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The physico-chemical analysis of five major areas drinking water quality in Moradabad district

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Abstract

About 90% of earth's water is unfit for human consumption as it is in the form of Ocean/Sea water of the remaining two percent in form of polar ice and one percent in form of lakes, rivers, streams and ground water for safe uses of human beings. However, the quality of drinking water is always a less priority area for the rural population in developing countries like India. Now a days, the potable water crisis facing by us are in two forms firstly, quantity is depleting and secondly quality is deteriorating day by day either by point or non point (diffusion) pollution and by increasing population density. Hence the poor attention towards the quality of drinking water concerns with the several health problems such as digestive problems, hypertension, sickness and falling of hairs, renal problems etc.

In Moradabad town there is no tap water connection in residential areas which were found to be suitable for drinking and domestic purposes, only bore well (tube well) is used and to be used mostly for domestic purposes. In the present study an attempt has been made to find out the status of ground water taking into account physicochemical characteristics of drinking water. A comprehensive rather selective water quality parameters which affect the health were assessed *viz.*- temperature, pH, COD, turbidity, total hardness, fluoride, chloride, nitrate and iron. Inhabitants using ground water resources were found to suffer from various water born diseases/ailments. The result of the study is compared with the drinking water quality parameters of different agencies (BIS/WHO/ISI/ICMR) more over the result may provide a chemical index formulation needed for ground water management in this gagan region, Moradabad.

Keywords: ground water contamination, health problems

Introduction

Water pollution is a serious cum alarming problem as in India almost 70% of surface and ground water reservoirs have been contaminated by biological, inorganic and organic pollutions. However, the ability and quality of drinking water or fresh water has become a scare commodity due to over exploitation.

Much of the health problems in developing countries are largely due to lack of safe drinking water. According to WHO, about 600 cases of diarrhea and 46,00,000 child deaths are reported annually due to contaminated water and improper sanitation ground water is particularly safe drinking water in rural and sub-urban areas, where population is widely dispersed which completely lacking of infrastructure for treatment of surface water and contaminated water. In the absence of good quality of drinking water people resort to unsafe sources which affect their health especially children^[1]. It is of concerned that about 2.4% of infants below one year die of diarrhea in India and this figure is 3.7% for UP.

However the rural drinking water depends on ground water (85%) which contaminated due to geo chemical activities and industrial waste disposal -iron, fluoride, arsenic, total dissolved solids etc. and anthropogenic activities such as wide use of agrochemicals and improper sanitation and pit laterins. Hence several pollutants/contaminants affect human health in different ways. For example- consumption of water with high salinity (total dissolved solids) causes kidney stones, skin diseases and blood pressure and these are commonly seen in this Gagan river region, Moradabad, UP.

The quality of ground water has been compared with the standard desirable limit & quality parameters as prescribed by different agencies is shown in Table-1

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Table 1: Portable water quality standards (desirable) of different agencies [2-7]

Parameters	BIS		ISI		ICMR		WHO	
	HDL	MPL	HDL	MPL	HDL	MPL	HDL	MPL
pH	7.0-8.53	8.5-9.0	6.5-8.5		7.0-8.5	6.5-9.2	7.0-8.5	6.5-9.5
TDS mg/L	500	2000	500	2000	500	1500	-	-
TH mg/L	200	600	300	600	300	600	200	600
Alkalinity mg/L	300	600	200	600	300	600	-	120
COD mg/L	150	255	150	245	-	-	-	255
Ca mg/L	-	75	-	75	-	-	-	75
Chloride mg/L	-	250	-	250	-	250	-	250
F mg/L					-	-	-	1.5

HDL-Highest Desirable Level, MPL-Maximum Desirable Level

Experimental

Study area: Moradabad is a city of Uttar Pradesh, India, famous for Brass Metal Handicrafts not only in India but also in abroad since ancient times. This city is situated in western U.P. between 28°-21' to 28°-16' Latitude North and 78°- 4' to 79 Longitude East. Ram Ganga River flows in the north east and Gagan River is there in south west of the city. Gagan river rises in the north of the district Bijnor and enters in the district Moradabad near village of Kalmukhia, district Amroha and forms the boundary of the district in the north for a short distance. It then flows in a winding course in a south-easterly direction for about 5 Kms and then goes on towards the south west about two Kms. Near the village of Isapur it makes a bend and again flows on in a south easterly direction. Preceding in the same direction it forms the natural boundary between Amroha and Moradabad for about 2 Kms and again further on between Moradabad and Bilari. It leaves the district near the village of Turtipur (In Bilari). It has well defined banks which are generally high and firm on the east and low and sandy towards the west. In the upper course the character of the bed is clayish sand which gradually becomes clayish in the south. The river is crossed by Girder bridge near the villages of Lakri Fazalpur and Pandit Nagla in Moradabad on the Delhi –Lucknow and the Moradabad –Chandausi road respectively.

The brass industry in Moradabad is regularly discharging the effluents into the river Gagan. River Gagan receives almost all the domestic and industrial effluents of Moradabad city. The water of river Gagan is highly polluted by direct contamination of sewage and industrial effluents. Quality of river water is degrading day by day hence there is an acute need of measuring physico-chemical parameters of rivers at a

regular basis. In present study, an attempt is made to monitor the physico chemical water parameters of river Gagan and assess the extent of pollution by comparing the results with WHO standards.

The physicochemical characteristics of ground water of five selected points in Moradabad Town viz. PA campus Mandi chowk, Lajpat nagar, Katghar, Majhola, Moradabad, were studied. Borewell water from these stations was collected in the months of October 2018 to February 2019. The depth of the bore wells ranges from 16 feet to 22 feet in all stations or areas of Moradabad Town. The sampling stations with their corresponding habitats and bore well sampling depths are summarized Table-2. The samples were collected in a clean 2 liter polythene bottles. The bottles were tightly sealed after sampling and labeled of stations. The colour and temperature of the sample were also measured of the time of sampling. The samples were refrigerated of temperature 4 °C to 5 °C as per standards procedures.

Analysis water samples

Analysis of water sample was carried out for various physicochemical parameters viz. Temperature, pH, Total Hardness (TH). Alkalinity, COD, Electrical Conductivity (EC), fluoride Chloride nitrate, calcium and iron. The electrical conductivity and pH was measured with digital conductivity meter and pH meter respectively. Total hardness (TH) and calcium content by EDTA titrimetric method alkalinity and COD by open reflux method.

Results and Discussion

Experimental results of various physicochemical parameters of the underground water samples are summarized in Table 3.

Table 2: Sampling localities with their corresponding habitats and bore well depth

S.no	Sampling Locality (Station)	Habitat	Bore Well Depth (In feet)	Source
1	Police academy campus	Residential Area	22-22	Bore Well
2	Mandi chowk	Residential Area	19-21	Bore Well
3	Lajpat nagar	Residential Area	18-19	Bore Well
4	Katghar	Residential Area	20-22	Bore Well
5	Majhola	Residential Area cum Marketing Yard	18-21	Bore Well

Table 3: Physico-Chemical analysis of bore well/hand pumps Water (Oct 2007 to Feb 2008)

S.no.	Temp (°C)	Moradabad town municipality areas				
		PA campus	Mandi chowk	Lajpat nagar	Katghar	Majhola
1	Temp (°C)	22	21	20	21.5	23
2	pH	7.8	7.3	6.9	6.8	7.3
3	EC (ms)	0.12	0.10	0.12	0.32	0.10
4	TH (mg/L)	121	130	201	150	150
5	COD (mg/L)	120	140	148	156	169
6	Chloride (mg/L)	70	80	87.8	112	193
7	Alkalinity (mg/L)	90	102	140	170	195
8	Calcium (mg/L)	70	80	88	109	115
9	TDS (mg/L)	800	980	1100	1400	1820
10	Fe mg/L.	72.10	79.5	87.4	92	102.80

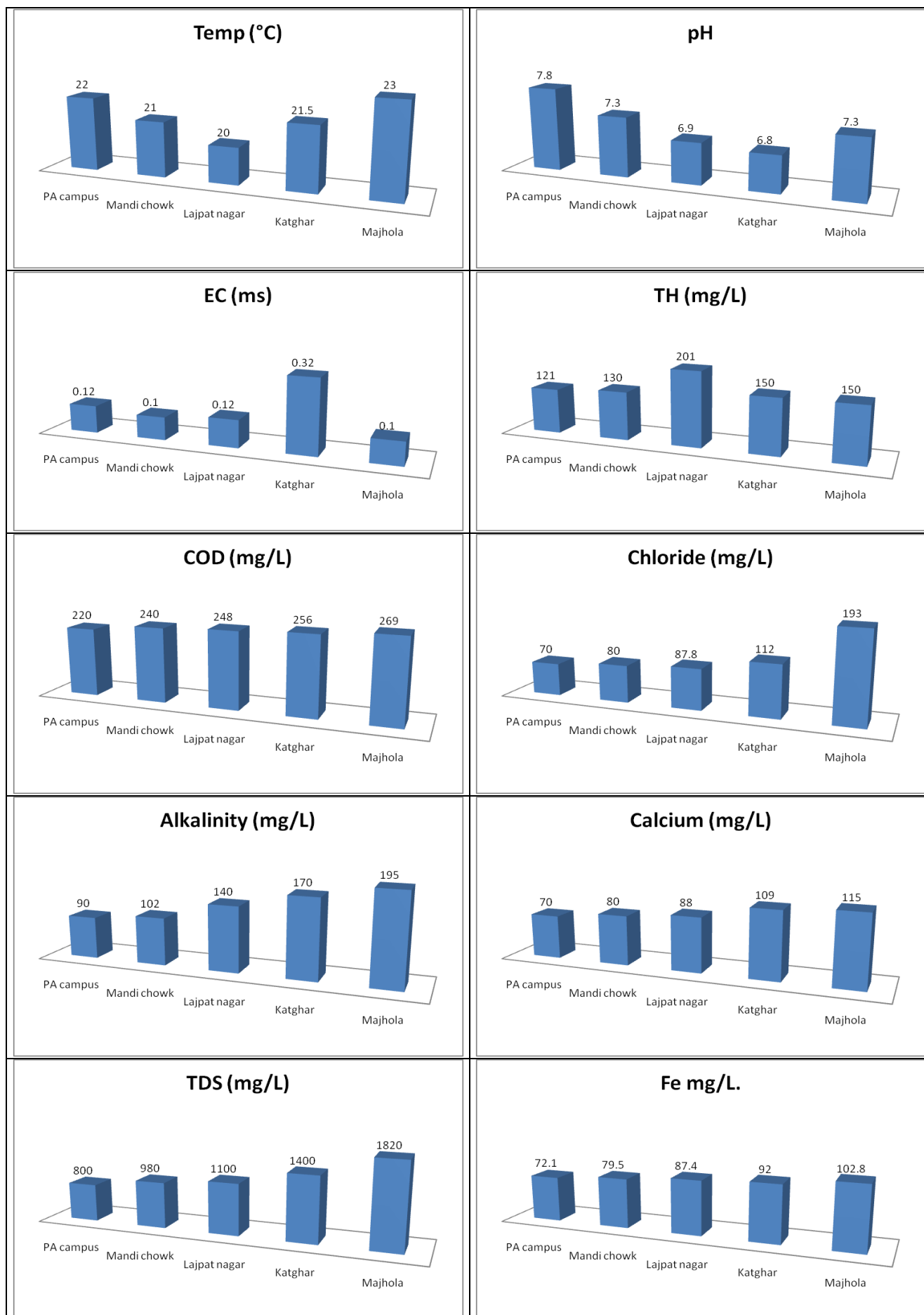


Fig 1: Comparative analysis of Physico-Chemical analysis of bore well/hand pumps Water

Existing concentration of Fe in Ground water due to geochemical activities in anaerobic condition 72.10–102.80 mg/L.

The temperature was found to be in the range between 21 °C to 23 °C during study. High temperature can enhance the activities of microorganism hence it can increase the pollution level [8-12].

pH: The pH of ground water in the study area is varying between 6.8 to 7.8. It is observed that most of the ground water is alkaline in nature and it is influenced by geology of catchment area [13-16].

Electrical Conductivity (EC): The electrical conductivity of the borewell samples varies from 0.10 to 0.12 ms of 25 °C [17].

Total Hardness (TH): The observed TH values were within the limits and fluctuating trends in its value were observed in all the five stations and varies from 121-150 mg/L. The specified limit for TH as per WHO is 200 mg/L [18-20].

Chemical Oxygen Demand (COD): The permissible limit of chemical oxygen demand for drinking water or potable water is 255 mg/L (ISI 1983) and the observed values are 220 to 269 mg/L of all selected habitat areas are not within the desirable limit to use the water as drinking or even washing purposes [21].

Chloride: Chlorides were found to be 70 mg/L to 193 mg/L and highest value (193 mg/L) in the Majhola water sample. Higher concentration of chlorides in the ground water may be accounted to seepage of septic tanks and somewhere adjacent position of bore well with respect to septic tanks [22].

Calcium: Calcium concentrations were found to vary from 70 to 115 mg/L. The Ca hardness observed in four stations is above the desirable limits as specified by ISI Le. 75 mg/L [16].

Alkalinity: It is a quantitative capacity to neutralize a strong acid to a designated pH. The alkalinity determined as phenolphthalein alkalinity and total alkalinity or as methyl orange alkalinity. The reaction which takes place can be summed as

- i) $\text{OH}^- + \text{H}^+ \rightleftharpoons \text{H}_2\text{O}$ end point with End point with
- ii) $\text{CO}_3^{2-} + \text{H}^+ \rightleftharpoons \text{HCO}_3^-$ phenolphthalein methyl orange
- iii) $\text{HCO}_3^- + \text{H}^+ \rightleftharpoons \text{H}_2\text{CO}_3$ (phenolphthalein Alkalinity) (Methyl Orange alkalinity or total)

The alkalinity of catchment areas varies in between 90 to 195 mg/L [16-21].

Geochemical/Environmental Activity: Ground water may not be of desired quality for potable use because of geochemical conditions of geochemical formation. For instance fluoride, arsenic and iron contamination its ground water is mainly due to geochemical activities. Though iron content in drinking water may not affect the human system as a simple dietary load or overload. However in the long run high accumulation of iron in the body may result in Hemochromatosis (damaging of tissues) [4, 14-16, 23]. On the other face this gagan river region (eastern part of UP) On standing the ground water sample (contaminated by Fe(ii)

ion) in aerobic condition Fe(ii) oxidized to Fe(iii) and impart a Reddish Brown (light) on the surface of water. After long use the container inner wall get reddish brown.

Conclusion

River Gagan, in the western gangetic plains, is posing serious threat to riparian communities by contaminating shallow riparian zone groundwater. To manage groundwater contamination, this study attempts to investigate the nature of groundwater-river water interaction, during February to April 2018, along a segment of river Gagan near Moradabad in western Uttar Pradesh, India. River discharge was measured at three locations in two phases. Hydraulic heads in mini-piezometers were observed twice weekly. Forty water samples were analyzed for major ions, nitrate, fluoride, TDS, pH, EC. River discharges and river bank vertical hydraulic gradients reveal that river gagan is losing water to riparian aquifers. Hydro-chemical analysis shows discordance in the pattern of ionic concentrations of river and groundwater, a distinct clustering of river and groundwater for both sampling periods. Ionic concentrations in groundwater with distance from channel indicate potentially clogged riverbed conditions that reduce the interaction of river water with riparian groundwater. According to the study the borewell water quality of police academy campus is in range of good while mandi chowk is found to be polluted, the lajpat nagar and katghar bore well water is highly polluted and not suitable for drinking, while majhola borewell water is subjected to heavy metal contamination and highly opposes to drinking as it may cause the cancer and other water born diseases.

Also the Improper and poor location of bore wells/hand pumps with respect to septic tanks and sewer pipes will increase the potential for the leaching of effluent to the underground table. Besides the large brass industry and the waste disposal treatment of these metallic industry were also found to be more responsible for the ground water contamination. The result indicates that the water quality of bore wells are polluted (having existing concentrations of iron) is not best for domestic purposes. In conclusion from the results it may be said that the ground water of Moradabad town is through fit for domestic and drinking purpose need treatments to minimize the contamination.

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