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# Assessment of Quality of Drinking Water and Risk of Contamination of Various Water Sources in a Rural Area of Belagavi from North Karnataka

KEYWORDS: Water quality, Ground water, Microbiological quality of water.


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**ABSTRACT** *Background: Availability of safe drinking water is a major problem having percussions on different dimensions of health. More than 50% of rural habitations in selected districts of Karnataka have less than 50 litres per capita of water supply. Ground water quality is a serious problem in more than half the habitations in 14 districts of Karnataka. Objective: To assess the quality of drinking water supplied to rural population and risk of contamination of water sources. Materials and Methods: Present study on water quality analysis was conducted in rural area of Belagavi, North Karnataka. Totally 56 water samples from different sources of water supply from 14 villages were assessed for physical, chemical & microbiological qualities. Results: Of all the samples, 84.3% samples residual chlorine was zero parts-per-million (ppm). Conclusion: Residual Chlorine was nil in most of the samples and half of the samples were unfit for drinking on microbiological grounds.*

## INTRODUCTION

Water is one of the most important constituents of the human body and plays vital role in human life. It is extremely essential for survival of all living organisms [1]. Adequate supply of fresh and clean drinking water is a basic need for all human beings, yet it has been observed that millions of peoples worldwide are deprived of it and only less than 1% of the world's fresh water is accessible for direct human uses [2, 3]. In India More than one billion people lack access to safe drinking water and about more than 2.6 billion people lack adequate sanitation.

Availability of safe drinking water is a major problem having percussions on different dimensions of health. Water acts as vehicle for transmission of many communicable(water borne) diseases like Cholera, Typhoid, Paratyphoid fever, bacillary dysentery, Hepatitis, Amoebic dysentery[2]. Today, 37.7 million Indians are affected by water born diseases annually. On an average 3900 children die every day from water borne diseases and 1.5 million children are estimated to die of diarrhea alone. Census 2011 depict that still 53 per cent households in India had "no latrine facility within premises" and around half of India's population (600 million) were practicing open defecation- the largest share in the world [4]. Major causes of water contamination are lack of sanitation in rural population, ignorance about pollution caused by open air defecation, non utilizing existing latrine facilities, insufficient water supply, lack of knowledge of scientific methods for water disinfection, inadequate operation and management of water supply schemes [5].

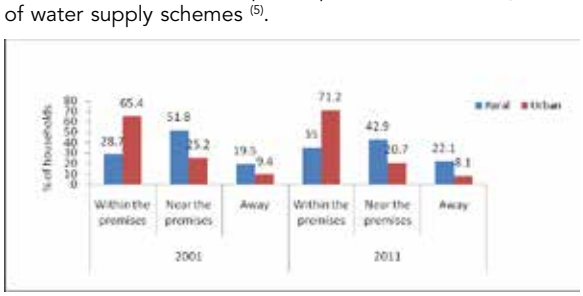


**Fig1:Rural-Urban differential in availability of drinking water in India, 2001-2011 (in %) [6]**

The key to providing microbiologically safe drinking water lies in understanding the various mechanisms by which water gets contaminated and formulating interventions at critical points to decrease and prevent contamination of drinking water [7].Hence this study was carried out to assess the quality of drinking water supplied to rural population and to assess the risk of contamination of water sources in the rural area of Belagavi, north Karnataka.

## Materials & Methods

The present cross –sectional study, to assess quality of drinking water and risk of contamination of water sources was planned and conducted in a rural area Uchagaon of Belagavi, North Karnataka. Uchagaon covers 5 sub centers and comprises of 14 villages .The study was carried out in association with district surveillance officer and analysis of water samples was done at IDSP Laboratory, Belagavi.

**Samples**: Sources were divided into 4 types, for the purpose of sampling. Four samples were selected randomly using standard aseptic precautions from each type of source and from each village and totally 51 samples were selected from all the villages.

**Tools for data collection**: Two standard questionnaires were used for data collection [8] .One for general information of villages and sanitary inspection of the water sources and another for physical and microbiological analysis. General information regarding population, number of reservoirs, open/closed wells, stand posts, no of house hold connections etc of each village was collected from Gram Panchayat using questionnaire and Information regarding chlorination was collected from watermen.

**Collection of water samples:** Two sets of water samples were collected from each selected source. Water Samples for physical analysis from respective sources were collected in plastic bottle of 1 litre capacity and analysis was done at PHC. The physical parameters like colour, odour, taste and

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turbidity were assessed.

Sample for bacteriological and chemical analysis were collected under all aseptic precautions according to WHO guidelines and all the samples were transported to district lab within 2 hours in Vaccine carriers [8].

**Results:**
The total population of Uchagaon was 45686 .Total number of houses were 8571 and total number of house hold connections were 3970. The proportions of house hold connections to houses were 46.3%.

Source wise distribution of samples **(Table no 1)** according to physical parameter of water samples from14 villages unders PHC shows that ,out of the total samples collected from open well 13(93%) samples of them were colorless, 1(7%) sample was yellowish. None of the samples had any odour or taste while 1 (7%) sample showed turbidity.

Out of the 4 samples collected from bore well, 3(75%) samples were colorless and 1(25%) sample was yellowish. None of the samples had any odour while 1(25%) showed turbidity. Out of 12 samples collected from taps, 7(58%) samples were colorless, 4(33%) were yellowish, 1(9%) was reddish. None of the samples had any taste or odour, while 5(42%) samples showed turbidity.

Out of the 13 samples collected from tanks, 9(69%) samples were colorless, 3(23%) were yellowish and 1(8%) was brownish. None of the samples had any odour while 1(8%) had sour taste and 4(31%) samples were turbid. Out of the 8 samples collected from hand pumps/ mini water supply, 7(88%) were colorless, 1(12%) was reddish. None of the samples had any odour, taste or turbidity.

Out of the total 51 samples collected 39(76%) samples were colorless, 9(18%) samples were yellow, 2(4%) samples were red and 1 (2%) sample was brown. None of the samples had any odour while 1(2%) sample had taste and 11(21%) samples had turbidity.

**Table no.1:Source wise water quality analysis of physical parameters of PHC, Uchagaon**

| Sl. no. | **Type of source** | **n =51** | **Colour** | | | **Turbidity** | |
|---|---|---|---|---|---|---|---|
| | | | **Colorless No. (%)** | **Yellow No. (%)** | **Red No.(%)** | **Present No.(%)** | **Absent No. (%)** |
| 1 | Open well | 14 | 13 (93) | 1 (7) | 0 (0) | 1 (7) | 13 (93) |
| 2 | Bore well | 4 | 3 (75) | 1 (25) | 0 (0) | 1 (25) | 3 (75) |
| 3 | Tank | 13 | 9 (69) | 3 (23) | 1 (8) | 4 (31) | 9 (69) |
| 4 | Tap water | 12 | 7 (58) | 4 (33) | 1 (9) | 5 (42) | 7 (58) |
| 5 | Mini water supply/ hand pump | 8 | 7 (88) | 0 (0) | 1 (12) | 0 (0) | 8 (100) |
| | **Total** | **51** | **39 (76.8)** | **9 (17.8)** | **2 (3.9)** | **11 (21.5)** | **40 (78.5)** |

*none of the water samples were having bad odour.

Source wise distribution of samples (**Table no** 2) according to chlorine concentration of shows that ,Out of total 51samples 43(84%) showed 0 ppm , 2 (4%) samples showed 1ppm , 1(2%) showed 1.5 ppm and 5(10%) showed 2 ppm .

Out of 51 samples analysed for microbiological quality of water (**Table no.2**), 28(52.50%) samples were showing >11 coliforms and were unfit for drinking. Out of 51 samples tested for $H_2S$, 37(72.5%) were positive for $H_2S$ production and were unfit for Drinking.

**Table No.2**: Source wise distribution of samples according to microbiological & chlorine concentration parameters

| Sl No | Type of source | **n=51** | **Chlorine concentration** | | **MPN Count** | |
|---|---|---|---|---|---|---|
| | | | 0 ppm No (%) | > 1 ppm No (%) | Nil No (%) | ≥11 No (%) |
| 01 | Open well | 14 | 09 (64) | 05 (35.71) | 07 (50) | 07 (50) |
| 02 | Bore well | 04 | 04 (100) | 00 (0) | 00 (0) | 04 (100) |
| 03 | Tank | 13 | 11 (85) | 02 (15) | 06 (46) | 07 (54) |
| 04 | Tap | 12 | 11 (92) | 01 (8) | 04 (33) | 08 (67) |
| 05 | Mini water supply / hand pump | 08 | 08 (100) | 00 (0) | 06 (75) | 02 (25) |
| | **Total** | **51** | **43 (84.31)** | **08 (15.16)** | **23 (45.10)** | **28 (54.90)** |

Assessment of risk of contamination of 14 opens wells from 11 villages was done using 'contamination risk scoring' by WHO (**Table 3**). Six (43%) of the wells were at high risk of contamination, 5(36%) were at intermediate risk and 3(21%) were at low risk, while none of them were at very high risk.

**Table 3**: Distribution of wells according to level of risk of contamination

| Sl. no | Contamination risk score | Number of wells (%) |
|---|---|---|
| 1 | Very high risk (9-11) | 0 **(0)** |
| 2 | High risk (6-8) | 6 **(43)** |
| 3 | Intermediate risk(3-5) | 5 **(36)** |
| 4 | Low risk (0-2) | 3 **(21)** |

(Note: contamination risk score 9-11 -> very high, 6-8 -> High, 3-5 -> intermediate, 0-2 -> low) [7]

## DISCUSSION

Physical parameters or aesthetic properties are of much importance in acceptability of water [9]. Turbidity is important because it affects both the acceptability of water to consumers and efficiency of treatment processes, particularly the disinfection with chlorine. Turbidity exerts a chlorine demand and protects microorganisms and may also stimulate the growth of bacteria. Drinking water should not have disagreeable odour or taste and drinking water should be free from any colour [10].

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In our study Out of total samples collected 76% were colorless, 18% were yellowish, 4% were red, 2% were brown, 2% had taste and 21% had turbidity. In a similar study conducted in Nigeria to assess quality of drinking water , 39% of the sample showed turbidity ,3% had taste 21% were yellowish and 60% samples were colourless [11].

In areas where there is risk of a water borne outbreak, residual free chlorine of 0.2mg/lt to 0.5 mg/lt at all points in the supply is recommended .when water leaves the treatment plant or the source residual free chlorine of 1mg /lt is needed for health reasons and it is recommended that such levels is maintained at points of consumption [12].

In our study samples collected from different sources showed that 84% samples were having 0 ppm , 4% sample showed 1ppm, 2% showed 1.5 ppm and 10% showed 2ppm residual chlorine .In a similar study conducted in Saqqez Iran to assess the quality of drinking water , only 5% of the samples were not having free residual chlorine [13].

In our study, out of 51 samples collected 72.5% were $H_2S$ negative, $H_2S$ test was not performed on rest of the 6 samples. In a similar study conducted in Saqquez, Iran only 12% of the samples were positive for fecal coliforms [13]. In another study about microbiological quality of drinking water conducted in Kashan, Iran where 342 samples were collected from raw and tap water sources from forty villages only 3% of water samples were positive for coliforms illustrates that 97% of the rural people were having access to safe drinking water [14].

Microbiological studies show that out of 14 samples collected from open wells 12 (86%) were $H_2S$ positive and out of 4 samples from bore wells 3 (75%) were $H_2S$ positive. Out of 13 samples collected from tanks 9 (69%) were $H_2S$ positive. Out of 12 samples collected from taps 11(92%) were $H_2S$ positive. Out of 8 samples collected from mini water supply /hand pump 2 (25%) were $H_2S$ positive.

In a similar study conducted in Nelvoy village of Tamil Nadu coliform counts in samples from 2 tanks were 24/100 ml and 54/100ml, where as in 8 tap waters ranged from 54/100ml to >180/100 ml and 9 out of 10 house hold samples showed coliform counts > 180/100ml.The presence of bacteria in water pipes could be attributed to cross contamination between water supply and sewer or area of contamination in the course of water pipes .

**Limitations:**
Some physical and chemical parameters could not be assessed because of lack of chemicals and equipments.

**Conclusion and recommendations:**
Majority of water sources were non potable and unfit for drinking on biochemical and microbiological grounds and most of the water sources were at risk of contamination. The availability of safe drinking water remains as major environmental problem in rural areas of North Karnataka

Every gram panchayath should have adequate supply of bleaching powder in all villages. Chlorination of all water sources should be done regularly and residual chlorine in water should be monitored by gram panchayaths and health assistants. Awareness program regarding sanitary measures, water borne diseases, chlorination of water source etc should be conducted by sanitary committee water treatment should be done before pumping water in to stand posts or to households. Maximum pipe lined water supply should be achieved to prevent contamination of wells ,all dug wells and open wells should be converted in to sanitary wells and unhealthy practices near wells should be prohibited .There is a need to convert all high risk contaminated sources to least risk source by adopting sanitary measures. Utilization of sanitary latrines should be increased to prevent contamination of water sources.

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