SURVEY OF WELLS IN RESIDENTIAL AREA OF T WARD OF MUMBAI CITY AS A SUPPLEMENTARY SOURCE OF WATER

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Abstract: Due to rapid urbanization and industrialization, natural resources like water are either overexploited or used insensibly and the alternative resources are totally neglected, thus posing a variety of challenges to the government with regard to meeting the ever increasing demands for the water resources. Thus exploring all the possible alternatives of natural resources to meet the projected demands of this city is necessary. An average requirement of water in Mumbai city is estimated to be 135 lpcd (liters per consumer per day), however, because of water shortage, MCGM (Municipal Corporation of Greater Mumbai) supplies only 90 lpcd which is only 66 % of the average requirement.

Dug up wells & bore wells in Mumbai city are more than 7000 in number. Revival of abandoned wells & replenishing dug up & bore wells by Rain Water Harvesting (RWH) will help in improving quality of groundwater. It is necessary to ensure that the ground water is not contaminated by mixing of sewage / sullage or by other impurities. Survey of wells and its quality and quantitative Physico-Chemical& microbiological analysis was done in 'T' Ward Area of Mumbai city.

Keywords: Alternate water sources, Fecal Contamination, MPN Test, Well Water**.**

Introduction: The present water demand of Mumbai city is 3400 MLD against supply of 2900 MLD. This difference was expected to grow much higher in 2021 when the projected demand of water would be 5400 MLD for a projected population of 15.60 millions [1]. But with the rising population, the city is facing water shortage in many areas. So creating new impoundage and water supply networks, extracting more & more ground water, recycling waste water, desalination in case of coastal areas and water shed development with rain water harvesting are various alternate sources that can be developed to meet the growing water demand [2].

Henceforth M.C.G.M. would grant residential water connections at 90 lpcd i.e. no municipal water for flushing requirement. The properties are expected to generate the flushing water either by RWH or by recycling.

Akola city, in Maharashtra, has faced catastrophic drinking water supply situation during the years 2004 and 2005 [3]. Under the circumstances, the development of groundwater resource was one of the long term strategy suggested to provide a complementary source to meet drinking and other water needs in the region especially in area, where dry summers or extended droughts

Considering the increasing population and new developmental activities in Mumbai, the demand for water is increasing and water resources are getting polluted [4]. This will need to treat the water using various water purification processes. As a result, water is no more a free commodity. In view of this, ground water can serve as important alternate or

supplementary water source; minimize pressure on municipal water supply system. Thus rejuvenation of well in Mumbai city and assessment of quality of well water will help to decide the usability of well water. Water Quality study was done of well water in wells situated in 'T' Ward Area of Mumbai city.

Material and Methods:

Survey selection:

The survey of wells situated in 'T' Ward area of Mumbai city was done with the help of Municipal Corporation staff.Wells from residential area of Mulund East and Mulund West region were selected for study considering type of well and its status.

Measurement: Diameter, Depth of wells selected and Depth of water level from ground in all the wells was measured in winter, Pre Monsoon and Monsoon seasons using the meter tape.

Sample collection: Water samples were collected from 32 wells at selected locations in residential area,during the monsoon, pre-monsoon and post monsoon to ascertain seasonal impacts. The samples were analyzed immediately for the parameters like Turbidity, pH, Dissolved Oxygen, MPN Test for Coliform and E. coli, COD. Other parameters were analyzed within a week time.

MPN Test for checking the water potability: Multiple Tube Technique using Lauryl Tryptose Broth [5].

Elevated Temperature Test [5]:

The positive tubes of MPN Test were further tested for the presence of *Escherchia coli*. One loopful of culture from each positive primary tube was transferred to a fermentation tube containing sterile Brilliant Green Lactose Bile Broth (BGLB) and the tubes were incubated at 44°C for 24 hrs. For elevated temperature test, production of gas within 24 h constitutes a positive confirmatory test for *E.coli*. MPN value for *E.coli* was calculated by referring MacCrady's Tables.

Enrichment and Isolation:

Well water samples were enriched and streaked on Nutrient Agar and MacConkey's agar. The representative isolates obtained, after incubation at 37°C for 24 h. and were further characterized by colonial, morphological and biochemical tests [6].

Results and Discussion:

Survey &Selection: The groundwater quality survey locations were chosen (dug/open wells, bore well etc.) so that they depict the influence of the prevailing anthropogenic activity.(Table 1)

Table: 1 Details of no. of wells chosen for

	Residential	
Wells	Mulund East	Mulund West
Open In Use	9	11
Open not in use	3	4
Bore wells	3	2
Total	15	17

Mulund East Residential Area : MERA 1 to MERA 15

Mulund West Residential Area: MWRA 1 to MWRA 17

The study of value of depths of water column in all seasons indicate that the water level in wells

is well maintained. (Table 2)

It is observed that pH of well water in all areas is higher in pre-monsoon (7.2 to 7.4), which may be due to intrusion of water with more dissolved salts from deeper soil. The pH of water is observed to be acidic in monsoon season (6.8 to 7.1) due to surface water run offs as a result of rain.

pH of all wells are within the permissible limits in all seasons.(Table 3)

Table: 2 Details of well depth and water level

Location	Av Diam. Mtr.	Av Depth Mtr.	Average Water Level Mtr.		
			Winter	Pre-mon	Mon
Mulund East l	4.8	8.5	4.8	4	4.5
Maximum	7.4	9.3	8.5	7	8
Mulund West	4.1	8.2	3.0	3.4	2.8
Maximum	9	11.7	10.4	7.8	7.2

Conductivity values are between 550 to 700 µS/cm, for all samples in all seasons which indicates the higher concentrations of dissolved solids.(Table3)

The hardness and chloride contents in all the wells, are within acceptable range of drinking water standards.(Table 3)

Table 3: Average of Physico – Chemical Parameters tested in well water in three seasons

Parameters	Mulund east		
	Winter	Pre	Monsoon
Turbidity NTU	2.8	2.0	2.0
pH	7.15	7.2	6.9
Conductivity µS/cm	749	754	745
Hardness mg/l	252	363	338
Chlorides mg/l	84	94	115
	Mulund west		
Turbidity NTU	1.4	1.6	1.6
pH	7.15	7.2	7.0
Conductivity	733	823	700
Hardness mg/l	304	401	340
Chlorides mg/l	139	130	89

Bacteriological Examination: The most probable number (MPN) for the presumptive total coliform count of the water samples from well no. MERA 1 to MERA4, in Mulund East Residential area ranges from 600 to 1600 MPN/100 ml in premonsoon season and 200 to 700 in winter season. (Table 4)

However, MPN/100ml for the presumptive total coliform count in monsoon is observed to be low in those wells except MERA 4. It indicates sub-surface leaching of faecal matter from poorly maintained sewer lines, waste water drains and solid waste dumps in close vicinity of these wells. The other well MERA 7 To MERA 9 and MERA 12 to MERA15, which are situated close to each other near railway station are showing MPN/100ml for the presumptive total coliform count 10 to 25. The most probable number (MPN) for the presumptive total coliform count of the water samples from well no. MWRA 1 to MWRA 14, in Mulund West Residential area ranges from 400 to 600 MPN/100 ml in monsoon and winter seasons and 100 to 200 in premonsoon season. Higher MPN values in monsoon and winter suggest localized interflow of recharge water through preferential flow paths or direct ingress through poorly maintained infrastructure. Lower values in premonsoon suggest lesser percentage of sub-surface leaching. However, the well no MWRA 16 and MWRA 17 which are in close vicinity of waste water drain show higher MPN values 900 to 1600 in all three seasons indicate sub-surface leaching of faecal matter from waste water drains and solid waste dumps in close vicinity of these wells and interflow of recharge water. All the wells were found to be contaminated due to presence of *E. coli* indicating sewage seepage in the well waters.

Atotal 112 isolates was obtained in all three seasons .Results presented in Table 5.

Table 4: Results of MPN Tests

MPN/100ml				
Seasons	MERA 1 to MERA4		MERA 7 to MERA15	
Winter	250 to 750	200 to 750	25-250	100-130
Pre-Monsoon	600 to 1600	600 to 900	20-250	15-200
Monsoon	20-550	10-550	10-175	5-130
	MWRA 1to MWRA14		MWRA15to MWRA17	
Winter	100-350	130-250	900	550 to 900
Pre-Monsoon	50-275	175-200	1400to 1700	750 to 1400
Monsoon	250-750	20- 350	1600	1600

Table 5: No. of Isolates obtained in three			
Area	Winter	Premonsoon	Monsoon
MERA	14	33	14
MWRA	11	19	21
Total	25	52	35

In winter, *Shigella* was found in water of 67 % wells in residential area in Mulund East, It was not found in well water in Mulund West residential area. In Premonsoon, *Enterobacter* was found predominantly in Mulund East residential area in 35% wells and 24% wells in Mulund West residential area. *Salmonella* was present in well water in residential area of Mulund

In monsoon, *Shigella* was found in 62 – 65 % wells in Mulund west, *Escherchia* was found in water samples of 12 % wells in residential area of Mulund west. Presence of common enteric pathogens like *Enterobacter, Shigella,* and *Escherchia* was observed in all three seasons with increasing percentage in monsoon season.

The primary source of intestinal pathogens is animal and human wastes. The surface runoffs from land areas where animal wastes are deposited, septic tanks serve as sources by which pathogens enter the well water.

Other bacteria isolated from all water samples such as *Aeromonas* spp., *Acidomonas* spp., *Pseudomonas* spp, *Pimelobacterium* spp., *Flavobaterium* spp., *Staphylococcus* spp. *etc.* were found in well water of wells in residential area in postmonsoom, premonsoon and monsoon season. The primary clinical diseases from *Aeromonas* infections are gastroenteritis and bacterial septicemia. *Aeromonas are predominantly found in premonsoon and monsoon seasons in well water of wells in study area.*

Flavobacteria are a group of commensal bacteria & opportunistic pathogens. It causes the septicemic diseases rainbow trout fry syndrome and bacterial cold water disease and are widely distributed in soil and freshwater habitats.

Well water in Mulund West Residential area was observed to be having *Flavobacterium* in 60 % wells in monsoon season and 20 % wells in Premonsoon season. In winter season no sample showed presence of these bacteria.

Pimelobacter is a grouping of bacteria that is commonly found on human skin and is known to be one of the harmless bacteria that live on us.20 – 30 % wells in residential area showed presence of *Pimelobacter*. *Chromobacterium violaceum* is part of the normal flora of water and soil of tropical and sub-tropical regions of the world. It produces a natural antibiotic called violacein, which may be useful for the treatment of colon and other cancers It grows readily on nutrient agar, producing distinctive smooth low convex colonies with a dark violet metallic sheen (due to violacein production).

Chromobacter were found in wells in Mulund West Residential area. (Table 6)

Table 6: Biodiversity observed in well water of residential area of						
	Percentage of Wells					
Region	Mulund East			Mulund West		
Season	Winter	Premon	Mon.	Winter	Pre-mon	Mon.
Shigella	67	0	0	0	0	66
Enterobacter	7	35	0	6	34	7
Klebsiella	0	14	77	0	30	24
Salmonella	0	7	0	0	6	0
Psuedomonas	60	77	0	60	6	0
Actinomonas	60	0	14	30	0	0
Proteus	14	21	0	0	0	12
Pimelobacter	33	0	0	6	0	0
Staphylococci	14	0	0	90	0	7
Aeromonas	0	70	77	0	78	78

S*taphylococcus aureus* is known to produce enterotoxin. *Staphylococcus was* found predominantly in winter season in well water of residential area.

Proteus spp. belongs to the intestinal flora but is also widely distributed in soil and water, found in wells in residential area in all three seasons.

Conclusion: Presence of common intestinal pathogens and other biodiverse organisms in well water indicates sub-surface leaching of faecal matter from waste water drains and solid waste dumps in close vicinity of wells.

References:

1 Bambale R B, Water Reforms Mumbai, Maharashtra , Municipal Corporation Of Greater Mumbai, http://www.icrier.org/pdf/Maharashtra_05

2 Water Conservation and Rainwater Harvesting,

3 http://www.mcgm.gov.in/irj/portalapps/com.mcgm.solidwastemanagement/docs/

4 Dhabadgaonkar S. M., "Water Resource Development in morna River Basin: A Potential Measure to eliminate Water Related Problems in Akola City", Journal of Indian Water Works Association,Vol. XXXIX, No. 3, pp.167, 2007.

5 Gill G. S., Parasnis A. S., Deshpande S. C. CIDCO, Challenges Pertaining to preservation of wetlands in a developing city – a case study of Navi Mumbai, India, Mumbai City And Its Resource Crunch , wldb.ilec.or.jp/data/ilec/WLC13_Papers/S1/s1-1.

6 Methods of sampling and microbiological examination of water (first revision), IS 1622: 1981, Published by Bureau of Indian Standard, New - Delhi

7 Idowu, Oluremi, Odubawo, "Bacteriological Analysis of Well Water Samples in Sagamu", African Journal of Clinical and Experimental Microbiology, Vol.12, No.1, pp.86 -90,2011.

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