International Journal of Innovation Sciences and Research
Vol.4, No, 6, pp.271-275, June- 2015

Available online at
http://www.ijisr.com

RESEARCH ARTICLE

EVALUATION OF HANDPUMP WATER FOR DRINKING PURPOSE IN AREA OF URBANIZATION AND AGRICULTURAL DEVELOPMENT

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Accepted 24th May, 2015; Published Online 30th June 2015

ABSTRACT

Introduction: Pumps are a common means of lifting water from a clean groundwater in developing countries.
Materials and Methods: The present cross-sectional study was conducted in district Faridkot, Punjab. The total of 20 water samples, 10 each from urban and rural areas were obtained using random sampling method. The samples were tested in District Public Health Laboratory. Data was collected, compiled and analyzed by using SPSS-16 and chi-square test was used to statistically analyze and p value <0.05 was considered as significant value.
Results: The pH was same for urban and rural areas (9.0) which exceeded the guidelines limit according to WHO standard. Total alkalinity values (urban area was 211, rural area was 181, p = 0.053) and hardness (rural area was more, 195 as compared to 169, p = 0.107) were found to be greater than the value prescribed by WHO standards The iron was same for urban and rural areas(0.200) which was twice the permissible guidelines of WHO.
Conclusion: Water should be treated with reverse osmosis system to render it fit for drinking purpose.

Key Words: Ground water, Handpumps, WHO water permissible limits, Alkalinity, Punjab.

INTRODUCTION

Drinking water plays an important role in social prosperity and well being of people (Damo and Icka, 2013). Groundwater is used for domestic and industrial water supply and irrigation all over the world (Ramakrishnaiah *et al*., 2009). Pumps are a common means of lifting water from a clean groundwater in developing countries, (Stewart *et al*., 2003). Human health is threatened by most of the agricultural development activities particularly in relation to excessive application of fertilizers and unsanitary conditions. Rapid urbanization, especially in developing countries like India, has affected the availability and quality of groundwater due to its overexploitation and improper waste disposal, especially in urban areas (Ramakrishnaiah *et al*., 2009). Groundwater is usually regarded as cleaner as and safer than surface water. However, several factors such industrial, agricultural and domestic wastes, land use practices, geological formation, rainfall patterns and infiltration rate affects the groundwater quality and once contamination of groundwater in aquifers take place, it persists for hundreds of years because of very slow movement in them (Jayalakshmi *et al*., 2006). The present study was undertaken to evaluate of the quality of water available from handpumps and to compare the obtained data with standards provided by WHO guidelines to evaluate whether quality was fit for drinking purpose or not.

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MATERIALS AND METHODS

The present cross-sectional study was conducted in urban area (Faridkot block) and rural area (villages under community health centre, Bajakhana) of district Faridkot, Punjab. The study area (Faridkot district) consists of geographical area of 1475.70 Sq. km, comprises of 618008 Population as per 2011 Census. It is a part of Indo-Gangetic alluvial plain which lies in the south-western zone of the Punjab state, India popularly known as cotton belt (Verma *et al*., 2008). The study evaluating the water quality standards procured from handpumps in rural and urban areas of District Faridkot was carried out in the Department of Community Medicine from May 2013 to August 2013. Ethical clearance for the commencement of the study was taken from the college ethical committee. The total of 20 water samples, 10 each from urban and rural areas were obtained using random sampling method and location of samples are mentioned in Table 1. The samples were tested in District Public Health Laboratory. Data was collected, compiled and analyzed by using SPSS-16 and t-test was used to e statistical analysis and p value<0.05 was considered as significant value.

Comparison of parameters of water procured from handpump in urban and rural area of Faridkot district showed that turbidity of rural area was more, 2.08 as compared to 1.55 of urban area (p = 0.00), was within WHO limits. The pH was same for urban and rural areas (9.0) which exceeded the guidelines limit according to WHO standard.

Table 1. Location and number of samples

Handpump (Urban)	Number of samples
Near sewage treatment plant, Bazigar basti, Sadiq road, Faridkot.	1
Near LIC office, Sabji Mandi, Ferozpur Road.	1
Bhagat Singh Park, Main Bazaar, Faridkot.	1
Gali no.12, Balbir basti, Faridkot.	1
Near Bhai Ghanaiya Chowk, Court Complex, Faridkot.	1
Sanjay Nagar, Faridkot.	1
Gali no.4, Near GTB Water Works, GTB Nagar.	1
Dogar Basti, Faridkot.	1
Near Street No.5,Teacher Colony, Faridkot	1
Opposite Cantt. Road, Faridkot.	1
	Number of samples
Handpump (Rural)	
Near Main Road, Bargari, Faridkot.	1
Near Water Works, Jhakkarwala, Faridkot.	1
Village Lambwali, Faridkot.	1
Near Gurdwara Sahib, Near main road, Dod.	1
Near CHC Bajakhana, Faridkot.	1
Village Punjgrain kalan, Faridkot.	1
Village Seda Singh Wala, Faridkot.	1
Village Wander Jatana, Faridkot.	1
Near R.O system, Village Malla, Faridkot.	1
Near R.O System, Village Thara, Faridkot.	1

Table 2. WHO standards and obtained chemical parameters

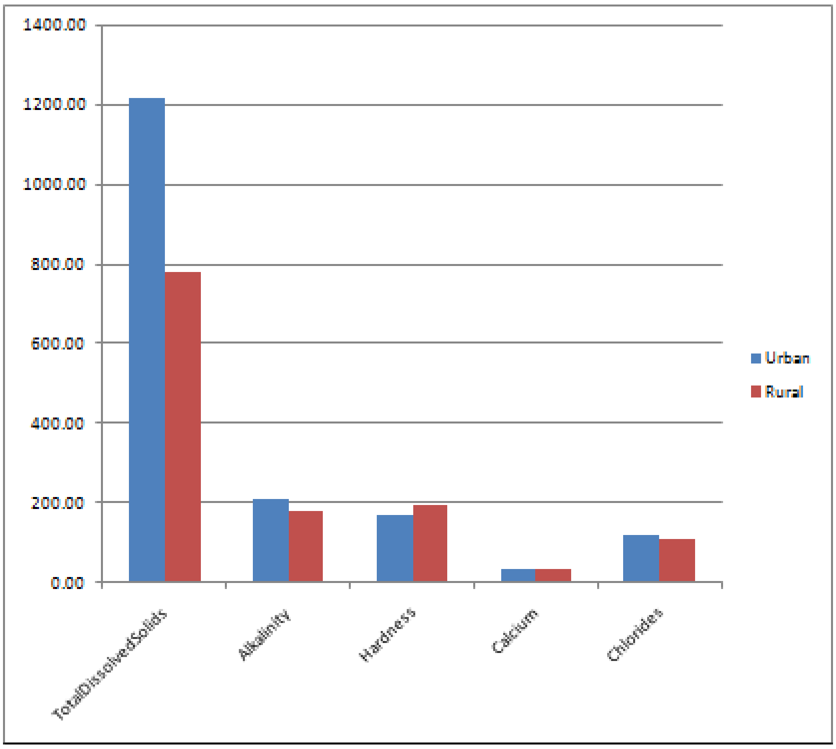
Chemical Parametes	WHO standards	Obtained values (Mean±SD)		
		Rural	Urban	p value
Turbidity	5 NTU	2.0840 ±0.068	1.5570± 0.38	.000
pH Value	7.0-8.0	9.0±0.00	9.0± 0.00	-
Total Dissolved Solids	500	7.7940E2±2.42	1.2210E3±3.63	.000
Alkalinity mg/L	200	181.6000±42.9	211.8000±78.6	.053
Total Hardness mg/L	100	195.4000±45.19	169.8000±40.13	.107
Calcium mg/L	75	35.4000±1.34	35.6000± 0.84	.651
Chlorides mg/L	250	110.4000±15.4	122.0000±63.73	.042
Flourides mg/L	1	2.2000±0.48	1.6500± 0.48	.006
Iron mg/L	0.1	.2000± 0.00	.2000± 0.00	

The total dissolved solids of rural area was more, 7.79 as compared to 1.22 of urban area (p = 0.00). The alkalinity of urban area was more, 211 which was more than WHO standards as compared to 181 of rural area (p = 0.053). The hardness of rural area was more, 195 as compared to 169 (p = 0.107) which was more than permissible levls of WHO. The calcium of urban area was almost same, 35.6 as compared to 35.4 of rural area (p = 0.651), chlorides of urban area was more, 122 as compared to 110 of rural area (p = 0.042) and fluoride of rural area was more, 2.20 as compared to 1.65 (p = 0.006) which were within the WHO limits. The iron was same for urban and rural areas (0.200) which was twice the permissible guidelines of WHO.

DISCUSSION

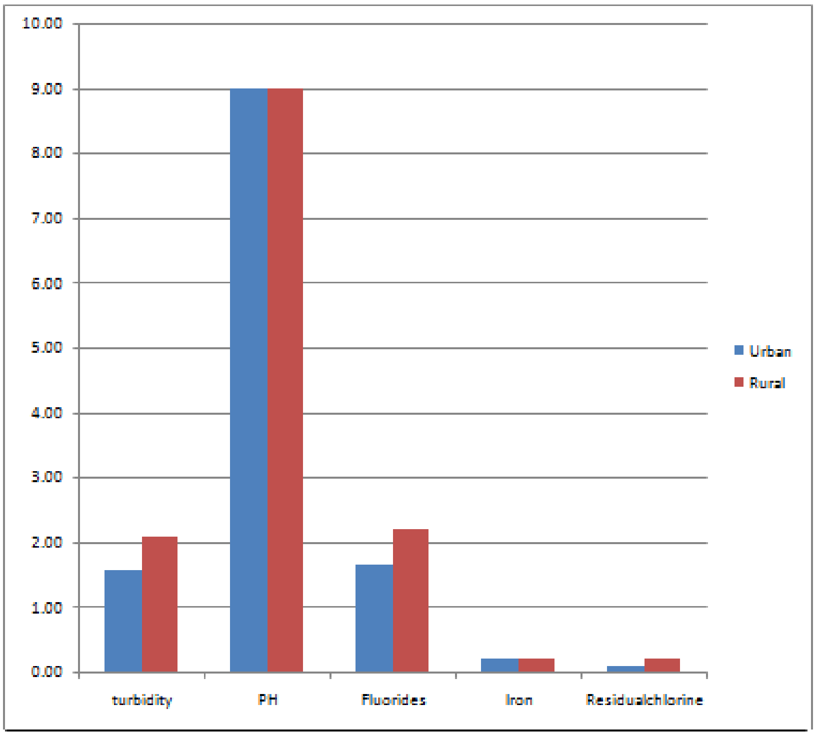
Groundwater depths around 7 m (23 ft) or less may be considered shallow. Some common types of pumps used for shallow wells are the traditional suction (pitcher) pump, foot pedal (treadle) pump and row pump. All of these pumps apply suction to the air or water in the rising main which in turn lifts water from the groundwater table up into the pump and out the spout. These pumps cannot lift groundwater deeper than 7 m because of their limitation in applying enough suction called net positive suction head (NPSH). This takes into account atmospheric pressure at sea level (1 atmosphere = 33.9 ft. of water at 4 C) friction losses, minor seal leakage and the normal temperature range of groundwater (Stewart *et al*., 2003).

Turbidity is a measure of cloudiness in water. The higher the turbidity, the cloudier the water appears. This can be caused by soil erosion, waste discharge, urban runoff, algal growth etc (Parmar *et al*., 2010; Chauhan *et al* 2010) in a study concluded that turbidity of river water increases in monsoon season due to erosin of soil from nearby areas. The higher the turbidity, the harder it is to see through the water. Drinking water should have a turbidity of ≤ 5 NTU. Turbidity becomes visible at approximately 5 NTU, and water with any visible turbidity may be rejected in favor of a clearer, possibly more contaminated source (Myre and Shaw). At places where water is chlorinated, turbidity should be less than 5 NTU/JTU and preferably less than 1 NTU/JTU for chlorination to be effective (Turbidity measurement). In the present study turbidity was less than 5 NTU however it was more than 1 NTU. Ground water pollution is intrinsically difficult to detect as the problem may well be concealed below the surface and monitoring is time consuming and hard to resolve. Pollutants move through several different hydrologic zones as they migrate through the soil to the water table. The contamination of ground water by heavy metals and pesticides has assumed much significance during recent years due to their toxicity and accumulative behaviour. Industrial disposal of chemicals by surface and sub surface runoff, direct release into natural water bodies or waste, dumped near the factories can be subjected to reaction with percolating rain water and reach the ground water level.



Comparing Mean
Y-Axis=Values
X-axis= Parameters

Fig. 1. Bar diagram showing the comparison of handpump in rural and urban area



Comparing Mean
Y-Axis=Values
X-axis= Parameters

Fig. 2. Bar diagram showing the comparison of handpump in rural and urban area

The percolating water picks up a large amount of dissolved constituents and reaches the aquifer system and contaminates the ground water (Govindarajan *et al*., 2014). The pH values of drinking water is an important index of acidity, alkalinity and resulting values of the acidic-basic interaction of a number of its mineral and organic components. pH below 6.5 starts corrosion in pipes, resulting in release of toxic metals In the present study pH value was 9, which was above the range prescribed by WHO (Telkapalliwar *et al*., 2014).

Alkalinity is a total measure of substance in water that has "acid-neutralizing" capacity. The main sources of natural alkalinity are rocks which contain carbonate, bicarbonate and hydroxide compounds; silicates and phosphates also contribute to alkalinity. Hardness in water is due to the natural accumulation of salts from contact with soil and geological formations or it may enter from direct pollution by industrial effluents. Hardness of water mainly depends upon the amount of calcium or magnesium salts or both. Total alkalinity values and hardness were found to be greater than the value prescribed by WHO standards (Sinha *et al*., 2011). The water used for drinking purpose should be free from any toxic elements, living and nonliving organism and excessive amount of minerals that may be hazardous to health. Some of the heavy metals are extremely essential to humans, for example, Cobalt, Copper, etc., but large quantities of them may cause physiological disorders.

The contamination of groundwater by heavy metals has assumed great significance during recent years due to their toxicity and accumulative behavior. These elements, contrary to most pollutants, are not biodegradable and undergo a global eco-biological cycle in which natural waters are the main pathways. The determination of the concentration levels of heavy metals in these waters, as well as the elucidation of the chemical forms in which they appear is a prime target in environmental research today. In the Faridkot district, ground water occurring in the shallow aquifer is saline except in some places where ground water is fresh which is due to occurance of fresh water lenses created by return seepage and canal seepage. Out of 149 villages only 17 villages are covered under safe ground water drinking supply schemes and remaning villages are covered under canal drinking water supply. Ground water decline and salinity is the major problem in the district. As there is vast Canal network in the block so presence of fresh water lenses due to return flow and canal seepage caused partial dependence on groundwater which causes water level decline. Ground water is declining at a rate of 0.75 m/yr (Pandey *et al.,* 2007; Patel *et al*., 2001), concluded that unlike surface water, ground water in south western districts namely Mansa, Bathinda, Muktsar, Firozpur and Faridkot contain varying concentrations of soluble salts and their use for irrigation adversely affects agricultural production.

Reverse osmosis (RO) systems are used to improve the quality of water. It is a water treatment method converts brackish or seawater to drinking water, to clean up wastewater and to recover dissolved salts from industrial processes. It is an effective method of reducing the concentration of total dissolved solids (TDS) and many impurities found in water. In the reverse osmosis process a cellophane-like membrane separates purified water from contaminated water. The RO membrane also functions as an ultrafiltration device, screening out particles, including microorganisms that are physically too large to pass through the membrane's pores. RO membranes can remove compounds in the 0.0001 to 0.1 micron size range (thousands of times smaller than a human hair) (Kneen *et al.,* 2005).

Conclusion

Analysis of handpump water in Southern region of Punjab during the study period revealed that the water is not suitable for drinking purpose and water should be treated with reverse osmosis system to render it fit for drinking purpose.

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