Assessment of Water Quality Variables from Peerwadi Well of Uran Beach, Dist. – Raigad, Navi Mumbai

Rauphunnisa F. Inamdar	Veer Wajekar Arts, Science & Commerce College, Mahalan Vibhag, Phunde, Tal. – Uran, Dist. – Raigad, Navi Mumbai
Prabhakar R. Pawar	Veer Wajekar Arts, Science & Commerce College, Mahalan Vibhag, Phunde, Tal. – Uran, Dist. – Raigad, Navi Mumbai. Corresponding author

ABSTRACT   *Physico-chemical characteristics of water are of vital concern to human as it is directly related to human health. Water quality is an important criterion used for evaluating the suitability of water for drinking, irrigation and recreation. During present investigation, water quality variables of ground water were assessed from Peerwadi open well of Uran Beach, Dist – Raigad, Navi Mumbai from October 2010 to August 2013. Various physico-chemical parameters assessed includes pH, Temperature, Total solids (TS), Total dissolved solids (TDS), Total suspended solids (TSS), Conductance, Dissolved oxygen (DO), Biochemical oxygen demand (BOD), Carbon dioxide (CO2), Chemical oxygen demand (COD), Salinity, Chloride, Alkalinity, Total hardness, Calcium hardness and Magnesium hardness. This study reveals that except the high values of chlorides and salinity, values of other physico-chemical variables are within the guideline values of WHO Standard for potable water. The quality of water from Peerwadi open well of Uran Beach was found to be safe and utilizable for drinking and other purposes.*

Introduction:

Ground water is considered as one of the purest forms of water available in nature and meets the overall demand of rural as well as urban population. With the growth of industry the ground water is made susceptible for contamination due to addition of waste materials. Waste materials from the factories percolate with rain water and reach aquifer resulting in erosion of ground water quality. Groundwater is used for domestic, industrial, water supply and irrigation all over the world (Rao et al., 2013).

Water quality depends on the quality of recharged water, atmospheric precipitation, inland surface water, rock water interaction time, mineral weathering, ion exchange process and sub-surface geochemical processes. The intensive use of natural resources and increased human activities are posing great threat to groundwater quality. Water Quality Index is defined as a technique of rating that provides the composite influence of individual water quality parameters on the overall quality of water for human consumption. It becomes an important parameter for the assessment and management of ground water (Singh et al., 2013).

Fresh water is a finite resource, essential for agriculture, industry and even human existence, without fresh water of adequate quantity and quality, sustainable development will not be possible. The addition of various kinds of pollutants and nutrients through urban sewage, industrial effluents, agricultural runoff etc. into the water bodies brings about a series of changes in the physicochemical quality and its characteristics of water. Fresh water resource is becoming day by day at the foster rate of deterioration of the water quality is now a global problem (Sharma et al., 2013).

Water is one of the most important compounds that profoundly influence life. In the last few decades, there has been a tremendous increase in the demand for fresh water due to rapid growth of population and the accelerated pace of industrialization. According to WHO organization, about 80% of all the diseases in human beings are caused by water. Water quality index is one of the most effective tools to communicate information on the quality of water to the concerned citizens and policy makers. It, thus, becomes an important parameter for the assessment and management of groundwater (Dohare et al., 2014).

Over burden of the population pressure, unplanned urbanization, unrestricted exploration policies and dumping of the polluted water at inappropriate place enhance the infiltration of harmful compounds to the ground water. Contamination of water resources available for household and drinking purposes with heavy metals, metal ions and harmful microorganisms is one of the serious major health problems (Rajappa et al., 2011).

Mumbai, a major metropolis and generates 0.85 millions m3/d of liquid effluent and 14,600 t/d of solid waste, which without any treatment are discharged in the coastal region in and around Mumbai (Zingde, 1999). The coastal environment of Uran (Navi Mumbai) has been under considerable stress since the onset of industries like Oil and Natural Gas Commission (ONGC), Liquid Petroleum Gas Distillation Plant, Grindwell Norton Ltd., Gas Turbine Power Station, Bharat Petroleum Corporation Limited Gas Bottling Plant, Jawaharlal Nehru Port (JNP, an international port), Nhava-Seva International Container Terminal (NSICT), Container Freight Stations (CFS), etc. These activities affect the water quality of coastal region (Pawar, 2013). Although many studies have been undertaken to evaluate the ground water quality in coastal cities in India, no scientific studies have been carried out on ground water quality of Uran, Navi Mumbai; hence, the present study is undertaken.

Study Area:

Geographically, Uran (Lat. 180 50' 5" to 180 50' 20" N and Long. 720 57' 5" to 720 57' 15" E) with the population of 30,439 is located along the eastern shore of Mumbai harbor opposite to Coloba. Uran is bounded by Mumbai harbor to the northwest, Thane creek to the north, Dharamtar creek and Karanja creek to the south, and the Arabian Sea to the west. Uran is included in the planned metropolis of Navi Mumbai and its port, the Jawaharlal Nehru Port (JNPT) (see Fig. 1).

Peerwadi well is located about 210 mt away from the Peerwadi coast of Uran and was built up in 1945. The well is with 20 ft in diameter and 40 ft in depth, of which 25 ft is built up with stones. It has safety wall of about 3.6 ft in height at the surface. It is the only source of freshwater for livelihood of the local community. Well water is lifted by traditional Indian method using rope and bucket or other suitable utensils by nearby population of about 600 people of the Nagaon village, Uran till today. Municipal waste water canal and canal of Oil and Natural Gas Commission (ONGC) are passing from nearby the well.

Many times during the year, local population claims that taste of water from the Peerwadi well of Uran differs from the normal and has repellent odour. Hence during present investigation, water quality variables of Peerwadi well were assessed to investigate impact of anthropogenic inputs on it.
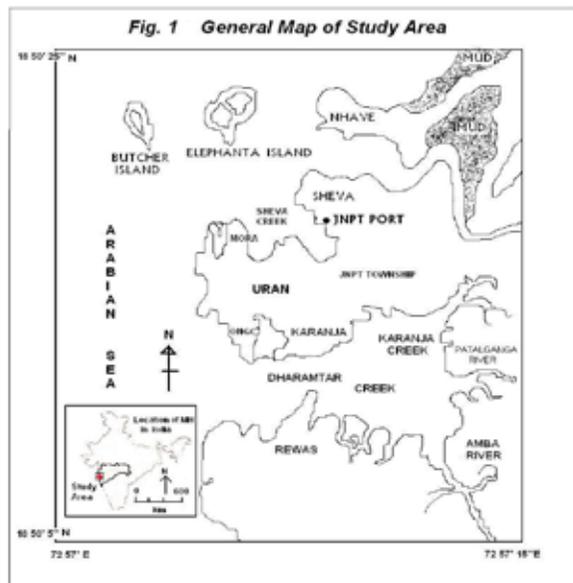

Fig. 1 – General map of study area of Peerwadi well of Uran

Materials & Methods:
The present study was carried out from October 2012 to August 2013. Well water samples were collected monthly in a clean, leak-proof plastic container in triplicate and average value for each variable was reported. Standard methods described by APHA (2005) were followed for assessment of water quality variables.

The pH was measured with an accuracy of ±0.02 pH unit on a battery operated portable Philips pH meter. Temperature of water was measured by using a centigrade thermometer. Total solids (TS) and Total Dissolved solids (TDS) were determined by weighing the residue left after evaporation of 100 ml unfiltered and filtered water samples, respectively. Total suspended solids (TSS) were calculated by subtracting value of TDS from TS. Winkler's Iodometric method was adopted for high precision dissolved oxygen (DO) estimation. Biochemical oxygen demand (BOD) and carbon dioxide (CO_2) were determined by titrimetric method. Chemical oxygen demand (COD) was estimated by open reflux method. Salinity was estimated by argentometric method. Electrical conductivity was determined by conductivity meter (Elico), whereas total hardness was by EDTA titration. Alkalinity was estimated by indicator method. Calcium and Magnesium was determined by complexometric titration with standard solution of EDTA. All colorimetric measurements were done on ERMA INC (AE 11D) colorimeter. Values of water variables obtained during present investigation were compared with standard values of World Health Organization and Indian standard.

Results & Discussion:
pH: During present study, observed pH is in the range of 5.4 to 6.5. Seasonal range of pH is 5.4 to 5.5 during monsoon, 5.9 to 6.4 during winter and 5.9 to 6.5 during summer. Higher pH observed during summer season is attributed to the sewage discharge and also to the decomposition of organic matter by microbes. Similar results were reported by Patil et al. (2012) and Rao et al. (2013) (see Fig. 2). During remaining period of investigation, values of pH are within the prescribed limits.
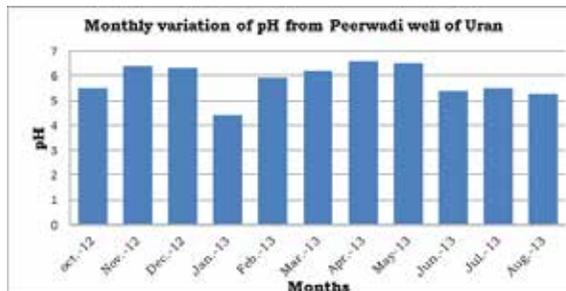

Fig. 2 - Monthly variation of pH from Peerwadi well of Uran

Temperature:
In present study, water temperature varies from 28⁰C to 32⁰C with maximum during summer and minimum during monsoon. High temperature during summer could be attributed to high solar radiation. No major temperature variation is observed in water of Peerwadi well during present study (see Fig. 3) and similar results are reported by Sharma et al. (2013) from ground water of Abhanpur block of Raipur, Chhattisgarh.
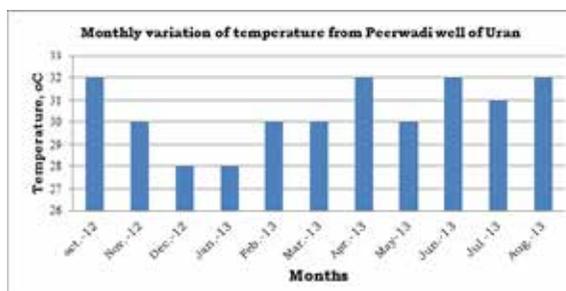

Fig. 3 - Monthly variation of temperature from Peerwadi well of Uran

Total solids (TS):
Total solids reported during present study are in the range of 39.24 to 44.00 mg/l. Seasonal variation of TS is in the range of 39.36 to 44.00 mg/l during monsoon, 39.24 to 39.92 mg/l during winter and 39.36 to 40.6 mg/l during summer (see Fig. 4). Reported values of TS are found to be within the standard limit of WHO.
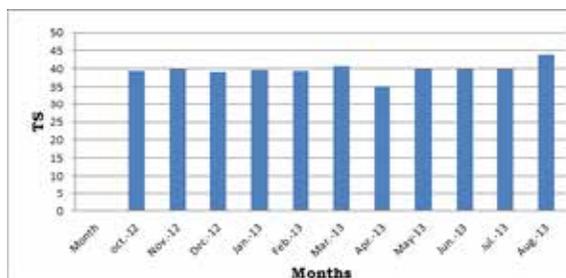

Fig. 4 - Monthly variation of total solids (mg/l) from Peerwadi well of Uran

Total dissolved solids (TDS):
High Level of TDS (40.00 to 50.72 mg/l) is recorded during monsoon and is may be due to the increased turbulence during monsoon and particulate matter normally associated with the surface run off (see Fig. 5).

Fig. 5 - Monthly variation of total dissolved solids from Peerwadi well of Uran

Total suspended solids (TSS):
Higher level of TSS in the range of 14.30 to 15.10 mg/l was recorded during Oct 2012 and Nov 2012 where as lower values were recorded during Dec 2012 i. e. 0.84 mg/l. Low level of TSS observed during remaining period indicates discharge of industrial waste water into cannel (see Fig. 6)..
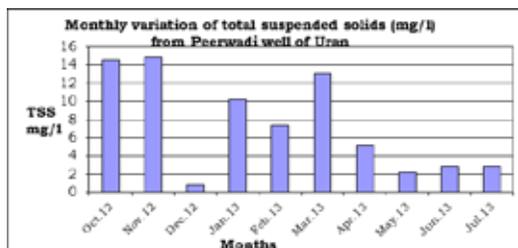

Fig. 6 - Monthly variation of total suspended solids from Peerwadi well of Uran

Conductance:
Electrical conductance of water is the capacity of water to transmit an electric current and is a tool to assess the purity of water. Recorded conductance during present study is 0.042 - 0.05 μmhos/cm in monsoon, 0.03 μmhos/cm in winter and 0.03 μmhos/cm in summer (see Fig. 7).

Fig. 7 - Monthly variation of conductance from Peerwadi well of Uran

Salinity:
No significant variation is observed in salinity in well water of Peerwadi (see Fig. 8) and reported salinity is in the range of 0.1197 to 0.5459 ppt in monsoon, 0.247 to 0.444 ppt in winter and 0.1730 to 0.4524 ppt in summer. Higher salinity in summer is attributed to excessive evaporation and negligible input of fresh water.
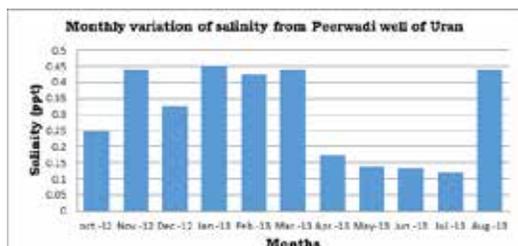

Fig. 8 - Monthly variation of salinity from Peerwadi well of Uran

Dissolved Oxygen (DO): Except Nov 2012 and Jan 2013, DO values recorded during present investigation are present in the range of 2.31 to 4.14 mg/l. Higher DO recorded during Nov 2012 and Jan 2013 were attributable to wind velocity and monsoon influence and also to increase in photosynthetic activity with lower temperature (see Fig. 9). During present study, an inverse relationship between temperature and DO is observed. Similar results were also noted by Usharani et al. (2010) in Noyyal river and ground water quality of Perur, India.
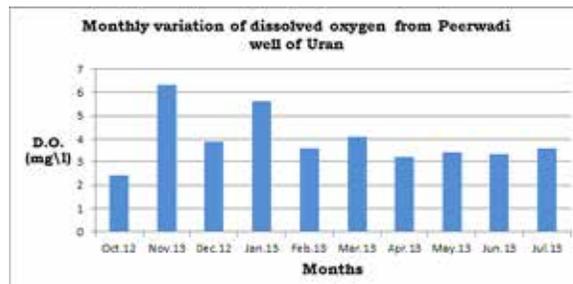

Fig. 9 - Monthly variation of dissolved oxygen from Peerwadi well of Uran

Biochemical Oxygen Demand (BOD): BOD value is lowest in Month of May and is highest in month of January 2013. It is within the permissible limit.

Higher BOD values recorded during Nov 2012 were attributed to the contamination of organic material in the water (Patil et al., 2012) (see Fig. 10).
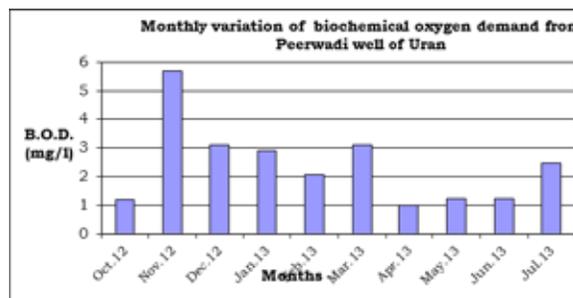

Fig. 10 - Monthly variation of biochemical oxygen demand from Peerwadi well of Uran

Carbon-di-oxide (CO_2): Except the month of Nov 2012, moderate values of CO_2 were recorded during present investigation. High values of free CO_2 recorded during Nov 2012 were attributed to the high rate of decomposition in the warmer months (see Fig. 11). Similar results were also reported by Dohare et al. (2014).
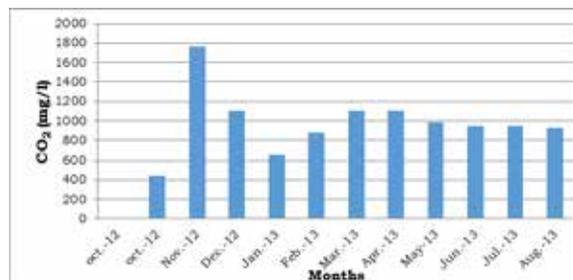

Fig. 11 - Monthly variation of Carbon-di-oxide from Peerwadi well of Uran

Chemical Oxygen Demand (COD): Except the month of Feb 2013 and Jul 203, average values of COD

were recorded during present investigation. High values of free COD recorded during Feb 2013 and Jul 2013 were attributed to contamination of organic material in the water (Patil et al. 2012) (see Fig. 12).
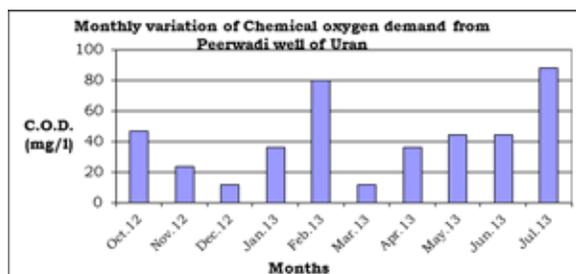

Fig. 12 - Monthly variation of COD from Peerwadi well of Uran

Total Hardness:

Hardness is the property of water to prevent lather formation with soap. It also elevates the boiling point of the water. Total hardness recorded during present investigation is in the range of 132.21 to 293.54 mg/l (see Fig. 13), which lies within desirable limit of hardness of 200 to 600 mg/l (Dohare et al, 2014). Results of total hardness are in agreement with Ramesh et al. (2012) recorded for ground water of Manachanallur block, Trichy, Tamil Nadu, India.
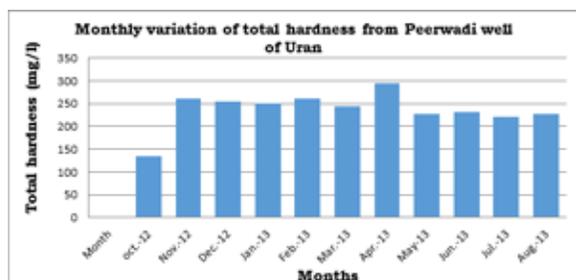

Fig. 13 - Monthly variation of total hardness from Peerwadi well of Uran

Calcium Hardness:

Ca hardness recorded in present study is in the range of 24.08 to 60.92 mg/l and is within the acceptable limits for water for domestic use (Rajappa et al., 2011) (see Fig. 14).
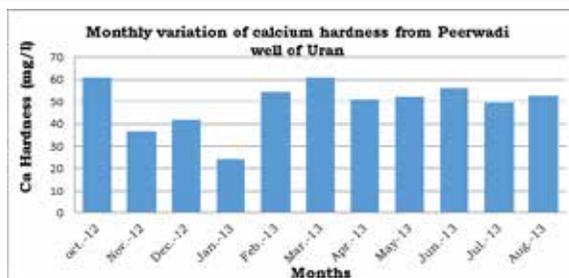

Fig. 14 - Monthly variation of calcium hardness from Peerwadi well of Uran

Mg Hardness:

Recorded values of magnesium hardness in this study are in the range of 0.461 to 0.923 mg/l and are within the acceptable limits for water for domestic use (Rajappa et al., 2011) (see Fig. 15).
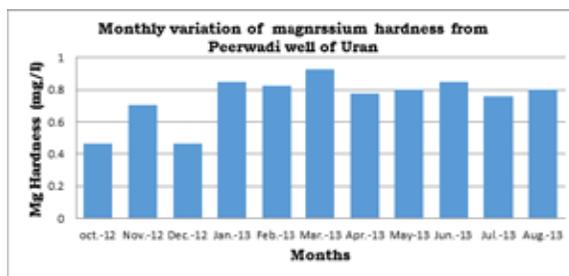

Fig. 15 - Monthly variation of magnesium hardness from Peerwadi well of Uran

Conclusion:

In conclusion it is to be stated that water quality variables of Peerwadi well of Uran are within the desirable limit and permissible limit as per IS: 10500-2012. The water is suitable for the human use and also for the domestic purpose. In future, due to heavy urbanization and industrialization around Uran, care should be taken to maintain the natural quality of this water to sustain the nearby population.

REFERENCE

• APHA. (2005). Standard Methods for the examination of water and wastewater. American Public Health Association. | • B. Rajappa, B., S. Manjappa, E. T. Puttaiah and D. P. Nagarajappa (2011) Physico-chemical analysis of underground water of Harihara Taluk of Davanagere District, Karnataka, India. Advances in Applied Science Research, 2(5): 143-150. | • Dohare Devendra, Shriram Deshpande and Atul Kotiya. (2014). Analysis of Ground Water Quality Parameters: A Review. Research Journal of Engineering Sciences, 3(5): 26-31. | • Patil. P.N, Sawant. D.V, Deshmukh. R.N (2012). Physico-chemical parameters for testing of water – A review. International Journal of Environmental Sciences, 3 (3): 1194 – 1207. | • Pawar, Prabhakar. R. (2013) Monitoring of impact of anthropogenic inputs on water quality of mangrove ecosystem of Uran, Navi Mumbai, west coast of India. Marine Pollution Bulletin, 75, 291–300. http://dx.doi.org/10.1016/j.marpolbul.2013.06.045 | • Ramesh, M., Dharmaraj, E. and Jose Ravindra Raj, B. (2012). Physico- chemical characteristics of ground water of Manachanallur block, Trichy, Tamil Nadu, India. Advances in Applied Science Research, 3: 1709 -1713. | • Rao Janardhana D., Hari Babu B., Swami AVVS. and Sumithra S. (2013). Physico-Chemical Characteristics of Ground Water of Vuyyuru, Part of East Coast of India. Universal Journal of Environmental Research and Technology. 3 (2): 225-232. | • Sharma Pramisha, Amit Dubey and S.K. Chatterjee. (2013). Physico- Chemical Analysis of Surface and Ground Water of Abhanpur Block in Raipur District, Chhattisgarh, INDIA. International Journal of Innovative Technology and Exploring Engineering, 2(5): 71- 74. | • Singh Prasoon Kumar, Ashwani Kumar Tiwari, Binay Prakash Panigary and Mukesh Kumar Mahato. (2013). Water Quality Indices used for Water Resources Vulnerability Assessment using GIS Technique: A Review. International Journal of Earth Sciences & Engineering, 6(01): 1594-1600. | • Usharani K., Umarani K., Ayyasamy P. M. Shanthi K. And Lakshmanaperumalsamy P. (2010). Physico-Chemical And Bacteriological Characteristics Of Noyyal River And Ground Water Quality Of Perur, India. Journal of Applied Sciences and Environment Management. 14 (2): 29 – 35. | • Zingde, M. D. (1999) Marine environmental status and coastal zone management issues in India. South Asia Regional Workshop on Estuarine modelling and Coastal Zone Management. A Joint START/LOICZ/IGBP-SL Workshop, 28th–30th April 1999, Colombo, Sri Lanka. pp. 153-164. |