



Short Communication

Assessment of Water Quality For Drinking Purpose In Agra City, India

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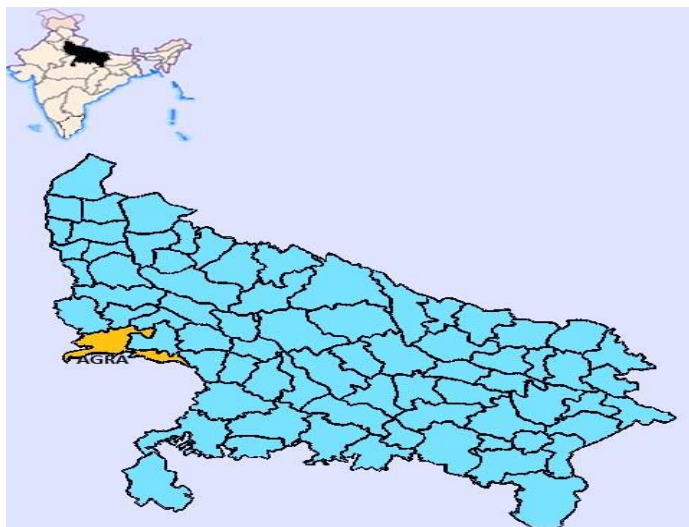
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Accepted on 18th November 2017, Published online on 27th November 2017

ABSTRACT

This paper presents a geochemical evaluation of the various parameters of drinking water sources of Agra city. Agra is situated on the banks of Yamuna River known for its brackish water, also the south-west side of city lies near fluoride rich area of Rajasthan. Therefore, it is desirable to independently monitor the quality of ground water sources. Groundwater quality shows wide variations which depends upon depth, hydrogeological conditions and human activities. Ten samples of ground water were collected from different locations in the city. It is observed that in ground water fluoride levels are much higher. The groundwater samples also show higher values of hardness, TDS. Apart from already affected people, a larger part of population is at risk. Similarly, estimation of other parameters like hardness etc. agrees well with observed ill effects.

Graphical Abstract:



Map of Agra District and Study Area

Keywords: Agra, Drinking water, fluoride, Ground water, hardness, TDS.

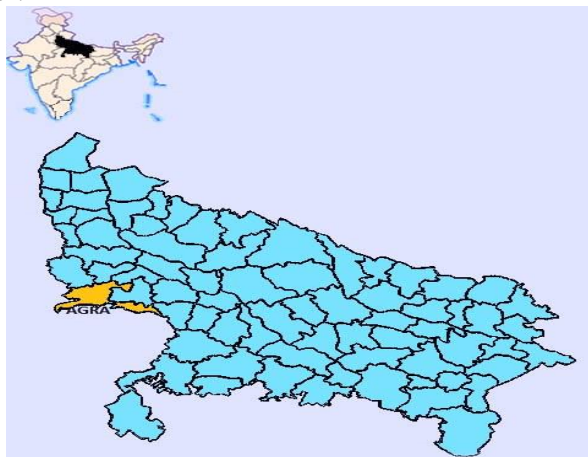
INTRODUCTION

Groundwater contamination is a serious global issue today. Continuously increasing level of contamination with a variety of toxic substances and lowering down of the groundwater table due to over-exploitation to meet globally increasing water demand followed by the declining annual recharge have brought them under severe constraints worldwide [1]. Majority of world population live in the areas with scarcity of clean potable water. Also, the dramatic increase in population resulted in an enormous consumption of the world's water reserves [2]. It is observed that human activities are a major factor determining the quality of the surface and groundwater through atmospheric pollution, wastewater discharges, use of agricultural chemicals, eroded soils, and land use [3-4].

Groundwater is a significant water resource in India and around the world for domestic, irrigation, and industrial needs. Most of the states like Andhra Pradesh, Rajasthan, Punjab, Uttar Pradesh, West Bengal, Bihar and Jharkhand are affected by fluoride and Arsenic [5-6]. Subba Rao (2009) has suggested that the main source of groundwater fluoride in granitic rocks is the dissolution and anion exchange with micaceous minerals and their clay products. Fluoride is found in all natural waters at some concentrations. Fluoride is one of the very few chemicals that have been shown to cause significant effects in people through drinking water. Fluoride has beneficial effects on teeth at low concentrations in drinking water, but excessive exposure to fluoride in drinking water, or in combination with exposure to fluoride from other sources, can give rise to a number of adverse effects. These range from mild dental fluorosis to crippling skeletal fluorosis as the level and period of exposure increases [8-9].

MATERIALS AND METHODS

Study Area: Agra city is selected for the study as it is known to be hotspot of drinking water supply because of the presence of major problems such as inadequate water supply, declining groundwater level and poor water quality. The major source of drinking water in city is groundwater with most of the drinking water supply depending on it. The Agra district is situated in western U.P., between 27.11' degree Latitude North and 78.0' degree to 78.2' degree Longitude East. Its Altitude is 169 meters above sea level. On the North it is bounded by Mathura District, On the South it is bounded by Dhaulpur District, On the East it is bounded by Firozabad District and On the West it is bounded by Bharatpur. Agra is situated on the bank of Yamuna River.



Map of Agra District

Most parts of city are known to having high fluoride content in ground water. The recommended level for tropical countries like India, where the maximum temperature goes above 45°C during summer season, should be in the range of 0.6–0.7 mg L⁻¹. In Agra Maximum Temperature in summer reaches above 45°C.

Ten ground water samples were taken from bore wells from various locations in different parts of city.

Table 1: Sampling stations

S.No.	Place	Area Type	Direction	Depth(approx)
S-1	Balkeshwer	Residential	NE	20m
S-2	Belanganj	Residential	E	15m
S-3	Trans Yamuna	Residential	E	15m
S-4	MehtabBaag	Garden	S	25m
S-5	Agra College	Institute	Centre	30m
S-6	Raja Mandi	Residential	Centre	30m
S-7	Sikandra	Residential	W-SW	40m
S-8	Lawyers Colony	Residential	N	40m
S-9	Shaheed Nagar	Residential	S	25m
S-10	DayalBaag	Residential	N	40m

All sample bottles were stored in a dark place and in their original closed plastic containers at room temperature until the fluoride analysis was made. After shaking the bottle of water, a 50mL sample was taken and kept in container, then coded so the type and the brands were unknown by the technician testing the water. Water samples were diluted with equal quantities of TISAB (Total Ionic Strength Adjustment Buffer) and the fluoride ion concentration was determined using a colorimetric method (alizarin dye). Other parameters were determined as per standard methods [10]. Two readings were taken for each sample then the average was recorded. The results are shown in Table 2.

RESULTS AND DISCUSSION

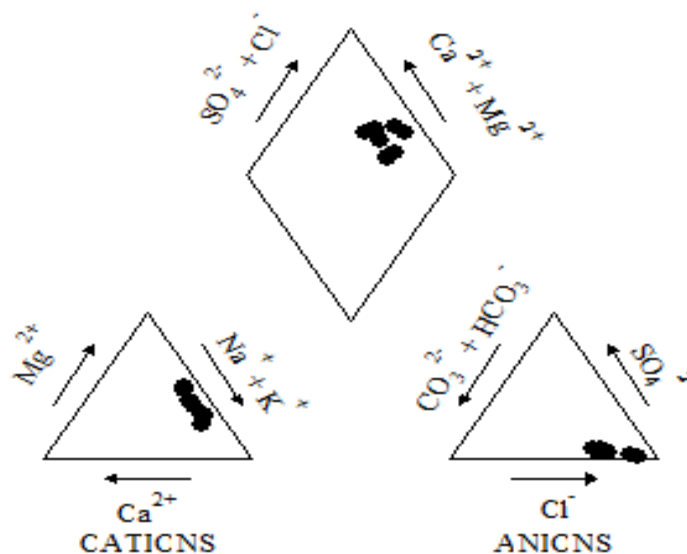
The Physico-chemical parameters of drinking water samples from six different locations of Agra city are given in Table 2. These results were compared with WHO (2006) and BIS (1991) drinking water standard [11-12].

Table 2: Parameter Results

Parameter	pH	DO	Alkn.	Cond	TDS	Hardness	Cl-	F-	K+	Na	Ca++	Mg++	SO ₄	HCO ₃
Mean	7.84	5.65	79.8	3.28	767.1	807	445.1	2.13	5.9	145.9	20.6	52.3	29.5	117.8
SD	0.18	1.54	11.26	1.58	126.9	271.91	248.36	0.77	1.28	12.96	2.17	19.6	7.04	9.57
Max	8.1	8.1	109	5.98	925	1280	855	3.1	8	162	25	88	42	135
Min	7.5	4	69	1.44	574	480	234	1.2	4	129	18	26	21	105

Determination of TDS is associated with the general acceptance of water by population as its presence in excessive quantities reduces the palatability and imparts bad taste to water. Wide range of TDS values are obtained from 574mg L⁻¹-925mg L⁻¹. All samples have total hardness value above permissible limit. On leaving for some time ground water leave white crust on pots. Fluoride content is found to be surprisingly high in most cases. Fluoride content in higher quantities is very dangerous and causes fluorosis. Fluoride is released into the ground water through weathering of primary silicate and associated accessory minerals. Most of samples have fluoride values near or above WHO permissible limit. Large numbers of graphical and statistical methods are available to depict the relative concentrations of various ionic components of natural water [13].

One of the most used methods is Piper Diagram (Fig.3). It graphically shows the relative abundance or occurrence of ionic constituents in a given water sample [15,16]. As seen from Piper diagram in figure the most abundant type is Na-K-Cl. The chloride contents are found to be spread over a wide range of 234ppm to 855ppm. Due to the relatively higher sodium content most of ground water samples have salty taste.



Piper Diagram of groundwater samples

APPLICATIONS

These results bring awareness in Public to know what type of water they are drinking.

CONCLUSIONS

Water quality standards WHO (2006) and BIS (1991) shows water quality of none of the samples is not suitable for domestic purposes without prior treatment. Most of the samples are not potable for drinking purpose. These contain high amount of Cl^- , TH and F values as given in table 2. The values of EC are quite high. Higher values of EC indicate higher TDS. Overall water from all sampling stations has excessive concentration of dissolved solids and hard to very hard. Therefore all the water samples may be used for drinking purpose only after proper treatment like reverse osmosis.

ACKNOWLEDGEMENTS

Author is grateful to University Grant Commission (UGC), New Delhi for financial assistance under the major research project scheme.

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