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# Assessment of Ground water quality used for Drinking water supply of Guvvalacheruvu village using Water Quality Index

**M. Govindamma[1], S. Sumithra[1]* and P. Mercy Jasper[1]**

Department of Environmental Sciences, Yogi Vemana University, Kadapa -516 005, A.P

## Abstract

Physcio – chemical parameters of ground water quality at Guvvalacheruvu village, Kadapa district, A. P, India have been analyzed to evaluate its suitability for drinking purpose. pH, EC, TDS, Turbidity, Total Hardness, Total Alkalinity, Chloride, Sulphate, Phosphate, Nitrate, Calcium, Sodium and Potassium are in the range 6.08 – 8.04, 914 – 1382, 455 - 675, 0 - 0.05, 546 – 830, 242.1 – 1364.4, 13.47 – 106.36, 1.0 -5.1, 0.1 – 1.4, 0.89 – 8.42, 541.7 – 733.3, 103.3 – 215, 1425 – 2000, respectively. In addition Water Quality Index (WQI) was applied to investigate the ground water quality. Even though some parameters studied in the ground water were high, they can be processed before consumption.

**Key words:** Total Hardness, Chloride, Ground water, Parameters, Water Quality Index.

## 1. Introduction

Water is an absolute necessity if life must be sustained on earth (Hiremath et al., 2011). Naturally, water is second only to air among the most important resources for human existence; however, it is the most threatened. Due to increased human population, industrialization, use of fertilizers and man made activities water is highly polluted with different harmful contaminants (Patil et al., 2012). It has been suggested that it is the leading worldwide cause of deaths and diseases, and that it accounts for the deaths of more than 14,000 people daily. Ground water constitutes 97% of global fresh water and many regions, ground water sources are the single largest supply for serving drinking water to the community. Today, with a global withdrawal rate of 600–700$km^3$/year, groundwater is the world's most extracted raw material (IAH, 2003). 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. In the last few decades, there has been a tremendous increase in the demand for fresh water due to rapid growth of population, unplanned urbanization, industrialization and too much use of fertilizers and pesticides in agriculture (Joarder et al., 2008). Ground water meets domestic needs of more than 80 % rural and 50 % urban population besides irrigation. Around two fifth of India's agriculture output is contributed from areas irrigated by groundwater (Anita and Gita, 2008). Contamination of groundwater by domestic, industrial effluents and agricultural activity is a serious problem faced by developing countries. The industrial waste water, sewage sludge and solid waste materials are currently being discharged into the environment indiscriminately. Groundwater becomes polluted when materials seep through the soil and reach the water, which can happen when rainfall washes contaminants into the ground, when polluted surface water connects with groundwater, and when buried tanks or waste disposal sites start to leach. The availability of ground water depends upon the rate at which it is recycled by hydrological cycle than on the amount that is available for use at any moment in time. According to WHO organization, about 80% of all the diseases in human beings are caused by water. Water quality Index based on some very important parameters can provide a simple indicator of water quality. It gives the public a general idea of the possible problems with water in a particular region.

The objectives of this study are:

1. To evaluate some of the parameters that can cause contamination and in what concentration

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if present, and comparing it with set standards of WHO and ISI.

2. To find out the Water Quality Index (WQI) for obtained data.

## 2. Materials and Methods

Guvvalacheruvu is located at 14. 8080ºN 78. 7072 ºE. 23 KM towards South from District head quarters Kadapa and 11 KM from Ramapuram. According to Census 2011 Guvvalacheruvu total population is 1795 and number of houses are 379. Female Population is 48.6%.

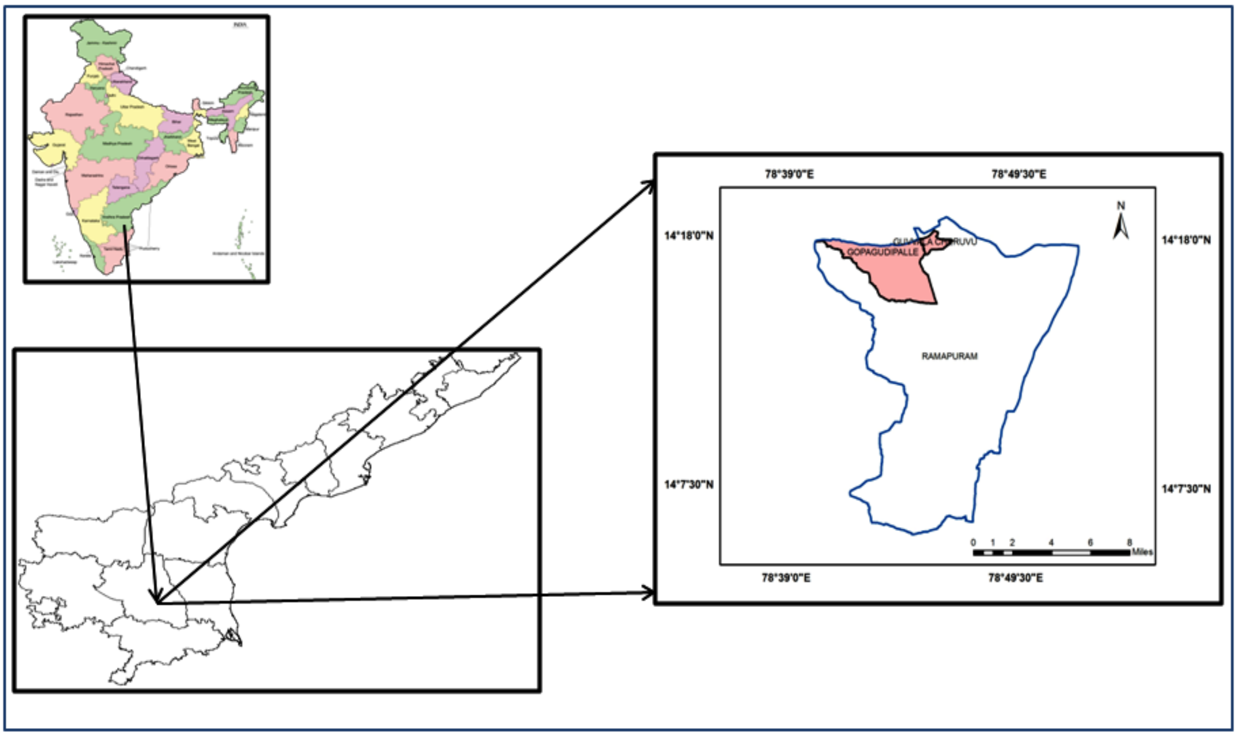


**Fig. 1.** Location map of the study area

The water samples are collected and stored in clean polythene bottles fitted with screw caps and brought to the laboratory for detailed physical - chemical analysis. The samples are kept as cool as possible without freezing. The methods followed for the estimation of various physical - chemical parameters are recorded in Table 1.

**Table 1. Methods followed for estimation of Physical - Chemical Parameters (APHA)**

| S.No | Parameters | Methods |
|---|---|---|
| 1 | pH | pH meter (ELICO) L1614 |
| 2 | Electrical Conductivity (µS/cm) | Conductivity meter (Hanna) |
| 3 | Total Dissolved Solids (mg/L) | TDS meter (Hanna) |
| 4 | Turbidity | Turbidity meter |
| 5 | Total Hardness (mg/L) | EDTA method |
| 6 | Total Alkalinity (mg/L) | Indicator method |
| 7 | Chloride (mg/L) | Silver nitrate method |
| 8 | Sulphate (mg/L) | Colorimetric method |
| 9 | Phosphate (mg/L) | Stannous chloride method |
| 10 | Nitrate (mg/L) | Phenol Disulphonic acid method |
| 11 | Calcium, Sodium and Potassium (mg/L) | Flame photometer |

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## 3. Results and Discussion

The Physical and Chemical properties of ground water sample collected from Guvvalacheruvu village, Ramapuram mandal, Kadapa district are shown in Table 1.

The pH values of the ground water ranged from 6.08 to 8.04, which are within the permissible limits of WHO standards 6.5- 8.5. Although pH usually has no direct impact on consumers, it is one of the most important operational water quality parameters. pH is considered as an important ecological factor and provides an important piece factor and piece of information in many type of geochemical equilibrium or solubility calculation (Shyamala et al., 2008).

Electrical conductivity depends and increases with increase in ionic strength of water. Change in conductivity of sample may signal changes in mineral composition of raw water and intrusion of domestic water (Sayed and Gupta, 2010). The EC values in the present study ranged between 914 to1382 µS/cm which are above the permissible limit (1000 µS/cm) (Fig. 2). TDS in drinking-water originate from natural sources, sewage, urban runoff and industrial wastewater. Concentrations of TDS in water vary considerably in different geological regions owing to differences in the solubility of minerals. TDS values of water samples varied from 455 to 675 mg/L and are above the limits of WHO (Fig. 2).

Total hardness of water is due to the presence of bicarbonate, sulphate, chloride and nitrates of calcium and magnesium (Kumar et al., 2010). In the present study it was found that the total hardness ranges from 529 to 830 mg/L. High values of hardness are probably due to regular addition of sewage and soaps into water from nearby areas (Fig. 2).

Turbidity is a measure of the degree to which the water loses its transparency due to the presence of suspended particulates. It is essentially a function of reflection of light from the surface and is influenced by the absorption characteristics of both water and its dissolved and particulate matter (Stepane et al., 1959). For all the water samples, turbidity was in the range of 0 to 0.05 NTU. It indicates absence of suspended and colloidal matters like decomposed vegetation, sewage, sediments in the samples.

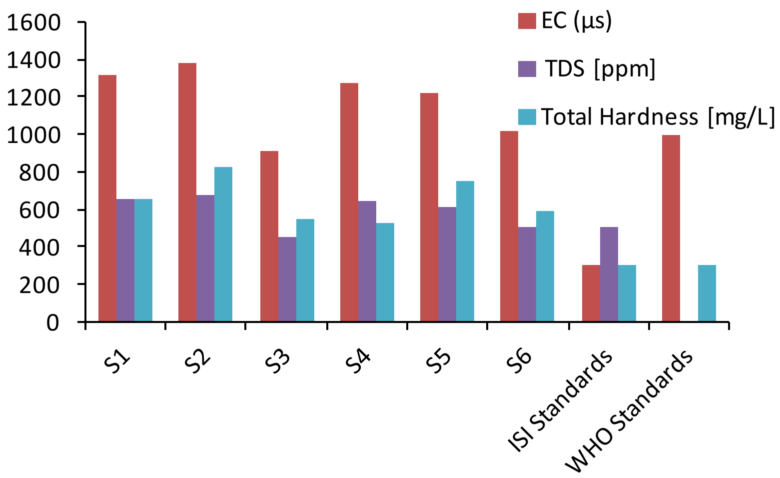


**Fig: 2. EC, TDS and Total Hardness**

Alkalinity is an important parameter because it measures the water's ability to resist acidification. The major portion of alkalinity in natural water is caused by hydroxide, carbonate and bicarbonate. Alkalinity in itself is not harmful to human beings (Surve et al., 2005). Alkalinity can be considered as phenolphthalein alkalinity and methyl orange alkalinity. As per the results obtained, phenolphthalein alkalinity ranges from 70.2 to 425.7 mg/L, methyl orange alkalinity ranges from 173.34 to 1364.4 mg/L. WHO standards for total alkalinity are 200 mg/L. The maximum level of chloride was 106.36 mg/L and minimum level of chloride was 13.47 mg/L. Chloride was one of the major anion found in water and are generally combined with calcium, magnesium or sodium. Chloride does not pose a health hazard to humans and the principal consideration is in relation to palatability (Jena and Sinha, 2017). The utility of water for domestic purposes will therefore be severely limited by high sulphate concentrations, hence the limit of 200 mg/L $SO_4^{2-}$ (WHO, 2000;

Jena et al., 2012). Sulphate in assessed water sample ranges from 1.0 to 4.0 mg/L. Phosphate level in pond water samples varies between 0.1 to 1.4 mg/L. Phosphates are not toxic to people or animals unless they are present in high levels. The value of nitrate in studied ground water ranged between 0.2 to 1.9 mg/L which was below the WHO standard of drinking water permissible limit (Fig. 3). Runoff and decomposition of organic matter is the main sources of nitrate in the water bodies. The U. S. Environmental Protection Agency also uses 10 mg/L as N as a mandatory national standard for public supplies under the safe drinking water act.

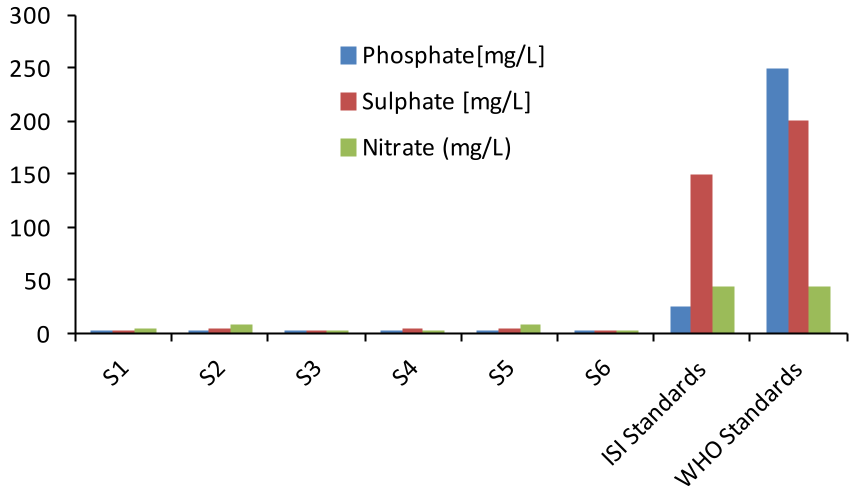


**Fig 3. Nitrate, Phosphate and Sulphate.**

Calcium, Sodium and Potassium are very common ions in water samples due their higher solubility in water and association with carbonates and sulphate. Calcium levels assessed in samples ranges from 541.7 to 787.5 mg/L. Higher levels of calcium found in all the samples. Sodium levels in the samples ranged from 103.3 to 215 mg/L. Higher levels of sodium may cause bitter in taste. This result is in accord to the findings of Mishra et al., (2014). Potassium levels in samples ranged from 1425 mg/L to 2175 mg/L. Higher values of potassium were found in all samples exceeding the WHO permissible limit (Fig. 4). Potassium remains mostly in solution without undergoing precipitation (Lashari et al., 2009; Mahananda et al., 2010). Similar observation was also revealed by Ravichandran et al., (2009).

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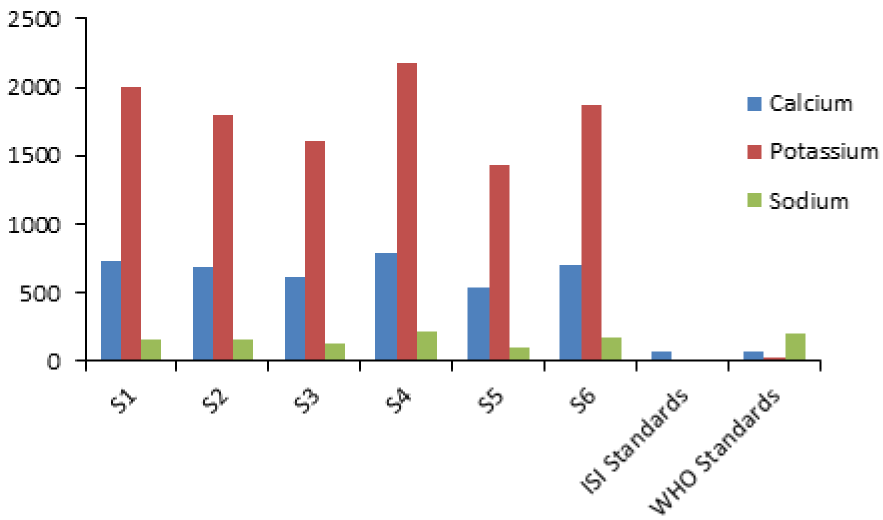


**Fig: 4. Calcium, Sodium and Potassium**

## Table: 1 Physical and Chemical characteristics of ground water

| Parameters | S1 | S2 | S3 | S4 | S5 | S6 | WHO Standards | ISI Standards |
|---|---|---|---|---|---|---|---|---|
| pH | 7.07 | 6.08 | 7.24 | 8.04 | 7.35 | 7.85 | 6.5 -8.5 | 8.5 |
| EC (µS/cm) | 1317 | 1382 | 914 | 1273 | 1219 | 1012 | 1000 | 300 |
| Total Dissolved Solids (mg/L) | 650 | 675 | 455 | 639 | 609 | 509 | 1000 | 500 |
| Turbidity (NTU) | 0.05 | 0 | 0 | 0 | 0 | 0 | 5 | 10 |
| Total Hardness (mg/L) | 655 | 830 | 546 | 529 | 751 | 591 | 300 | 300 |
| Total Alkalinity (mg/L) | 70.2 | 0 | 0 | 425.7 | 0 | 658.4 | 200 | 120 |
| | 173.34 | 242.1 | 360 | 900 | 592.2 | 1364.4 | | |
| Chloride (mg/L) | 90.39 | 106.36 | 44.13 | 13.47 | 85.08 | 69.12 | 250 | 250 |
| Sulphate (mg/L) | 2.2 | 5.1 | 1 | 4 | 3.8 | 1.6 | 200 | 150 |
| Phosphate (µg/L) | 1.4 | 0.3 | 0.1 | 0.3 | 0.3 | 0.4 | 250 | 25 |
| Nitrate (mg/L) | 3.98 | 8.42 | 1.77 | 0.89 | 8.42 | 3.1 | 45 | 45 |
| Calcium (mg/L) | 733.3 | 679.2 | 604.2 | 787.5 | 541.7 | 691.7 | 75 | 75 |
| Sodium (mg/L) | 163.3 | 161.7 | 131.7 | 215 | 103.3 | 171.7 | --- | 200 |
| Potassium (mg/L) | 2000 | 1800 | 1600 | 2175 | 1425 | 1875 | 15 | 20 |

## Table 2. Water quality standards, recommending agency and unit weights

| Parameters | Standard Value | Ideal Value | Unit weight ($W_n$) | Observed Value (S1) | Quality rating ($q_n$) | $W_n q_n$ |
|---|---|---|---|---|---|---|
| pH | 8.5 | 7 | 0.314 | 7.07 | 4.67 | 1.466 |
| EC (µS/cm) | 300 | 0 | 0.009 | 1317 | 439 | 3.951 |
| Total Dissolved Solids (mg/L) | 500 | 0 | 0.005 | 650 | 130 | 0.65 |
| Turbidity (NTU) | 10 | 0 | 0.267 | 0.05 | 0.5 | 0.133 |
| Total Hardness (mg/L) | 300 | 0 | 0.009 | 655 | 218.3 | 1.965 |
| Total Alkalinity (mg/L) | 120 | 0 | 0.022 | 173.34 | 144.45 | 3.178 |
| Chloride (mg/L) | 250 | 0 | 0.01 | 90.39 | 36.16 | 0.362 |
| Sulphate (mg/L) | 150 | 0 | 0.018 | 2.2 | 1.47 | 0.026 |
| Phosphate (µg/L) | 25 | 0 | 0.107 | 1.4 | 5.6 | 0.599 |
| Nitrate (mg/L) | 45 | 0 | 0.059 | 3.98 | 8.84 | 0.521 |
| Calcium (mg/L) | 75 | 0 | 0.036 | 733.3 | 977.73 | 35.198 |
| Sodium (mg/L) | 200 | 0 | 0.013 | 163.3 | 81.65 | 1.061 |
| Potassium (mg/L) | 20 | 0 | 0.133 | 2000 | 10,000 | 1330 |
| | | | **$\Sigma W_n$= 1.002** | | | **$\Sigma W_n q_n$= 1379.1** |
| **WQI** | **1376.35** | | | | | |

## Table 3. Water quality Index

| Location | WQI | Remarks |
|---|---|---|
| S1 | 1376.35 | Unsuitable |
| S2 | 1221.57 | Unsuitable |
| S3 | 1108.37 | Unsuitable |
| S4 | 1527.09 | Unsuitable |
| S5 | 999.76 | Unsuitable |
| S6 | 1327.22 | Unsuitable |

The overall water quality index was calculated by aggregating the quality rating with the unit weight linearly.

$$WQI = \Sigma W_n q_n / \Sigma W_n$$

## Table 4.Water Quality Classification Based on WQI Value

| WQI range | Water quality status | Possible usage |
|---|---|---|
| 0–5 | excellent water quality | drinking, irrigation and industrial |
| 26–50 | good water quality | drinking, irrigation and industrial |
| 51–75 | poor water quality | irrigation and industrial |
| 76–100 | very poor water quality | irrigation |
| Above 100 | unsuitable for drinking | proper treatment required before use |

## 5. Conclusion

Analysis of ground water samples collected from various location of Guvvalacheruvu village revealed that all water samples do not comply with WHO and ISI standards. The non – potability of the ground water may be due to high levels of Total Hardness, Total Alkalinity, Calcium and Potassium contents. The highest value of WQI was observed in all the studied samples. So the water samples that are collected cannot be used not even for domestic purposes and requires a substantial degree of treatment/purification. It must be noted that a regular chemical analysis must be done to insure that the quality of water in this area is not contaminated.

## References

[1] Anita J and Gita S. Physico chemical characteristics of ground water of sambhar lake city and its adjoining area Jaipur district, Rajasthan, India. Int. J. Chem. Sci. 6: 1793 – 1799 (2008).

[2] APHA, Standard Methods for the Examination of Water and Wastewater, 21st edition, American Public Health Association, Washington DC, (2005).

[3] Hiremath SC, Yadawe M S, Pujeri US, Hiremath DM, Pujar AS. Physicochemical analysis of groundwater in municipal area of Bijapur (Karnataka). Curr. World Environ. 6: 265 269 (2011).

[4] Joarder M A, Raihan F, Alam JB and Hasanuzzaman S. Regression analysis of ground water quality data of Sunamjang district, Bangladesh. International J. Environ. Research. 2: 291 -296.
(2008).

[5] Jena V and Sinha D. Physcio – chemical analysis of ground water of selected areas of Raipur city. Indian J. Sci. Res. 13, 61 - 65 (2017).

[6] Jena V, Dixit, S and Gupta S. Comparative study of ground water by physico-chemical parameter and water quality index. Der. Chemica Sinica. 3 (6), 1450 – 1454 (2012).

[7] Kumar A, Bisht B S, Joshi V D, Singh AK and Talwar A. Physical and chemical bacteriological study of water from rivers of Uttarakhand. J. Hum Ecol. 32(3):169-173 (2010).

[8] Lashari K H, Koari A L, Sahato GA, Kazi T G. Limnological studies of Keenjhar Lake district, Thatta, Sindh Pakistan. Pakistan Journal Anal. Environ. Chem. 10 (1-2); 39 - 47 (2009).

[9] Mahananda M R, Mohanty BP, Behera N R. Physico- chemical analysis of surface and ground water of Bargarh district, Orissa, India, IJRRAS, 2(3); 284-295 (2010).

[10] Mishra S, Singh AL and Tiwary D. Studies of physico –chemical status of the ponds at Varanasi holy City under Anthropogenic Influences. International J. of Environmental Research and Development. 4, 261 – 268 (2014).

[11] Patil PN, Sawant DV, Deshmukh RN. Physicochemical parametersfor testing of water A review. Int. J. Environ. Sci. 3(3): 1194 1207 (2012).

[12] Ravichandran C, Suthabala S, Jayalakshmi S. Environmental quality of selected Temple ponds in Tiruchirapalli, Indian J. Environmental Protection. 29(5); 392-398 (2009).

[13] Shyamala R. Shanthi M. and Lalitha P. Physicochemical analysis of Bore well Water Samples of Telungupalayam Area in Coimbatore District, Tamil Nadu, India, E-Journal of Chemistry,5(4) 924- 929 (2008).

[14] Sayed RA and Gupta SG. River water quality assessment in Beed district of Maharashtra: Seasonal parametric variation. Iranica Journal of Energy and Environment. 1(4); 326-330 (2010).

[15] Stepane KM. Limnological study of the reservoir sedlice near Zelive, IX. Transmission and transparency of water. Sci.pap. Inst. Chem. Tedind; Pragne. Fac-Technol Fuel Water. 3; 363-430 (1959)

[16] Surve P R, Ambor N E and Pulle J S Eco.Env. and Consv. 8(1),87-90 (2005).

[17] WHO (World Health Orgainzation) and UNICEF (United Nation Children's Fund) 2000, Global water supply and sanitation assessment. Report: WHO/UNICEF, Geneva/New York. 80 pp.