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Quality Assessment of Drinking Water Supplied by Municipal Corporation in Dhule City, MS, India

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ABSTRACT: The present study is carried out during the study period Jan 2015 to Nov 2015. It deals with the assessment of water quality in terms of physico-chemical and microbial parameters. The water samples were collected from nine sites of municipal water supply spread across Dhule city of Maharashtra state, India. Data collection based on the questionnaire and laboratory analysis of water samples. Certain physico-chemical parameters like temperature, pH, alkalinity, turbidity, total hardness (TH), total dissolved solids(TDS), dissolved oxygen (DO), chlorides, nitrates, chemical oxygen demand (COD) and biochemical oxygen demand (BOD) etc. The main objective of the study was to determine suitability of the water for human consumption and other domestic uses. The results were compared with the standards prescribed by National and International agencies like World Health Organization (WHO), International Standard Institute (ISI) and Bureau of Indian Standards (BIS). The results reveal that the values of physico-chemical and microbial parameters tested were found to be in the prescribed permissible limit. Thus the drinking water making suitable for human use.

KEYWORDS: WHO, ISI, BSI, Water quality, Physico-chemical parameters, Drinking water.

INTRODUCTION

We are all aware of water thus; there is no need to discuss the importance of water in our life. Water is basic necessity in our life; hence lives cannot survive without water(Khadse et al.,2005). It is being a basic need of human development, health and wellbeing, safe drinking water is an internationally accepted human right (WHO, 2008) which has been enlisted as one of the ten targets in the Millennium Development Goals (MDGs). An adequate supply of safe and potable water assist in preventing the spread of gastrointestinal diseases supports domestic and personal hygiene and improves the standard of living (Ezeribe et al., 2012). Now a day due to increase human population, rapid industrialization and indiscriminate use of chemical fertilizers in agriculture are causing heavy and varied pollution in aquatic environment leading to deterioration of water quality and depletion of aquatic biota. On other hand due to use of contaminated drinking water, the population suffers from a variety of water born disease. In developing countries like India, the drinking water quality is continuously being contaminated and hazardous for human use due to high growth of population, expansion in industries, throwing away of waste water and chemical effluents into canals and other water sources. Secondly increased use of metal based fertilizer in agriculture revolution of the government could result in continued rise in concentration of metal pollution in fresh water reservoir due to the water run-off cause's water born diseases which has led to the death of millions of people. High levels of pollutants mainly organic matter in river water cause an increase in biological oxygen demand, chemical oxygen demand, total dissolved solids, total suspended solids and fecal coliform. They make water unsuitable for drinking, irrigation or any other use (Patil et al., 2012). According to recent estimates, the quantity of available water in developing regions of South Asia, Middle East and Africa is decreasing sharply while quality of water is deteriorating rapidly due to fast urbanization, deforestation

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and land degradation etc (Mohsin et al., 2013). It is therefore necessary that the quality of drinking water should be checked at regular time intervals.

Water is elixir of life, it is essential to all known life forms and is required for hydration to sustain health, sanitation needs, as a solvent to wash everyday items, for industrial applications and as a thermal transfer agent, among others. Inadequate water treatment has a significant and divesting impact on public health. About 1.2 billion people, worldwide, lack access to safe drinking water and twice that many lack adequate sanitation. The World Health Organization (WHO, 1996) estimates that 3.4 million people, mostly children, die every year from water-related diseases. The joint monitoring programme for water supply and sanitation, implemented by the World Health Organization (WHO) and UNICEF (2012), reports that 783 million people in the world (11 % of total population) have no access to safe water, 84 % of whom live in rural areas. The increase of fecal pollution in water resources is a problem in developing as well as in under developed countries (Rout and Sharma, 2011).

There are trends in developing countries to use sewage effluent as fertilizer has gained much importance as it is considered a source of organic matter and plant nutrients and serves as good fertilizer. Farmers are mainly interested in general benefits, like increased agriculture production, low cost water source, effective way of effluent disposal, source of nutrients, organic matter etc, but are not well aware of its harmful effects like heavy metal contamination of soils, crops and quality problems related to health. Research has proven that long term use of this sewage effluent for irrigation contaminates soil and crops to such an extent that it becomes toxic to plants and causes deterioration of soil (Adnan et al., 2010; Patole and Patil, 2012). This contains considerable amount of potentially harmful substances may lead to contamination of food chain, as observed that soil and plants contained many toxic metals, that received irrigation water mixed with industrial effluent (Adnan et al., 2010; Asadullah et al., 2013).

Recent UNESCO report indicates that a vast chunk of population in India has no access to safe drinking water and that about 66 million people still rely on unsafe ground water for consumption (Patole and Patil, 2012). Most diseases and deaths occurring globally are directly linked to lack of adequate water, sanitation and unhygienic conditions. Regarding the quality of drinking water, microbiological contamination is a primary concern of developing countries (Ubharhande and Sonawane, 2012). The quality of water is all more important when it comes for human consumption and also in domestic use as it has a precise bearing on human health. Taps running unpurposefully, leaking water supply pipes, using filtered water for gardens and building construction are few instances of inefficient and misuse of water in daily life (Bhalerao, 2012; Reda, 2016). It is a challenge in itself, to provide a potable water quality to growing population with increasing demand for water. As per the available records no scientific study on the water quality has been conducted here so far. The present work has been undertaken to understand the seasonal fluctuations in water quality as well as the quality aspects of water which supplied by Dhule Municipal Corporation(DMC).

II. MATERIALS AND METHODS

Study area

Dhule city is North Western part of Maharashtra State. It is formerly known as West Khandesh and situated between 21⁰10' North Latitude and 75⁰20' East Longitude. The city and its suburbs covering an area of nearly 46.46 Sq. km. The city is situated on the bank of the Panjhra River. The drinking water is supplied to the house hold through pipeline system from three important reservoirs like, Tapi River (Sulwade barrage), Nakane dam and Dedorgaon dam situated at three different sites of city.

To determine physico-chemical and microbial parameters, samples were collected at regular intervals. The water samples were collected from three sampling sites viz. I, II and III from Sulwade (Deopur area- Navrang tank), Dedorgaon (Panchkandil area- Malegaon road tank) and Nakane (Moglai area- Hanuman tekadi tank) pumping stations respectively. Water samples were collected from different locations, and point of collection was about 50-100 meters away from each other. The potable water samples were collected in one litre capacity cleaned polythene bottle and brought to the laboratory in an ice box jar to avoid unusual change in water quality. The sample bottles were labeled with date and sampling source. Prior to the sampling all the bottles are washed and rinsed thoroughly with distilled

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water. All the precautions were taken as given in APHA, AWWA, WPCF (2003) while sample collection and preservation

Immediately after sample collection various physico-chemical and microbial parameters like water temperature and pH were recorded at collection site as well as DO, TDS, BOD, COD, TH, alkalinity, chloride and nitrates etc were measured in laboratory by different methods are shown in table-1A. The analytical methods were followed are described by Manivasakam(2009), NEERI (1981), Trivedi and Goel (1986) and Kodarkar (2006).

III. RESULTS AND DISCUSSION

The statuses of physico- chemical parameters are direct or indirect indices of water quality. Certain limits have been recommended, the values above which required some corrective measures for chemical parameters. The absolute values of different parameters and their correlation enables to classify the chemical composition of water, characterize the level of water pollution and the nature and sources of prevalent pollutants. As shown in Table -1 A and B, the value of physico-chemical and microbial parameters found under permissible limits. The drinking water should be free from taste, odor, turbidity, harmful chemicals and microorganisms. The present study stated that the supplied water is free from fecal coliforms; a clear indication of water quality was supplied to various parts of the city by Dhule Municipal Corporation. Results on various physico-chemical parameters are presented in table-2 as discussed below:

- 1. Temperature:** It is an important abiotic factor, it has effects on certain chemical and biological activities in the organisms inhabiting in aquatic media. It is an important parameter for biological and physiological processes in aquatic organisms. For the growth of organisms it is a vital parameter (Patil et al., 2012). The water temperature is fluctuating between 25^oC to 33^oC in the study period. The maximum temperature (32-33^oC) was recorded in the month of May (summer) and minimum (25^oC) in the month of November (winter). Except in the month of winter season, the atmospheric temperature was found to be higher than the water temperature. The fluctuation in air and water temperature may be due to influence of season and location. High temperature during summer was due to greater heating of water and insolation heat from sun. Onset of monsoon results in fall in temperature of water bodies because clouds act as a barrier in the process of heating (Edimeh et al., 2011; Sabrina et al., 2013). The values reported in this work are within the permissible range recommended by WHO and others. Bhalerao (2012) reported similar results. Bernard and Ayeni (2012) reported that high water temperature enhances the growth of microorganisms and may increase taste, odor, color and corrosion problems.
- 2. pH (Hydrogen ion concentration):** The test for pH of drinking water is carried out to determine whether it is acidic or alkaline in nature. Like temperature, the role of pH is very important in the growth of flora and fauna of the aquatic ecosystem. Thus, the estimation of pH has most importance because most of the chemical and biological reactions depend on pH value of water (Ezeribe et al., 2012; Reda, 2016). It is the most significant parameter which indicates the pollution of the water body. The factor that affects pH is photosynthesis, exposure to domestic sewage, disposal of industrial wastes etc. In the present study the pH value ranges from 6.6 to 7.2. The pH range of such type was recorded in the study so the pH of water is suitable for drinking purpose. Although pH usually has no direct impact on consumers, it is one of the most important operational water quality parameters (Bernard and Ayeni, 2012). The higher pH values observed suggest that carbon dioxide, carbonate-bicarbonate equilibrium is highly affected (Patil et al., 2012). In present study, the pH values lie around neutral (pH- 7). This pH fluctuation depends on changes in air temperature that brings influence in biochemical and chemical reactions (Bhalerao, 2012). It is noticed that water with low pH tends to be toxic and with high degree of pH, it is turned into bitter taste (Mohsin et al., 2013). Extreme pH (pH > 11) results in irritation in eyes, skin and mucous membrane and also cause hair fibres to swell (Asadullah et al., 2013). Our results show that all the water samples were within permissible limit.
- 3. Turbidity:** Turbidity in drinking water is due to presence of inorganic particulate matter in suspended state (Ezeribe et al., 2012). High turbidity can protect microbes from the effect of disinfection thereby can stimulate

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bacterial growth (Bernard and Ayeni, 2012). It is one of the foremost parameter for the acceptability of drinking water quality. As per WHO, ISI and BIS guidelines for turbidity are < 5 NTU. The observed values in studied samples for turbidity were varied from 0.28 to 0.98 NTU. On the ground of turbidity all samples were found within the permissible limits.

4. **Total dissolved solids (TDS):** The higher concentrations of TDS show an unusual taste of water and reduce its portability. The TDS is also very significant parameter for drinking water and water to be used for other purposes (Reda, 2016). In the present study the range of TDS of analyzed sample varied between 56 to 116 mg/ L as shown in table -2. Our observations are in link with the earlier findings of Gonai et al (2010), Asadullah et al (2013). The TDS of water is mainly due to presence of carbonates, calcium, chloride, phosphates and other ions. Increased TDS related to increase in the load of soluble salts, mud, nutrients and other particles (Mohsin et al., 2013). The TDS proportionally increased the electrical conductance in water and ran parallel to each other. All the values of TDS were within the standard limit of WHO and BIS (500 mg/L). Therefore the water is safe for drinking in terms of TDS.
5. **Dissolved oxygen (DO):** The dissolved oxygen in water plays significant role in limnology. It regulates many of the metabolic processes of aquatic organisms. It also indicates the ability of water that support the sustainability of biological life is due to diffusion of oxygen from atmosphere, photosynthetic evolution by aquatic plants. DO is one of the most important parameter. Its correlation with water body gives direct and indirect information e.g. bacterial activity, photosynthesis, availability of nutrients, stratification etc (Premlata, 2009). In the progress of summer, dissolved oxygen decreased due to increase in temperature and also due to increased microbial activity (Kataria et al., 1996). The high DO in summer is due to increase in temperature and duration of bright sunlight has influence on the % of soluble gases. During summer the long days and intense sunlight seem to accelerate photosynthesis by phytoplankton, utilizing CO₂ and giving off oxygen. This possibly accounts for the greater qualities of O₂ recorded during summer (Patil et al., 2012). In present work higher (6 to 6.4 mg/ L) and lower (4.6 to 4.9 mg/ L) values of DO were observed during the month of May and November respectively. This variation in DO could be due to differences in organic matter that remains as residue in water (Edimeh et al., 2011; Patole and Patil, 2012). These results corroborated with earlier workers viz., Bhalerao (2012) and Ezeribe et al (2012).
6. **BOD:** BOD has been used as a measure of the amount of organic materials contamination in water, specified in mg/L. It indicates the strength of polluted waters, sewage, effluents and provides data on pollution load in natural waters. The increase in values of BOD indicates a higher consumption of oxygen and a higher pollution load. Thus it is used as measure of the amount of organic material in an aquatic solution which supports the growth of micro-organisms. In general BOD gives a quantitative index of organic substance, which is degraded rapidly. The high BOD created due to oxidation of organic waste by natural micro-organisms. The observed BOD level in present investigation is ranging from 13 to 20 mg/ L and it is below permissible limit of ISI. Similar results were reported by Patil et al., (2012).
7. **COD:** COD is another measure of organic material contamination in water and specified in mg/ L. It indicates the amount of oxygen required for chemical oxidation of organic matter using a strong chemical oxidant like Potassium dichromate under reflux conditions. The high COD values indicate the presence of chemically oxidizable carbonaceous matter as well as inorganic matter such as sulphides, nitrates and reduced metal ions (Patil et al., 2012). In present report the amount of COD were found to be within permissible limit prescribed by WHO and BIS.
8. **Alkalinity:** The alkalinity is also the most important parameter in which the measurement of the ability of water to resist the acidification for instance, to acid rain alkalinity of water is measure of its capacity to neutralize acids. The high alkalinity values are indicators of the eutrophic nature of the water bodies. Seasonal analysis shows that the higher value in summer months followed by winter and fall in monsoon months. Similar results were reported

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that alkalinity was maximum in summer due to high photosynthetic activity (Hujare, 2008; Bernard and Ayeni, 2012; Reda, 2016). The alkalinity of water may be caused by dissolving strong bases such as Sodium or potassium hydroxide ions (Bernard and Ayeni, 2012). Moderate concentration of alkalinity is desirable in most water supplies to stable the corrosive effect of acidity (Mohsin et al., 2013). The desirable limit according to WHO and BIS is 200 to 600 mg/L. The water of samples varied from 44.00mg/L to 86.00 mg/L. So the alkalinity content in all sampling sites has been found within the desirable limit. The alkalinity is itself are not harmful to the human being. However the taste of water is bitter when there is in large quantities alkalinity.

9. **Total hardness:** The hardness of water is due to presence salts of Ca^{+2} , Mg^{+2} and other heavy metals ions like Al^{+3} , Fe^{+3} and Mn^{+2} which are dissolved in the water (Raut and Sharma, 2011). In the natural water it is a common constituent due to the concentration of salts. The main sources of these ions are sedimentary rocks, seepage and run off from solid (Patole and Patil, 2012). Hard water is characterized with high mineral contents that are usually not harmful for humans (Asadullah et al., 2013). The water is soft which has the hardness below 50 mg/L. On the other hands, the water is to be objectionable for the domestic purpose if the hardness is found more than 150mg/L (Mohsin et al., 2013). Depending on the interaction of other factors, such as pH and alkalinity, water with hardness above approximately 200 mg/L may cause scale deposition in the treatment works, distribution system and pipe work and tanks within buildings. Soft water with hardness below 100 mg/L may have a low buffering capacity and so be more corrosive for water pipes (Bernard and Ayeni, 2012). Maximum permissible limit of total hardness is 500 mg/L prescribed by WHO and others. The values of hardness were recorded between 34.0 to 68.0mg/L in the present study and fall below WHO and BIS standards of drinking water which is soft in nature. These results clear that hardness of water is according to the WHO (2008) standards and it is not harmful for human consumption.
10. **Nitrates:** Nitrates can reach both surface water and ground water as a consequence of agricultural activity i.e. excess use of inorganic nitrogenous fertilizers and manures as well as nitrogen cycle and industrial waste (Bernard and Ayeni, 2012). Some ground water may also have nitrate contamination as a consequence of leaching from natural vegetation but most of unpolluted sources of water are deficient of nitrates because it exists only in few natural sources (Trivedi and Goel, 1986). Presence of nitrates in water indicates the presence of fully oxidized organic matter. Nitrate is one of the important disease causing parameter of water quality particularly excess level can cause Methemoglobinemia as blue baby syndrome in infants (Ezeribe et al., 2012; Mohsin et al., 2013). The WHO allows maximum permissible limit of nitrate in drinking water is 20 mg/L. In study areas, results clear that the concentration of nitrates ranges from 11.0 to 18.0 mg/L. These results indicate that the quality of water is acceptable which was bellowingthe WHO and BSI standards of drinking water permissible limit.
11. **Chlorides**The chlorides are the moststable component in water and its concentration is highly unaffected by most physico-chemical and biochemical processes. Hence value of chloride concentration in water is a useful measure in water sample (Ezeribe et al., 2012). The main source of chlorides in fresh water is the discharge of domestic and industrial sewage. The concentration of chlorides is thus the indicator of pollution (Venkateswara, 2011). Chloride may increase due base exchange phenomena, high temperature, domestic effluents, septic tanks and low rainfall (Reda, 2016). The surface water bodies often have low concentration of chlorides as compare to ground water. It has key importance for metabolism activity in human body and other main physiological processes (Mohsin et al., 2013). The maximum permissible limit of chloride in potable water is 250 mg/L. It produces salty taste at 250 to 500 mg/L (Trivedi and Goel, 1986). In analyzed water samples, the concentration of chloride varies from 74 to 148 mg/ L. The chloride content of the water sample when compared with WHO, ISI and BIS standards then it was found that all samples showed concentration within the permissible limit. The values of chloride content were found to be almost negligible in the water samples. This may be due to absence of any polluting industry in nearby areas.

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IV.CONCLUSION

In present study quality assessment of the physico-chemical parameters of drinking water from nine sites at different (supplied from 3 dams) location in Dhule city was carried out. To assess the quality of drinking water each parameter was compared with the standard desirable limits prescribed by World Health Organization (WHO), Indian Standard Institute (ISI) and Bureau of Indian Standard (BIS). From the study it can be concluded that drinking water supplied by DMC is safe for drinking purposes from the point of view of levels of pH, turbidity, TDS, DO, BOD, COD, alkalinity, TH, nitrates and chlorides. It was also observed that alkalinity, dissolved oxygen and temperature etc are higher in summer season and lower in winter season. This may due to higher photosynthetic rate in summer season. Whereas the pH value is higher in winter season and lower in summer season. It indicates reduction in photosynthetic activities in winter which reduces assimilation of CO_2 and HCO_3^- .

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Table-1: Water quality parameters with their analytical techniques and standard permissible limit.

Parameters	Techniques used	* Standard permissible limit		
		WHO	ISI	BSI
Temperature (⁰ C)	Thermometer	--	--	--
pH	pH meter	7.0 – 8.5	7.0 – 8.5	6.0 – 8.5
Turbidity (NTU)	Turbido meter	5.0	10.0	10.0
Total dissolved solid (ppm)	Evaporation method	500	5000-1000	300
Dissolved Oxygen (mg/ L)	Winkler’s method	4.0	3.0-7.0	4 - 6
Biological Oxygen Demand(mg/ L)	Incubation followed by titration	6.0	30.0	--
Chemical Oxygen Demand (mg/ L)	C.O.D. digester	10.0	--	40.0
Alkalinity (mg/ L)	Acid-base titration	200 - 600	200	200 - 600
Total Hardness (mg/ L)	EDTA- titration method	200	300	200
Nitrates (mg/ L)	UV visible spectrophotometer	10-20	10-20	10-30
Chlorides (mg/ L)	Mohr’s method	200	200	250

Sources: WHO (2008); ISI (2003); BSI (1991).

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Table -2: Physico-chemical parameters of drinking water samples from Dhule city.

Month	Sample location sites *	Physical parameters				Chemical parameters (mg/ L)						
		Temp (°C)	pH	Turbidity (NTU)	TDS (ppm)	DO	BOD	COD	Alkalinity	Total Hardness	Nitrates	Chlorides
Jan-2015	Site- I	26.0 ± 0.4	7.0 ± 0.2	0.36 ± 0.4	116 ± 8.0	5.6 ± 0.1	20.1 ± 0.6	23.2 ± 0.2	62.0 ± 4.0	45.0 ± 1.0	16.32 ± 1.2	146 ± 4.0
	Site-II	26.5 ± 0.4	6.6 ± 0.1	0.44 ± 0.2	108 ± 4.0	5.0 ± 0.2	17.3 ± 0.3	25.0 ± 0.1	64.0 ± 2.0	48.0 ± 1.0	14.12 ± 1.0	110 ± 2.0
	Site-III	28.1 ± 0.2	7.1 ± 0.2	0.28 ± 0.4	104 ± 6.0	5.1 ± 0.3	19.1 ± 0.2	24.0 ± 0.2	64.0 ± 4.0	46.0 ± 2.0	15.22 ± 1.4	78 ± 6.0
Mar-2015	Site- I	27.2 ± 0.3	7.2 ± 0.1	0.88 ± 0.4	112 ± 2.0	5.8 ± 0.6	19.3 ± 0.2	28.1 ± 0.1	84.0 ± 3.0	56.0 ± 2.0	15.35 ± 1.1	142 ± 10.0
	Site-II	28.0 ± 0.4	7.0 ± 0.2	0.68 ± 0.6	64 ± 2.0	6.0 ± 0.8	18.1 ± 0.8	27.1 ± 0.2	74.0 ± 3.0	48.0 ± 3.0	16.24 ± 0.8	110 ± 8.0
	Site-III	30.0 ± 0.1	7.1 ± 0.2	0.48 ± 0.4	70 ± 2.0	6.1 ± 0.8	17.1 ± 0.1	27.1 ± 0.2	66.0 ± 2.0	34.2 ± 3.0	12.32 ± 1.2	80 ± 6.0
May-2015	Site- I	32.1 ± 0.2	7.1 ± 0.2	0.56 ± 0.4	68 ± 2.0	6.3 ± 0.4	18.3 ± 0.4	32.0 ± 0.2	86.0 ± 4.0	45.0 ± 2.0	16.80 ± 0.4	148 ± 4.0
	Site-II	33.0 ± 0.4	7.0 ± 0.1	0.34 ± 0.6	58 ± 1.0	6.0 ± 0.4	17.2 ± 0.2	30.0 ± 0.3	68.0 ± 2.0	38.0 ± 3.0	14.72 ± 0.8	108 ± 6.0
	Site-III	33.0 ± 0.4	6.9 ± 0.1	0.46 ± 0.2	56 ± 2.0	6.4 ± 0.3	19.1 ± 0.2	27.0 ± 0.1	78.0 ± 4.0	44.0 ± 1.0	16.30 ± 1.0	86 ± 8.0
July-2015	Site- I	29.1 ± 0.2	6.9 ± 0.2	0.86 ± 0.4	78 ± 2.0	5.9 ± 0.4	16.2 ± 0.3	31.3 ± 0.2	46.0 ± 2.0	68.0 ± 1.0	12.18 ± 1.1	110 ± 3.0
	Site-II	29.0 ± 0.2	7.0 ± 0.1	0.98 ± 0.2	86 ± 4.0	5.4 ± 0.2	14.3 ± 0.4	30.1 ± 0.4	48.0 ± 2.0	68.0 ± 1.0	12.20 ± 0.6	96 ± 6.0
	Site-III	28.4 ± 0.4	7.1 ± 0.1	0.68 ± 0.4	72 ± 2.0	5.8 ± 0.2	14.1 ± 0.2	27.3 ± 0.3	56.0 ± 3.0	56.0 ± 2.0	11.32 ± 0.8	74 ± 4.0
Sep-2015	Site- I	29.1 ± 0.3	6.9 ± 0.2	0.56 ± 0.4	68 ± 2.0	6.1 ± 0.2	13.1 ± 0.3	30.3 ± 0.2	68.0 ± 2.0	68.0 ± 3.0	18.00 ± 1.4	148 ± 2.0
	Site-II	28.5 ± 0.3	7.0 ± 0.2	0.48 ± 0.6	74 ± 1.0	5.8 ± 0.3	14.3 ± 0.3	30.0 ± 0.4	64.0 ± 3.0	46.0 ± 2.0	14.68 ± 1.2	98 ± 4.0
	Site-III	27.1 ± 0.4	7.0 ± 0.1	0.64 ± 0.2	76 ± 2.0	5.3 ± 0.2	17.1 ± 0.4	32.3 ± 0.3	62.0 ± 2.0	48.0 ± 3.0	11.24 ± 1.1	76 ± 6.0
Nov-2015	Site- I	25.5 ± 0.2	7.2 ± 0.2	0.36 ± 0.4	78 ± 3.0	4.9 ± 0.2	19.3 ± 0.4	27.3 ± 0.3	60.0 ± 4.0	48.0 ± 2.0	16.18 ± 0.8	102 ± 2.0
	Site-II	25.0 ± 0.2	7.2 ± 0.1	0.58 ± 0.4	74 ± 4.0	4.6 ± 0.1	18.0 ± 0.2	27.0 ± 0.2	64.0 ± 4.0	66.0 ± 1.0	16.20 ± 0.8	74 ± 4.0
	Site-III	25.0 ± 0.1	7.1 ± 0.1	0.56 ± 0.4	68 ± 2.0	4.8 ± 0.3	18.3 ± 0.2	26.3 ± 0.4	44.0 ± 2.0	58.0 ± 2.0	14.52 ± 0.6	68 ± 3.0

* Sample collection sites: Site- I: Sulwade (Navrang tank); Site-II: Dedoragaon (Malegaon road tank); Site-III: Nakana (Hanuman tekadi).