Int. J. Adv. Res. Biol. Sci. 2(9): (2015): 84–92

International Journal of Advanced Research in Biological Sciences
ISSN: 2348-8069
www.ijarbs.com

Research Article

To monitor the drinking water quality for the Tribal villagers, Roha-Tahsil, Dist-Raigad (Maharashtra)

Bhagat D. V., Jadhvar V. R., Patil S. S.*

Department of Chemistry, K.E.S.Anandibai Pradhan Science College,
Nagothane- 402106,Tq.: Roha, Maharashtra.
* Department of Chemistry, Changu Kana Thakur Arts, Commerce and Science College,
New Panvel, Raigad, Maharashtra, India- 410206.
*Corresponding author: *bhagat.dinesh72@gmail.com*

Abstract

Assessment of physicochemical characteristics of well water of six tribal villages of Roha Tahsil has been carried out during the year 2011-12. For instance water moving through underground rocks and soils may pick up natural contaminates, even with no human activity or pollution in the area. In addition to nature's influence, water is also polluted by human activities, such as open defecation, dumping garbage, poor agricultural practices, and chemical spills at industrial sites. The present study was undertaken for six tribal villages of Roha tahsil,viz. Warvathane, Bhatsai, Ainghar, Bangalwadi, Kansai and Shenvai where the well water is the only source of drinking water . The water analysis was performed for the selected parameters such as Temperature, pH, Total Solids, Turbidity, Conductivity, D.O., etc. It was concluded from the study that the well water can be used for the drinking purpose after a suiTable No. treatment.

Keywords: Bhatsai, Bangalwadi,Shenvai,Kansai physicochemical parameters .

Introduction

Having safe drinking water and basic sanitation is a human need and right for every man, woman and child. People need clean water and sanitation to maintain their health and dignity. Having better water and sanitation is essential in breaking the cycle of poverty since it improves people's health, strength to work, and ability to go to school.

Yet 884 million people around the world live without improved drinking water and 2.5 billion people still lack access to improved sanitation, including 1.2 billion who do not have a simple latrine at all (WHO / UNICEF, 2008). Many of these people are among those hardest to reach: families living in remote rural areas and urban slums, and families living in the poverty- disease trap, for whom improved sanitation and drinking water could offer a way out.

The World Health organization (WHO) estimates that 88% of diarrheal disease is caused by unsafe water, inadequate sanitation and poor hygiene. As a result, more than 4,500 children die every day from diarrhea and other diseases. For every child that dies, countless others, including older children and adults, suffer from poor health and missed opportunities for work and education.

To safe guard the long term sustainability of well water and ground water resources, the quality of water needs to be continuously monitored (NEERI 1981).

Study area

Roha is a small city and taluka in the Raigad district of the Maharashtra state of India. It is located 120 km southeast of Mumbai. It is the starting point of kokan railways and end point of central railways. Raigad is one of the industrially developed districts in the Maharashtra state. It lies at the bank of Arabian Sea. The geometrical position of it has latitude 18.45^0 and

73.12^0 longitude. Hilly area is one of the silent features of this area. The present investigation was carried out at the six selected villages in the Roha tahsil between June 2011 to December 2012. By considering the different physico-chemical parameters.

Materials and Methods

For the purpose of study of well water quality in some selected tribal villages, the samples were collected quarterly, in early morning hours, in clean plastic carboy of 2 litres capacity. Air temperature, water temperature was recorded on the spot at the sites. The samples for DO were fixed immediately in the field itself. Other parameters such as pH, Total Solids, Turbidity, Conductivity, were analysis as per the methods describe in the standard methods (APHA, 1990); Trivedi and Goel (1984) and Kodarkar (1992).

Results and Discussion

The variations in analysised physical and chemical characteristics are tabulated along with the standard values in the Table No. 1 to 9.

Temperature

Temperature is an important abiotic factor as it has effect on certain chemical and biological activities performed by the organisms living in aquatic media. It not only varies seasonally and spatially, but also shows diurnal variation (Ramdas et al., 2005).

In fresh water environment, temperature regulates self purification capacity of water (Shaikh and Yeragi, 2004). It influences the viscosity, density, vapour pressure, surface tension and gas diffusion rates (Parker and Krenkel, 1969). Increase in temperature decreases the capacity of water to keep oxygen in solution and increases BOD (Ghavzan et al., 2005).

Air Temperature

The air temperature was found ranging between 23^{0}C and 32^{0}C (Table No. 1). The minima was observed in the month of December-12 and the maxima was in the month of March-12. There was no site to site variation in air temperature. The radiation from the sun as well as evaporation, relative humidity, wind, length of the day and cloud cover affect the air temperature (Shaikh and Yeragi, 2003).

Table No. 1: Quarterly values of Air Temperature (^{0}C) at 6 Sampling Stations from June 2011 to Dec. 2012

Site / Month	Warvathane (S1)	Bhatsai (S2)	Ainghar (S3)	Bangalwadi (S4)	Kansai (S5)	Shenvai (S6)
Jun-11	31	30	31	30	31	30
Sept-11	29	29	30	28	29	29
Dec-11	24	24	24	23	24	24
Mar-12	32	32	32	32	32	32
Jun-12	28	28	27	26	27	28
Sept-12	29	29	28	29	29	28
Dec-12	23	23	23	23	23	23
Max.	**32**	**32**	**32**	**32**	**32**	**32**
Min.	23	23	23	23	23	23
Average	28.00	27.85	27.86	27.28	27.86	27.71

Water Temperature

The surface water temperature depends on air temperature, wind, turbulence in water and biological activities taking place in the water. It is one of the important parameter as it directly affects the water chemistry and thus affects the biota in the water. During the present study the water temperature ranged from 17 to 23.5^{0}C (Table No. 2). The minimum was noted in the month of December 12. The maximum temperature was in March 2012 corresponding to air temperature.

Table No. 2: Quarterly values of Water Temperature (^{0}C) at 6 Sampling Stations from June 2011 to Dec. 2012

Site / Month	Warvathane (S1)	Bhatsai (S2)	Ainghar (S3)	Bangalwadi (S4)	Kansai (S5)	Shenvai (S6)
Jun-11	22.1	20	21.5	21.9	21.3	22.1
Sept-11	20.1	20	21	21.2	21.4	20.2
Dec-11	20.5	19.2	21.3	19.5	21	20
Mar-12	23.5	22.5	22.2	22.7	23.4	23.5
Jun-12	21	21.5	20.5	21.3	20.4	21.3
Sept-12	21	21	21.1	20.2	21	21
Dec-12	18	17	18	17.8	18.1	18.2
Max.	**23.5**	**22.5**	**22.2**	**22.7**	**23.4**	**23.5**
Min.	18	17	18	17.8	18.1	18.2
Average	20.89	20.17	20.8	20.65	20.94	20.90

pH

pH is one of the most important attributes of any aquatic ecosystem since all biochemical activities depend on pH of the surrounding medium.

It is important to determine pH because most of the plants and animals can survive within a narrow range of pH from slightly acidic to slightly alkaline (Pawar and Pulley, 2005). pH also governs the distribution , transport and fate of heavy metals in aquatic ecosystems (Manna and Das, 2004). It has synergistic effects that determine the toxicity of elements like iron, aluminium, ammonia etc.

The average pH values during the present study show water was slightly alkaline except in the village Warvathane. (Table No. 3). Alkalinity of pH is seen at every site except S1 due to unknown reason. Eutrophication and Sewage inflow are few of the causes of increased pH as stated by Ghavzan et al.(2005) and Chatterjee and Raziuddin, (2001).

Table No. 3: Quarterly values of pH (range of 1 to 14) at 6 Sampling Stations from June 2011 to Dec. 2012

Site / Month	Warvathane (S1)	Bhatsai (S2)	Ainghar (S3)	Bangalwadi (S4)	Kansai (S5)	Shenvai (S6)
Jun-11	6.8	7.2	7.5	7.2	7.6	7.6
Sept-11	7.2	7.3	7.2	7.1	7.5	7.9
Dec-11	7.3	7.0	7.3	7.1	7.6	7.8
Mar-12	6.8	6.9	7.0	7.3	7.2	7.8
Jun-12	7.0	7.0	7.4	7.0	7.0	7.6
Sept-12	6.3	7.3	6.9	6.9	7.5	7.8
Dec-12	6.7	7.5	7.5	7.4	7.6	7.7
Max.	**7.30**	**7.50**	**7.50**	**7.40**	**7.60**	**7.90**
Min.	6.30	6.90	6.90	6.90	7.00	7.60
Average	6.87	7.17	7.26	7.14	7.43	7.74

Total Solids

Total Solids are also referred as total residues and are related to turbidity. Total solids include suspended solids such as any particulate matter and dissolved solids such as mineral ions, calcium, phosphorus, iron, sulphur and bicarbonates.

The amount of solids in a water body may include many pollutants that happen to be solids. A certain level of these ions is essential for life. Cells also depend on the density of total solids to determine the amount of water that flows in and out of the cell. However, dissolved solids in excess in water can affect humans by inducing a laxative effect and giving the water a mineral taste. Increased total solids reduce water clarity, rise water temperature and reduce oxygen levels as a result of less photosynthesis. Moreover the solids can bind to toxic compounds and heavy metals.

The amount of total solids depend on various parameters such as geological character of the water shed, rainfall and the amount of surface run off (Akuskar and Gaikwad, 2006). The highest total solids elevate the density of water and such medium increases the stress on aquatic biota (Verma et al. 1978).

The present study indicates total solids ranging from 550 mg to 1100 mg/l (Table No. 4).

Table No. 4: Quarterly values of Total solids mg/l at 6 Sampling Stations from June 2011 to Dec. 2012

Site / Month	Warvathane (S1)	Bhatsai (S2)	Ainghar (S3)	Bangalwadi (S4)	Kansai (S5)	Shenvai (S6)
Jun-11	550	740	610	760	880	950
Sept-11	620	630	750	860	750	1000
Dec-11	590	850	790	780	860	780
Mar-12	750	750	860	900	900	950
Jun-12	620	960	800	700	1100	840
Sept-12	750	870	900	800	760	840
Dec-12	820	840	950	820	780	980
Max.	**820.00**	**960.00**	**950.00**	**900.00**	**1100.00**	**1000.00**
Min.	550.00	630.00	610.00	700.00	750.00	780.00
Average	671.43	805.71	808.57	802.86	861.42	905.71

The ISI-limit for total solids is 1000 mg/l. Present study indicates values crossing the permissible limit during some period of the year, especially at Kansai and Shenvai.

Total Suspended Solids

The amount of particles that suspended in a water sample is called total suspended solids (TSS). It is mentioned as mg/l. Total Suspended Solids (TSS), also known as non-filterable residue, are those solids (minerals and organic material) that remain trapped on a 1.2µm filter (U.S.EPA, 1998). Total suspended solids enter in water body through sanitary and industrial water. The non point sources are soil erosion, agriculture and construction sites. To remain permanently suspended in water (or suspended for a long period of a time), particles have to be light in weight (they must have a relatively low density or specific gravity), be relatively small in size, and have a surface area that is large in relation to their weight. The greater the TSS in the water, the higher is its turbidity and the lower is its transparency (clarity).

TSS has no drinking water standard. Therefore, data in this report are compared to the general standards for surface water discharge of effluents that indicate the value 100mg/L.

The present study reveals that the suspended particles were found to be very noticeable (Table No. 5) for most of the period, however, it was found to be ranging between 100 and 450mg/l. Chatterjee and Raziuddin (2003) noted high values in monsoon. However such seasonal trend was not noted during the present study.

Table No. 5: Quarterly values of Total Suspended solids mg/l at 6 Sampling Stations from June 2011 to Dec. 2012

Site / Month	Warvathane (S1)	Bhatsai (S2)	Ainghar (S3)	Bangalwadi (S4)	Kansai (S5)	Shenvai (S6)
Jun-11	100	250	210	120	150	180
Sept-11	160	250	160	220	250	150
Dec-11	250	120	100	200	210	260
Mar-12	150	150	200	350	200	310
Jun-12	260	160	250	150	110	230
Sept-12	250	150	210	240	250	140
Dec-12	450	210	110	240	200	210

Max.	**450.00**	**250.00**	**250.00**	**350.00**	**250.00**	**310.00**
Min.	100.00	120.00	100.00	120.00	110.00	140.00
Average	231.43	184.28	177.14	217.14	195.71	211.43

Total Dissolved Solids

Total dissolved solid is a measure of all the materials that are dissolved in water and are less than 2 µm in size. These materials, both natural and anthropogenic, are mainly inorganic solids, with minor amounts of organic material. Depending on the types of water, TDS can vary greatly from few mg/l to percents (tens of hundreds of mg/l). The principal application of TDS is in the study of water quality for streams, rivers and lakes, although TDS is generally considered not as a primary pollutant, but it is rather used as an indication of aesthetic characteristics of drinking water and as an aggregate indicator of presence of a broad array of chemical contaminants.

Primary sources for TDS in waters are agricultural runoff, leaching of soil contamination and point source water pollution discharge from industrial or sewage treatment plants. More exotic and harmful elements of TDS are pesticides arising from surface run off. Certain naturally occurring total dissolved solids arise from the weathering and dissolution of rocks and soils. Elevated TDS has been due to natural environmental features such as, mineral springs, carbonate deposits, salts deposits, and sea water intrusion, but other sources may include, salts used for road de-icing, anti-skid materials, drinking water treatment chemicals, storm water and agricultural runoff, and point/non-point wastewater discharges. The most common chemical constituents are calcium, phosphates, nitrates, sodium, potassium and chlorides.

The present study indicates high concentration of dissolved solids throughout the study period ranging from 340 to 990 mg/l (Table No. 6).However, the highest permissible limit according to ICMR and WHO is 500 mg/l. During the present study, high dissolved solids were noted almost throughout the year. The open wells and the direct run off from the surface might be some of the reasons.

Table No. 6: Quarterly values of Total Dissolved Solids mg/l at 6 Sampling Stations from June 2011 to Dec. 2012

Site / Month	Warvathane (S1)	Bhatsai (S2)	Ainghar (S3)	Bangalwadi (S4)	Kansai (S5)	Shenvai (S6)
Jun-11	440	490	400	650	750	750
Sept-11	470	410	600	640	500	860
Dec-11	340	730	690	580	650	520
Mar-12	600	600	660	550	700	640
Jun-12	370	800	550	550	990	610
Sept-12	500	710	690	560	510	700
Dec-12	370	640	840	580	560	770
Max.	**600.00**	**800.00**	**840.00**	**650.00**	**990.00**	**860.00**
Min.	340.00	410.00	400.00	550.00	500.00	520.00
Average	441.43	625.71	632.86	587.14	665.71	692.86

Turbidity

Turbidity is caused due to the scattering of light by suspended and colloidal particles present in the water. Turbidity is correlated with number of particles present rather than the weight of suspended particles. In natural waters, it is caused by the presence of clay, slit, organic matter, algae, zooplankton and other microorganisms. It is an expression of certain light scattering and light absorbing properties of water (Kataria et al., 2006).

High water turbidity is undesirable from aesthetic point of view. The colloidal matter present in the river imparts turbidity to water on account of pollution from organic matter, through sewage discharge, industrial waste and presence of large number of microorganisms.

The turbidity associated with soil erosion during rainy season is usually temporary and once such matter settles down, the water quality improves. However turbidity caused by sewage and industrial waste is much more harmful as it has many microorganisms and other chemicals that take longer period to settle down. When such water used by human beings or other animals, it has direct impact on their health.

The present study indicates that the turbidity ranged from 1.6 to 7 NTU (Table No. 7).The increased turbidity in water may be correlated with anthropogenic activities like washing clothes and vehicles near the water body which drains the water again to the well.

Table No. 7: Quarterly values of Turbidity NTU at 6 Sampling Stations from June 2011 to Dec. 2012

Site / Month	Warvathane (S1)	Bhatsai (S2)	Ainghar (S3)	Bangalwadi (S4)	Kansai (S5)	Shenvai (S6)
Jun-11	2	3.7	4.4	3.6	2.8	3.5
Sept-11	2.7	5.7	7	3.7	3.4	3.2
Dec-11	1.6	4.9	1.6	3.9	2.2	4.2
Mar-12	4.6	1.7	3.0	3.7	3.5	2.9
Jun-12	7	6	2.6	3.5	4.2	2.8
Sept-12	4.6	4.2	4.8	3.4	2.9	3.2
Dec-12	4.5	2.6	3.5	3	2	4
Max.	**7**	**6**	**7**	**3.9**	**4.2**	**4.2**
Min.	1.6	1.7	1.6	3	2	2.8
Average	3.86	4.11	3.84	3.54	3.00	3.40

Conductivity

Conductivity is the measure of conduction of electricity by water. It is a numeric expression of the ability of an aqueous solution to carry an electric current which is the property derived from ions suspended in it. As conductivity is a function of ion concentration, it is used for quick checking of dissolved substances in water. It also reflects the status of inorganic pollution qualitatively and evaluates total dissolved solids and ionized species in water (Almeida et al., 2007). Electrical conductivity of water is useful and easy indicator of its salinity or total salt content (Morisson et al., 2001)

During the present study the minimum conductivity was noted 49 mho cm-1 at Warvathane and maximum conductivity 312 mho cm-1 at Shenvai (Table No. 8).

Table No. 8: Quarterly values of Conductivity (μ mho/cm) at 6 Sampling Stations from June 2011 to Dec. 2012

Site / Month	Warvathane (S1)	Bhatsai (S2)	Ainghar (S3)	Bangalwadi (S4)	Kansai (S5)	Shenvai (S6)
Jun-11	120	89	158	243	124	130
Sept-11	125	95	145	235	160	125
Dec-11	49	165	145	126	251	162
Mar-12	51	117	265	132	210	254
Jun-12	110	236	208	281	97	230
Sept-12	125	120	200	200	154	312
Dec-12	130	210	156	192	147	217
Max.	**130**	**236**	**265**	**281**	**251**	**312**
Min.	49	89	145	126	97	125
Average	101.43	147.43	182.43	201.29	163.29	204.29

Dissolved Oxygen

Dissolved Oxygen is one of the most important parameters in aquatic systems. It is considered as water quality indicator (Manna and Das, 2004; Ghavzan et al.2005; Koshy, 2005; Mathur and Maheshwari, 2005). Dissolved Oxygen (DO) refers to the volume of oxygen that is dissolved in water. The atmosphere is an only major source of dissolved oxygen in river water. Waves and tumbling water mix atmospheric oxygen with river water. Oxygen is also produced by rooted aquatic plants and algae as a product of photosynthesis. The amount of oxygen that can be held by the water depends on the water temperature, salinity and pressure. Usually cold water holds more oxygen than warm water (Tiwary et al., 2005; Bhalla et al., 2007; Cerqueiria et al., 2007; Prakash et al., 2007; Kennedy and Whalen, 2008). It is also affected by water flow as stagnant water has less oxygen because of less internal mixing. Natural stream purification processes require adequate oxygen levels in order to provide for aerobic life forms. This gas is an absolute requirement for the metabolism of aerobic organisms and also influences inorganic chemical reactions. Therefore, knowledge of the solubility and dynamics of oxygen distribution is essential to interpret both biological and chemical processes within water bodies. (Jadhavar et al., 2010)

Decrease in dissolved oxygen is an index of increased organic pollution which is mainly due to the addition of waste through point and non-point sources from its catchment area. These organic matters undergo degradation by microbial activity in the presence of dissolved oxygen resulting in deoxygenating process and swift depletion of dissolved oxygen. The inflow of domestic sewage is one of the major point sources as reported by Maity et al., (2004); Ghavzan et al., (2005); Shah et al., (2005).

The present study reveals that the dissolved oxygen in the water body was neither too high nor too low which is the indication of good water quality. It ranged between 4.9 to 7.8 mg/l (Table No. 9). Though it was low occasionally, the average values where satisfying.

Table No. 9: Quarterly values of Dissolved Oxygen mg/l at 6 Sampling Stations fromJune 2011 to Dec. 2012

Site / Month	Warvathane (S1)	Bhatsai (S2)	Ainghar (S3)	Bangalwadi (S4)	Kansai (S5)	Shenvai(S6)
Jun-11	5.1	6.3	6.9	7.2	6.9	7.2
Sept-11	7.2	6.2	6.3	7.8	5.9	7.0
Dec-11	5.1	6.5	5.9	7.4	6.9	6.5
Mar-12	6.3	7	6.5	6.9	6.4	6.0
Jun-12	6.4	7.2	5.8	6.9	6.5	6.6
Sept-12	4.9	6.9	6.3	7	6.3	5.9
Dec-12	5.9	6.2	6.3	7.2	6.4	7.2
Max.	**7.2**	**7.2**	**6.9**	**7.8**	**6.9**	**7.2**
Min.	4.9	6.2	5.8	6.9	5.9	5.9
Average	5.84	6.61	6.29	7.20	6.47	6.63

Table No. 10: Standards of various physico-chemical parameters

S. No.	Parameters	USPH Standards	ISI Standards	WHO Standards	BIS Standards
1	pH	6.0-8.5	6.0-9.0	-	-
2	Conductivity	300µmhocm-1	-	-	-
3	Turbidity	<5NTU	-	-	-
4	TDS	500mg/lit	-	-	-
5	Free CO_2	-	-	-	-
6	Alkalinity	-	200 mg/lit	-	-
7	Total Hardness	-	300 mg/lit	-	-
8	Calcium	0.05	100-500 mg/lit	150 mg/lit	-
9	Magnesium	< 10 mg/lit	30-50 mg/lit	150 mg/lit	-
10	Chlorides	250 mg/lit	600 mg/lit	500 mg/lit	600 mg/lit
11	Sulphates	< 0.3 mg/lit	-	200-400 mg/lit	1000 mg/lit
12	Iron	< 0.3 mg/lit	0.3 mg/lit	0.1-1.0 mg/lit	-
13	DO	4-6 ppm	3.0 ppm	-	-
14	COD	4.0 ppm	10.0 ppm	-	-

Conclusion

The water was slightly acidic to alkaline but within permissible limit. Total solids were very high at some sites. Turbidity and conductivity were also high due to excess dissolved and suspended solid. Dissolved solids, Dissolved oxygen, Biological oxygen dissolved were within permissible limits.

Hence application of water quality techniques for the overall assessment of the water body could be useful tools. The awareness must be created in the villagers about safe drinking water. The villagers should be made aware of basic water treatments to improve water quality. Finally safe drinking water must be made available for the villagers.

References

1. Akuskar, S.K. amd A.V. Gaikwad (2006) Physico- chemical analysis of Manjara dam back water of Manjar river Dhanegaon, Maharashtra, India. Eco. Env. And Cons. 12(1),pp:73-74.
2. Almeida, G; Gagne, S.,Hernander, R.(2007) A NMR study of water distribution in hardwood at several equilibrium moisture contents. Wood Sci. Technol. 41(4), pp: 293-207.
3. APHA: (1990) Standard Methods for the examination of water and waste water, 15th edition. APHA, New York, USA.
4. Bhalla, R., V.S. Lomte and M.B. Mule (2007) Investigation of physico-chemical parameters of Godavari river in Nashik city, Maharashtra. Poll Res.,26(3), pp: 495-498.
5. BIS IS 10500 (1991), standard parameters given by Government of India.
6. BIS IS 13428 (2005), Standard parameters of drinking water given by Government of India.
7. Cerqueira, M.A; J.F. Silva; F.P. Magalhaes; F.M. Soares and J.J. Pato (2007) Assessment of water quality in the Antua river basin (Noethwester)
8. Chatterjee,Chinmoy and M.Raziuddin (2003) Assessment of physico-chemical and microbial status of river Nunia in relation to its impact of Public health. Journal of Environment and Pollution,8(3), pp:267-270.
9. Ghavzan , Naser Jafaro, V.R. Gunale and B. R. Pisal (2005). Water pollution monitoring of Mula and Pavana rivers from Pune (India) urbal area. Asian Jr. of Microbiol. Biotech, Env.Sc, 7(4), pp:785-790.
10. Jadhavar V.R.,Ghorade I.B.and Patil S.S. (2010).Assessment of Groundwater Quality in and around of Nagothane Dist.Raigad,Maharashtra.,J.Aqua.Biol.25(2) pp:91-99.
11. Kataria, H.C., Arun Singh and S. C. Pandey (2006) Studies on water quality of Dahod dam, India. Poll. Res.25 (3), pp: 553-556.
12. Kennedy, J.T. and S.C. Whalen (2008). Seasonality and controls of phytoplankton productivity in the middle Cape Fear River, USA.. Hydrobiologia,598,pp:203-217
13. Kodarkar M.S. (1992) Methodology for water analysis. Physico-chemical, biological and microbiological. I.A.A.B. Publication. Hyderabad Publication 2. pp:50.
14. Koshy Mathew (2005) A comparative study of the lotic and lentic systems of Mavelikara Taluk in Kerala. Poll Res.,24(4), pp:809-814.
15. Manna, R.K. and A.K. Das (2004) Impact of the river Moosi on river Krishna I. Limnochemistry. Poll Res.,23(1),117-124.
16. Mathur, S.P. and N. Maheshwari (2005) Physico-chemical aspect of pollution in Chambal river. Indian J. Enviornmental Protection,25(10) pp:933-937.
17. Morrison, G., O. S. Fotoki, L. Persson and A. Ekber (2001) Assessment of the impact of point source pollution from the Keiskamma river- pH, electric conductivity, oxygen demanding substance (COD) and nutrients. Water SA, 27, pp: 475-480.
18. Parker, F.L. and P.A. Krenkel (1969) Engineering aspects of thermal pollution. Vanderbill Univ. Press, Nashiville, Tennessee.
19. Pawar, S. K. and J. S. Pulle (2005) Studies on physico-chemical parameters in Pethwadaj dam, Nanded district in Maharashtra, India. J. Aqua.Biol.
20. Prakash, K.L.; K.Raghavendra and R.K Somashekar (2007) seasonal variation in the water quality of river Cauvery- a study with reverence to point source pollution at Kollegal stretch. Indian J.Environ and Ecoplan., 14(1-2),pp:29-34.
21. Ramdas, Suresh G., K.T. P. Naik and E. T. Puttaiah (2005) Diurnal variation in some physico-chemical characteristic of Tungabhadra river water near Mylara during the Great Sri Mylaralingeshwara fair. Eco. Envn. And Cons, 11(3-4), pp:445-449.
22. Shah, Bhavana A., Ajay V.Shah and Nilesh D.Ahire (2005) Characteristics of Purna rivers water of Navsari and removal of trace metals by ion – exchange process using

preconcentration technique. Poll. Res.24 (2), pp: 415-422.

23. Shaikh, Nisar and S.G. Yeragi (2003) Seasonal temperature changes and their influence of free carbon dioxide, dissolved oxygen and pH in Tansa river of Thane district, Maharashtra, J.Aqua. Bol.,18(1),pp:73-75.
24. Shaikh, Nisar and Yeragi S.G. (2004) Some physico-chemical aspects of Tansa River of Thane district, Maharashtra. J.Aqua. Biol.,98(1),pp:99-102.
25. Tiwary, R. K., G. P. Rajak, Abhishek and M. R. Mondal (2005) Water quality assessment of Ganga river in Bihar region, India. Journal of Environ, Science and ngg.,47(4),pp:326-335.
26. Trivedy, R.K. and Goel, P.K. (1984) Chemical and Biological methods for water pollution studies. Environmental Publ., Karad, India, pp:122.
27. U.S.EPA,1998, Total Suspended Solids Laboratory Method 160.2, cited August 2002:http://www.epa.gov/region09/lab/sop
28. Verma, S. R., Tyagi, A.R. and Dalella, R. C. (1978)Physico- chemical and biological characteristics of Karadabad drain in U.P. Indian J.Environ. Hlth.20 (1),pp:1-13.