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**Cell : 9595 359 435, Ph No: 02172372010 Email: ayisrj@yahoo.in Website: www.isrj.net**

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ORIGINAL ARTICLE

# WATER QUALITY ANALYSIS OF UNDERGROUND WATER IN VARIOUS SECTORS OF KOLHAPUR CITY.

**H.V.VYAS , V.A.SAWANT AND SMITA KHARADE**

Dept.of Zoology ,S.M.Dr.Bapuji Salunkhe College, Miraj Dist.Sangli.
Former Head, Dept. of Zoology, Shivaji University Kolhapur.
Mahatma Gandhi Jr.College Ashta,Sangali.
Dept.of Zoology ,S.M.Dr.Bapuji Salunkhe College, Miraj Dist.Sangli.

**Abstract:**

*Kolhapur is developed city suffering from pollution problems. The water supply to Kolhapur city is mainly from river panchanganga but now a days river panchanganga is severely polluted hence water quality from KMC water supply is deteriorated. Due to short supply and pollution of water most of residents use bore well water as an alternate source. Hence the monitoring and analysis of water quality from bore well is very essential. To evaluate quality of bore well water the samples were collected from selected sites of various sectors as Urban, Industrial, Slum and Agricultural regularly from march 2005 to February 2006. The water samples analyzed for physico-chemical and bacteriological parameters, certain parameters are beyond the permissible limit recommended by World Health Organization (WHO) and Indian standard Institute (ISI).From the results present study reveals that most of the bore well water is of poor quality and it is unfit for drinking purpose.*

**KEYWORDS:**

Physico-chemical parameters,Heavy metals,Bacteriological parameters,Water quality.

## INTRODUCTION:

Safe drinking water is basic need for human development, health and well being and because of this it is internationally accepted as human right. In fact the health critically depends upon the availability and quality of drinking water, so it is necessary for every person to adopt prevension measures against ground water pollution,because underground water pollution posses serious problem in cities and industrial area.

Presently river Panchaganga is severely polluted because of direct discharge from municipality, industrial effluents and waste water, domestic waste ,hospital waste similarly agricultural runoff mixes a large number of pollutants in water. Generally ground water is recharged by leakage from river channels in certain geological situation. Hence quality of underground water is deteriorated.

Kolhapur is an agro-industrial city suffering from pollution problem. The developmental activities in major sectors such as urban industrial slum and agriculture regions are polluting the natural surface and ground water bodies .Ground water is highly susceptible to pollution from natural as well as anthropogenic activities

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In certain urban area of Kolhapur due to irregularity and acute water supply from KMC tap water ,and non-availability of other water sources bore well water is used for domestic and sometime for drinking purpose. In industrial sector Shivaji Udyamnagar the metal processing units, electroplating, automobile servicing centers battery manufacturing, Shahu textile mill, dye Industries sugar factories ,tanneries, and other small scale industries discharges large amount effluents in the river Panchaganga.

Slum area of Kolhapur city having a poor sanitation, poor drainage system high domestic waste disposal by bathing, washing utensils and clothes near the water resources, so the bore well water is so much contaminated . Due to the irregularity and shortage of municipal water supply from tap water, residents from this area used bore well water as alternate source of drinking water .

In agricultural area the underground water pollution is mainly due to agricultural run off. Large amount fertilizers as nitrates, phosphates and pesticides seep into the ground water by process of leaching. Routine application of fertilizers and pesticides for agriculture being recognized as significant source of water pollution. Because of all these reasons water quality is deteriorated, so to evaluate the quality of bore well water from various sectors, the water samples are systematically collected and analyzed for physico-chemical, metal and microbiological parameters.

## MATERIAL AND METHOD:

The samples from selected bore well were collected to asses the quality of water from various sectors as Urban, Industrial Slum and agricultural sectors of Kolhapur city. Sampling was carried out during march 2005 – feb. 2006.Samples were collected in a sterilized 2L plastic cans and analysed as per the procedure given in standard method for examination of water and wastewaterby APHA(1985) WashingtonD.C. Physico-chemical parameters such as temperature, electric conductivity, pH, dissolved oxygen analysed at site only and COD, BOD, Chloride, Alkalinity, Sulphate,, Total hardness, Calcium, Magnesium, Sodium, Potassium in laboratory.

For metal analysis the water samples were collected in pre-cleaned bottles and acidified with conc. Nitric acid for preservation. Metals like Iron, Copper, Lead, Cadmium were determined by atomic absorption spectrophotometer (AAS). For bacteriological analysis water samples were collected in separate sterilized glass bottles.MPN of coliform, SPC of total coliform, E.coli estimated by multiple fermentation technique with Mac-conkeys broth(Hi-media),Nutrient agar medium and Endo agar medium respectively. Salmonella sp..isolated with Bismath sulphite agar medium by four quadrant method.

## RESULT AND DISCUSSION:

The results of physic-chemical, metal heavy metal and bacteriological analysis of bore well water samples from various sectors are depicted in table no.1 and 2 respectively. Temperature of water samples ranges from 27.7 ºC±1.54 to28.58ºC.pH of water samples ranged from7.21±0.27 to 7.31±0.21.The limit of PH value for drinking water is specialized at 6.5 to 8.5 (WHO,ICMR 1975) It is important in regulating respiration and enzyme system (Folkman and Mohmed 2001) pH has no direct adverse effect on human health (Khadson and kadu 2003) but all biochemical reactions are sensitive to the variation of pH.

Electric-conductivity recorded in urban area is 734.56±149.3mmhos/cm. In industrial region 864.5±84.88mmhos /cm. In slum region 751.58±164.2mmhos /cm and in agriculture region 1201.58±127 .These high values of EC were due to high concentration of ionic constituents present in water under study and reflect concentration from salinity, intrusion as well as pollution by industrial and domestic waste (Abbasi et. al. 1999).

Total Dissolved Solid cross the permissible limit, recorded as 516.58±122. 7,639.83±68. 67,502.75±105. and 802.25±99.5 mg/l,in urban, industrial, slum and agricultural sector respectively. The higher values of dissolved solids can be related with the solid waste deposit near bore well (Sharma & Kaur 1998, Mehta 2003).

Dissolved oxygen recorded was low ranges from 3.25±1.04,3.44±1.58 4.30±0.98 and 4.54±1.27mg/l in slum urban ,industrial and agricultural sectors. The recommended dissolved oxygen limit for all domestic purposes is 4 to 5 ppm (Garg 2003) Values of dissolved oxygen in groundwater indicating pollution by organic waste .(Sharma et. al. 1998,) In present investigation BOD values in urban sector 1.51±1.03,industrial sector 6.4±1.04, slum sector 5.46±3.4and 2.5±1.02 in agricultural sector. The recommended permissible value of BOD is 2.0 mg/L as per ISI standards .Water samples of industrial and slum region showed values of BOD beyond the ISI standard. More BOD indicates that water sources are polluted due to increased leaching of organic matter from dumping sites & biodegradable waste from sanitary waste.

Chemical oxygen Demand (COD) is important water quality parameter deciding to the pollution

load of water. In present investigation the average COD values in all four sites ranged from 17.09±6.75,35.35±13.85,21.35±12.58 12.69±5.77mg/l. The COD values more than 1 mg/L are due to pollution. The average COD values in all sites is beyond the guideline of WHO.

The average chloride concentration in bore well water recorded as 85.64±22.39, 140.14±16.79, 89.52±21.24, 180.77±17.10mg/L. In urban ,industrial, slum and agricultural sectors respectively. In the present study total alkalinity ranges from 361.56±52.20,457.58±34.42,312.55±47.21,555.55±31.60 mg/L in urban, industrial slum and agriculture sectors respectively. The ISI limit for alkalinity is 50-200 mg/L. It means water sample of bore wells have higher alkalinity which can be attributed to concentration of calcium and magnesium salts in water (Maniraskum 1984). Hardness of water is an important parameter determining the suitability of water for drinking and domestic uses. The average value ranged from 343.92±64.98, 420.17±77.08,574.51±66.61mg/LCaCO3.inurban,industrial,slum,agricultural sectors.. Hard water is unsuitable for domestic purpose and reports indicate that hazard in both heart and kidney problem (Peter1979). Park and Park (1986) observed correlation between hardness of water and its role in heart diseases.

Concentration of calcium in normal potable ground water generally ranges between 10-100 ppm. Calcium in these concentrations has no known effect on the health of human or animal .Calcium is necessary but excess leads to urinary calculi (Taquikhan 1986) Average concentrations Calcium was maximum in agriculture sector (162.13±24.02mg/l) In agricultural region water sample shows high calcium content beyond the maximum desirable limit may be due to organic fertilizers used in fields. The excess calcium in human body causes hypercalcemia, coma and death (Dasgupta et al. 2001),

Concentration of Magnesium was found less than concentration of Calcium possibly due to lesser occurrence of magnesium in rock.31.56±12.10mg/l(slum),3 3.94±12.21mg/ (urban) 41.37±11.79 (industrial) and 44.05±4.62rock.31.56±12.10mg/l(slum),33.94±12.21mg/(urban ) Sodium is one of the naturally occurring cation in natural water. Certain clay minerals and zeolite can release sodium into ground water. The average value of sodium in all sector is within limit of WHO standard

Iron is essential for good health because it transport oxygen in blood.. Excess quantity of iron is reported in groundwater sample ranges from 1.29 to1.69mg/lit. It cross the permissible limit of standard may be due to industrial effluents and discharge from automobile garages.Long time consumption of drinking water with high concentration of iron leads to liver diseases as hemosiderosis (Mehta 2003). In present study concentration of Iron is maximum in all water samples of four sectors. samples of four sectors four sectors. The lead influences growth, and its excess leads to damage to brain, kidney and liver (Taqui Khan, 1986). Lead concentration (0.045,0.344 mg/l in urban and industrial sectors) ) is higher than excessive limit. It may be due to waste water from electroplating and battery manufacturing units In present investigation the concentration of copper and cadmium is very low, below the permissible level of WHO &ICMR standard.

MPN of coliform is important microbiological parameter from public health point to assess any contamination of drinking water with sewage or excretory waste. The pathogenic coliform bacteria causes diseases such as typhoid, fever, dysentery, diarrhea, cholera( Trivedi andGoel1986.)In urban(45/100ml),industrial(35/100ml),slum(85/100ml),agricultural region(25/100ml) MPN count was maximum in rainy season, followed by winter season and minimum during summer season.

SPC is standard plate count method used for enumeration of microorganisms. In present study average SPC count / ml was 1710/ml, 350/ml, 800/ml and 900/ml at site of urban, industrial, slum and agriculture sectors respectively during year 2005-06 in rainy season.

The highest microbial contamination is observed during rainy season. According to Standard limit of WHO & BIS all bore well water samples are above the permissible limit. Water samples are contaminated by faecal coliform bacteria during rainy season than winter and summer season. Our finding are closely agreement with Garg (2003) E. coli reported in bore well water of slum region located near public toilet in rainy season .Salmonella sp. was detected in rainy season in slum and agricultural region. All bore well water are heavily contaminated by Salmonell sp. According to Isolation Hospital record most of the patient were suffered by typhoid and gastrointestival disorders during rainy season from slum area in the year 2005-06 which is positively correlated with our finding

s.

**Table No. 1 Average value of Physico-chemical parameters of Bore well water in various sectors of kolhapur city.**

| | | | | |
|---|---|---|---|---|
| Temperature $^{0}$C | 28.08 ± 1.10 | 28.04 ± 2.51 | 28.04 ± 2.76, | 28.0 ± 1.29 |
| pH | 7.39 ± 0.18 | 7.21 ± 0.27 | 7.24 ± 0.27 | 7.28 ± 0.27 |
| EC µmhos/cm | 734.56 ± 149.3 | 864.5 ± 84.88 | 751.58± 127.1 | 1201± 127 |
| TDS | 516.58 ± 122.7 | 639.83 ± 68.67 | 502.75 ± 105.2 | 802.25±99.560 |
| Dissolved oxygen | 3.44 ± 1.17 | 4.30 ± 0.98 | 3.25± 1.04 | 4.54 . ± 1.15 |
| Total Hardness | 343.92± 64.98 | 420.70± 34.16 | 315.35 ± 51.16 | 574.51± 60.65 |
| Calcium | 89.34 8.57 | 95.95± 11.15 | 74.49 ± 12.50 | 162.13± 20.12 |
| Magnesium | 33.94± 6.27 | 44.05 ± 4.62 | 31.86 ± 12.10 | 41.37± 11.79 |
| Chlorides | 85.64± 13.44 | 140.14 ± 16.79 | 89.52 ± 21.72 | 180.77± 17.10 |
| Alkalinity | 361.56 ± 52.20 | 457.58 ± 34.42 | 312.55±47.21 | 4555.55±31.60 |
| Sulphate | 116.45± 51.08 | 129.17± 52.16 | 98.02 ± 44.62 | 148.20± 51.14 |
| COD | 17.09±6.75 | 35.35±13.85 | 21.35±1.09 | 4.45±1.27 |
| BOD | 1.51±1.03 | 6.4±1.045 | 5.46±3.45 | 2.53±1.29 |
| Sodium | 42.84+ 14.20 | 49.5 + 22.74 | 31.91+ 10.63 | 45.25+ 14.95 |
| potassium | 2.75 + 1.54 | 3.83 + 2.54 | 3.0 + 2.13 | 3.41+ 2.50 |

Values are in mg/lit expect PH and EC

**Table No. 2: Metal, Heavy metal and Bacteriological Parameters of Bore well Water from various sectors of Kolhapur city.**

| | | | | |
|---|---|---|---|---|
| Iron mg/l | 1.507± 0.057 | 1.69 ± 0.12 | 1.21 ± 0.08 | 1.29± 0.124 |
| Lead mg/l | 0.045± 0.057 | 0.344 ± 0.051 | BDL | BDL |
| Copper mg/l | 0.01 ± 0.004 | 0.22 ± 0.035 | 0.076±0.004 | 0.023±0.0055 |
| Cadmium mg/l | BDL | 0.003±0.0019 | 0.001±0.0016 | 0.001±0.0006 |
| MPN/100ml(faecal coliform) | 45 | 35 | 85 | 25 |
| SPC/ml(total coliform) | 1710 | 350 | 800 | 900 |
| E.Coli/ ml | Nil | Nil | 10 | Nil |
| Salmonella sp/ ml | Nil | Nil | 10 | 12 |

## CONCLUSION & RECOMMENDATION:

From the assessment of physico-chemical ,metal and bacteriological parameters, it is concluded that the bore well water is unfit for drinking purpose. Some physico-chemical parameters such as EC, TDS, BOD, COD, Alkalinity, T.hardness, Iron, Lead showed values beyond the standard limit of WHO, ICMR & ISI. DO, chlorides, Calcium and Manganesium values are within permissible limit. All bore well water showed MPN of feacal coliform, SPC of total coliform, E. coli beyond the safe limit of WHO standard. Salmonella sp. are detected in water samples of slum and agriculture area which is positively correlated with hospital record. Most of the people depending upon bore well water in slum area are suffered from water borne diseases like dysentery, Diarrhea, Typhoid and Jaundice. Hence over all water quality is rated as very poor from WQI, Severally polluted and unfit for human consumption.

Therefore it is recommended that the constant monitoring and treatment of underground water is essential as pre-requisite for use of this water for drinking purpose. If this is not feasible, this water be used only for domestic purposes but not suitable for drinking purpose.

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