapse between the collection and analysis. Temperature, pH was recorded at the time of sample collection, by means of a standardized thermometer and a digital pH meter respectively. The water samples were instantly transported to laboratory for the determination of various other physicochemical pointers such as DO, TDS, BOD, Turbidity, Conductivity, Salinity in the laboratory by exploiting standard methods as given by APHA (ALPHA, 1989).

To analyze the parameter BOD, samples were taken in the BOD containers and were incubated immediately in the laboratory. Dissolved oxygen (% DO saturation) was set at the sampling spot itself at once after collection. To study Fecal Coliform, samples were collected separately and tested within one hour. Other parameters like pH, turbidity, TDS, salinity and electrical conductivity (EC) were analyzed in the laboratory. Turbidity was measured using Nephelometric method. To measure fecal coliform by MPN test, samples were gathered in the uncontaminated containers. To investigate the TDS, water sample was positioned in a drying oven to dry and to leave the sediments. After all experiments are over, the outcomes of each parameter were tabulated. To frame a WQI, Q - value of the outcome of each factor was assessed using the Q-chart. In addition to the aforementioned nine parameters, salinity was also tested for all the samples. When the outcomes of all these pointers were presented, the comparative weights for each factor were cross examined with the standard and the total was scaled so that the range remained between 0 and 100. This range gave intimation about the inherent nature of water (Rajendran 2001).

Preservation of samples

After collection, the samples were preserved to resist changes that occur during transportation to the laboratory and in the time between collection and analysis. The samples were taken to the lab under cool and dim environment within 4 hours of collection. Then the sample was refrigerated and analyses of

all parameters were carried out within 7 days (Trivedi and Goel, 1984).

Procedure for the calculation of the total water quality index (WQI)

The water quality indeed for sampling station of the ground water was formulated after the 11 water quality tests are completed and results of each test recorded.

Procedure for determining Q-value

The test value was located on the bottom of the respective weighting curve chart and a perpendicular streak was drawn until it traverses the weighting arc line. From the spot of meeting point, a straight line was drawn to the Y-axis. The point of intersection gives the Q-value of that particular test result (Fig. 2). This Q-value was recorded in column B on the WQI chart. The weighting arc quantity for each parameter was multiplied by the weighting factor listed on the chart for the particular test. This value was recorded in the total column of the WQI map. The weighting factor for each water quality test provides a relative gauge of a test's significance to the total water quality. For example, from WQI chart, dissolved oxygen (DO) with a weighting factor of 0.17 is considered a more important test than total dissolved solids 0.07 in overall water quality determination. The overall water quality index for the sampling station was determined by adding the total of the nine tests results (Padmavathy et al., 2003; Rajendran et al., 2001).

Results And Discussion

Neelangarai area

The over all WQI values of water samples collected from Habeeba Street, Begum Street, Sivan koil street, First North cross street and Second North Cross Street of Neelangarai area of central Chennai were 68.51, 68.92, 65.02, 71.36 and 72.25 respectively (Tables 1). Since these values lied in the range of 65.02–72.25 clearly showing that these water systems are grossly polluted except the samples of first north cross street and the second north cross street. % DO saturation of all these water samples had almost the same value (85%). The low % DO saturation may due to the discharge of oxygen demanding wastes from the nearby places. This low % DO saturation reflected in other related parameters such as BOD and total dissolved solids. BOD of water samples of this area ranged from 0.8–3.2mg/L. Normally, the low DO and high BOD may due to the presence of oxygen demanding wastes and microorganisms like fecal coliform and other bacteria. But, as far as these water samples are concerned, fecal coliform bacteria were found to be totally absent. However, other bacteria may be present in large numbers which may demand oxygen for their survival. The pH of this area was in the range of 7.8–8.6 which is well contained by the acceptable limit. The TDS values of this area ranged from 280–550mg/L. Among the sampling stations of this area, the sampling station namely, Sivan koil street recorded high Total dissolved solids value (550mg/L). Electrical conductivity and salinity of bore well waters of this Neelangarai area were found to be in the range of 300–750 μ S/cm and 850–1450 mg/L respectively (Table 3). These areas were also hit worst during 2004 Tsunami. Ocean water inundation from the tsunami might have caused salinization issues for earth and groundwater in coastal parts of Chennai, and also stimulated salt harms in drinking bore well waters (Kume et al., 2009). This is one of the examples of having the long term adverse impact of Tsunami. The results of pointers such as EC, TDS; BOD and salinity were very high and rendered the water systems of this area unfit for human consumption unless properly treated to improve the quality.

Table-1: Neelangarai area - Habeeba Street (Sample 1), Begum Street (Sample 2), Sivan koil street (Sample 3), First North cross street (Sample 4) and Second North Cross Street (Sample 5)

Sampling Site		Habeeba Street			Begum Street			Sivan koil street			First North cross street			Second North C Street		
Parameter	Weighting Factor	Test Result	WQI		Test Result	WQI		Test Result	WQI		Test Result	WQI		Test Result	WQI	
			'Q'	Total		'Q'	Total		'Q'	Total		'Q'	Total		'Q'	Total
			Value			Value			Value			Value			Value	
DO (% saturation)	0.17	85	91	15.47	85	91	15.47	85	91	15.47	85	91	15.47	85	91	
Fecal Coliform	0.16	0.0	98	15.68	0.0	98	15.68	0.0	98	15.68	0.0	98	15.68	0.0	98	
BOD (mg/L)	0.11	2.0	86	9.46	2.2	84	9.24	3.0	77	8.47	1.0	92	10.12	0.8	94	
pH	0.11	8.4	74	8.14	8.4	74	8.14	8.6	64	7.04	8.0	85	9.35	7.8	86	
Temperature	0.10	0	92	9.20	0	92	9.20	0	92	9.20	0	92	9.20	0	92	
TDS (mg/L)	0.07	450	40	2.8	380	49	3.43	550	20	1.4	340	54	3.78	280	62	
Turbidity	0.08	0	97	7.76	0	97	7.76	0	97	7.76	0	97	7.76	0	97	
Total WQI				68.51		68.92		65.02		71.36						

Triplicane area

Bore well water samples were collected from five sampling stations viz., Rajahanumantha Street, Venkataraghavan Street, Easwara Doss Street, Nallathambi Street and Muthukalathi Street of Triplicane area. The overall WQI values of this area were found to be 68.89, 70.33, 66.64, 70.71 and 69.59 respectively

(Tables 2). These values lied in the range of 66.64–70.71 which reveals a fact that these water systems are of medium quality and cannot be recommended for drinking purposes but could be used for agricultural purposes and partial body contact as per the recommendations of National sanitation foundation and water quality index (Rajendran, 2001). Among the seven parameters considered for the formulation of water quality index in this piece of task, factors such as temperature, fecal coliform and pH (7.4–8.6) do not contribute to pollution of these water systems despite this area being heavily affected during tsunami in 2004. % DO saturation of all the sampling stations was found to be only

Table.-2: Triplicane area - Rajahanumantha Street (Sample 6), Venkataraghavan Street (Sample 7), Easwara Doss Street (Sample 8), Nallathambi Street (Sample 9) and Muthukalathi Street (Sample 10)

Sampling Site		Rajahanumantha Street			Venkataraghavan Street			Easwara Doss Street			Nallathambi Street			Muthukalathi Street	
Parameter	Weighting Factor	Test Result	WQI		Test Result	WQI		Test Result	WQI		Test Result	WQI		Test Result	WQI
			'Q'	Total		'Q'	Total		'Q'	Total		'Q'	Total		
			Value			Value			Value			Value			
DO (% saturation)	0.17	80	87	14.79	80	87	14.79	80	87	14.79	80	87	14.79	80	87
Fecal Coliform	0.16	0.0	98	15.68	0.0	98	15.68	0.0	98	15.68	0.0	98	15.68	0.0	98
BOD (mg/L)	0.11	2.0	86	9.46	2.0	86	9.46	2.5	83	9.13	1.8	87	9.57	1.2	91
pH	0.11	8.2	80	8.8	7.4	91	10.01	8.6	64	7.04	7.8	86	9.46	8.0	85
Temperature	0.10	0	92	9.20	0	92	9.20	0	92	9.20	0	92	9.20	0	92
TDS (mg/L)	0.07	400	47	3.29	380	49	3.43	420	44	3.08	350	53	3.71	450	40
Turbidity	0.08	0	97	7.76	0	97	7.76	0	97	7.76	0	97	7.76	0	97
Total WQI				68.89		70.33		66.64		70.71					

65.02–72.25 which divulges a information that the nature of all the samples analyzed in this study is only moderate to good and could be used for drinking and other house hold uses only after suitable treatment. Among the various water samples analyzed, Neelangarai (Sivan Koil Street) had been registered with low WQI (65.02). Besides this low WQI value, salinity (1450 mg/L) and electrical conductivity (750 $\mu\text{S}/\text{cm}$) were also ascertained to be very high. Among the various samples analyzed Neelangarai (Second North Cross Street) had with high WQI (72.25). These indicate that these waters are fit for drinking purposes after a proper treatment. The overall WQI values of Triplicane area for all the samples were found to be in the range of 66.64–70.71, which discloses an information that the quality of all the samples examined in this study is only moderate to good and could be used for drinking after proper treatment. None of the analyzed water samples were found to be excellent with regards to human consumption and other domestic uses. The probable reasons could be the long term adverse impact of flood and tsunami.

Declarations

ETHICS APPROVAL AND CONSENT TO PARTICIPATE DECLARATION

Not applicable

CONSENT FOR PUBLICATION DECLARATION

Not applicable

AVAILABILITY OF DATA AND MATERIALS DECLARATION

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

COMPETING INTERESTS DECLARATION

The authors declare that they have no competing interests

FUNDING DECLARATION

There was no funding to do our research

AUTHOR CONTRIBUTION

A.Rajendran – The design of the study, collection and analysis

C.Mansiya – Doing Lab Research work

M. Shanmuganathan – Interpretation of data and in writing the manuscript

All authors read and approved the final manuscript

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References

1. C.Almeida, S.Quintar, P.González and M.Mallea, Environmental Monitoring and Assessment, 142 (1–3), 149–152 (2008)
2. American Public Health Association. Standard Methods for the Examination of Water and Wastewater. 20th edition. (1998).
3. **N.Bharti and D.Katyal**, International Journal of Environmental Sciences, **2** (1),154–173 (2011)
4. P. Debels, R. Figueroa, R. Urrutia, R. Barra and X. Niell, Environmental Monitoring and Assessment, 110,301–322 (2005)
5. R. Kumaraperumal, S. Natarajan, R. Sivasamy, S.S. Chellamuthu, S. Ganesh and G. Anadakumar, Science of Tsunami Hazards, 26(2):93–114 (2007)
6. T. Kume, C. Umetsu and K. Palanisami, Journal of environmental management, **90**(10), 3147–3154 (2009)
7. S. Padmavathy, A. Rajendran, T. Ramachadramoorthy and S. Priyadarshini, Indian Journal of environmental protection **23**(6), 654–659 (2003)
A. Rajendran, N.S. Subramanian, T. Ramachandramoorthy, J. Princy Merlin, I. Shamila Lydia and C. Raja, Journal of Ecotoxicology and Environmental Monitoring, 11(2), 135–141, (2001)
8. S.P. Gorde and M.V. Jadhav, International Journal of Engineering Research and Applications 3(6), 2029–2035 (2013)
9. P. Tirkey, T. Bhattacharya and S. Chakraborty, International Journal of Advances in Chemistry. 1 (1),15–29 (2015)
10. R.K. Trivedi and P.K. Goel Chemical and Biological methods of water pollution studies, Environmental Publications, India. (1984)

Figures

Figure 1

Map of major places of Chennai city

Figure 2

'Q' chart of each parameter