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Seasonal variation of groundwater quality in some villages of Barara block of Ambala district, Haryana

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Abstract
The present study was carried out to assess the presence of heavy metals in ground water of Barara block of Ambala district during pre-monsoon and monsoon session, 2015. A total 30 ground water samples were collected from 30 different villages of Barara block of Ambala district. All the water samples were tested positive for the presence of heavy metals. The cadmium, chromium, copper, lead, iron and zinc concentration in groundwater varied from 0.004-0.01, 0.02-0.05, 0.216-0.877, 0.033-0.057, 0.118-0.485 and 2.0-3.99 mg/l respectively. The highest concentration reported was for the Zn metal ions. The obtained results of the water quality parameters clearly revealed that groundwater of Barara block was safe for drinking purposes as all the tested metal ions concentration were found within the Bureau of Indian Standards (BIS).

Keywords: Groundwater, Water quality, AAS, Heavy metals, BIS.

1. Introduction
Drivers for change
Water is the most precious natural resource on this planet Earth. Polluted water leads to destruction of all life forms. For healthy environment, it is our duty to protect this natural precious resource for our future needs. As the population is growing day by day there is more requirement of drinking water. Good quality water makes our surrounding and environment healthy and poor quality water reflects nothing except epidemic diseases and degradation. One of the most important environmental issues today is groundwater contamination. Groundwater contamination unlike others is very critical, as once an aquifer becomes polluted, it is very difficult, expensive and time consuming affair to clean it up and may remain unusable for decades (Rout and Sharma, 2011) [1]. The problem of ground water pollution due to heavy metals has now raised concerns all over the Globe and results reported by various researchers have been alarming (Lueng and Jiao, 2006; Demirel, 2007; Nganje *et al*., 2007; Shinkai *et al*., 2007; Rout *et al*., 2011) [2, 3, 4, 5, 1]. The quality of ground water is very important in evaluating its utility in various fields such as domestic, agriculture and industrial purposes. Groundwater can be optimally used and sustained only when the quantity and quality is properly assessed (Rout and Rani, 2013) [7]. Realizing the significance of groundwater for various purposes, a systematic study was planned and conducted. The objective of the present study was to assess the status of heavy metals concentration in the groundwater of Barara block of Ambala district.

2. Materials and Methods
Description of Study Area
Study area is the Barara block of Ambala district in the Indian state of Haryana. At present Barara block is an emerging area for industries as its host's production units for paper, metals, chemicals, thread mills and air-conditioners, thus air pollution and water pollution is quite a concern. There are 66 numbers of villages in Barara Block. The geographical location of Barara block of Ambala district is shown in figure 1. For the present study 30 different villages of Barara block were selected randomly.

Fig 1: Geographical location of Barara block of Ambala district

Sampling and Analytical Methods

A total 30 ground water samples were collected from 30 different locations of Barara block of Ambala district during pre-monsoon and monsoon seasons of the year 2015. Water samples were collected directly from the tube wells after running the tube well for about 3 minutes. Water samples were collected in precleaned, sterilized, polyethylene bottles of 1 litre capacity, between 8:00am to 5:00pm. All the heavy metals were analyzed by Atomic Absorption Spectrophotometer (AAS). The details of the sampling sites are presented in table 1.

Table 1: Name of Sampling Stations

Sample No.	Name of sampling station	Approximate Depth (Feet)	Year of Establishment	Sources
1	Salhapur	200	2003	Tube well
2	Adhoyi	200	1999	Tube well
3	Buddian	280	2007	Tube well
4	Barara	260	2000	Tube well
5	Khan Ahmadpur	230	2007	Tube well
6	Tangail	250	2011	Tube well
7	Dheen	300	2004	Tube well
8	Gagan Pur	300	2008	Tube well
9	Hema Majra	250	2010	Tube well
10	Rajokheri	270	2012	Tube well
11	Paplotha	280	2004	Tube well
12	Sherpur	200	2003	Tube well
13	Simbla	270	2006	Tube well
14	Moujhgarh	280	2003	Tube well
15	Mullana	200	2004	Tube well
16	Ponti	270	2007	Tube well
17	Dhonora	250	2009	Tube well
18	Subri	250	2011	Tube well
19	Dliani	250	2005	Tube well
20	Sirasgarh	260	2003	Tube well
21	Jahangirpur	300	2012	Tube well
22	Patti Bagheru	300	2009	Tube well
23	Tangail	280	2013	Tube well
24	Sohana	250	2011	Tube well
25	Nahra	300	2006	Tube well
26	Rukri	320	2007	Tube well
27	Buhian	260	2012	Tube well
28	Duliana	270	2008	Tube well
29	Holi	250	1999	Tube well
30	Sarakpur	300	2011	Tube well

3. Results and Discussions

Cadmium (Cd^{2+})

The cadmium content in the ground water samples of the study area varied in between 0.004-0.010 mg/l. It was found minimum of 0.004 mg/l at sampling stations 2, 20 and 21 to maximum 0.010 mg/l at sampling stations 1, 3, 4, 5, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 22, 25, 26, 27, 28 and 30 in Pre-monsoon seasons. At sampling stations 6, 7, 23, 24 and 29, cadmium concentration was not detected in both the seasons as shown in figure 2. The overall result shows that cadmium concentration in ground water samples were found below the permissible limit as prescribed by BIS.

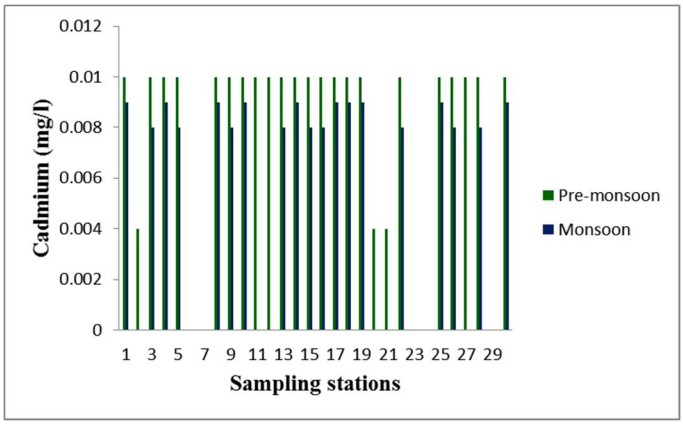

Fig 2: Cadmium concentration of ground water at sampling stations

Chromium (Cr)

The chromium content in analysed water samples varied from minimum 0.020 mg/l at sampling station 29 (Monsoon) to maximum 0.05 mg/l at sampling station 9, 16, 18 and 26 (Pre-monsoon), presented in table 2. The overall analysis results showed that the chromium content of groundwater was found below the permissible limit as prescribed by BIS. At sampling stations 11, 12, 22 and 23 chromium concentration was not detected in both the seasons, shown in figure 3.

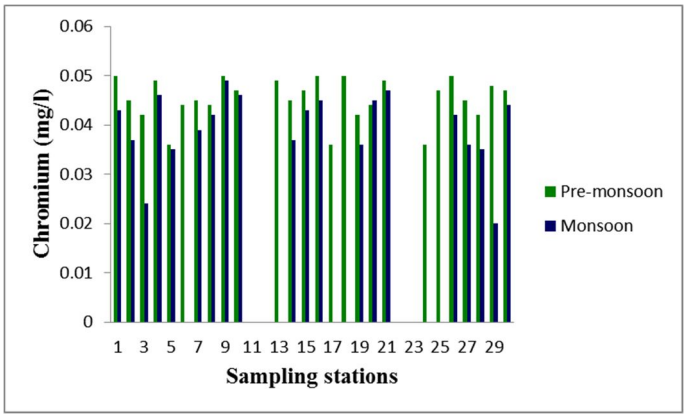

Fig 3: Chromium concentration of ground water at sampling stations

Copper (Cu^{2+})

In the present study the copper concentration was varied from minimum 0.216 mg/l at sampling station 24 (Monsoon) and to maximum 0.877 mg/l (Monsoon) at sampling station 9, shown in table 2 and figure 4. The overall analysis results showed that the copper concentrations of ground water samples were found below the permissible limit as prescribed by BIS.

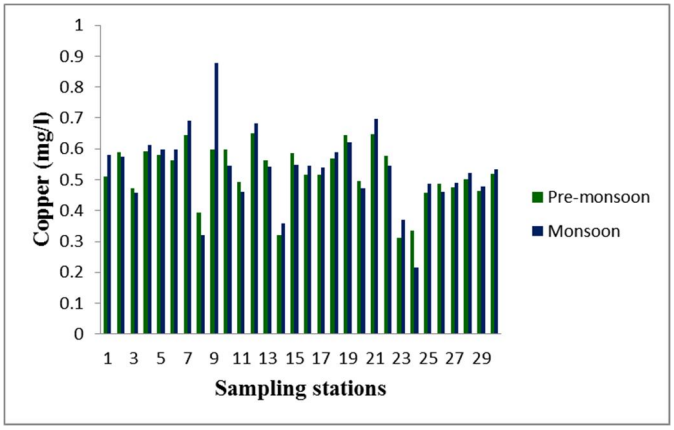

Fig 4: Copper concentration of ground water at sampling stations

Lead (Pb^{2+})

In the present study the lead concentration was varied from minimum 0.033 mg/l at sampling station 20 (Monsoon) to maximum 0.057 mg/l at sampling station 16 (Pre-monsoon), presented in table 2. At all sampling stations the lead content was found below the desirable limit as prescribed by BIS. At sampling stations 15, 22, 26 and 27 the lead concentration was not detected, shown in figure 5.

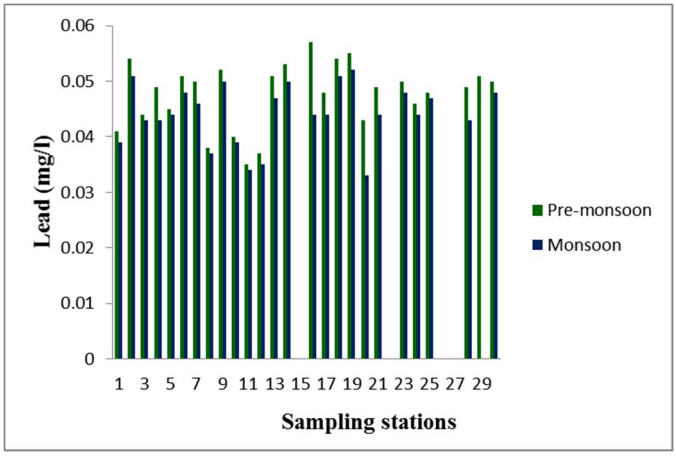

Fig 5: Lead concentration of ground water at sampling stations

Iron (Fe)

The iron concentration was varied from minimum 0.118 mg/l at sampling station 11 (Pre-monsoon) to maximum 0.485 mg/l at sampling station 21 (Pre-monsoon), shown in table 2 and figure 6. At all the sampling locations the iron content was found below the maximum limit as prescribed by BIS.

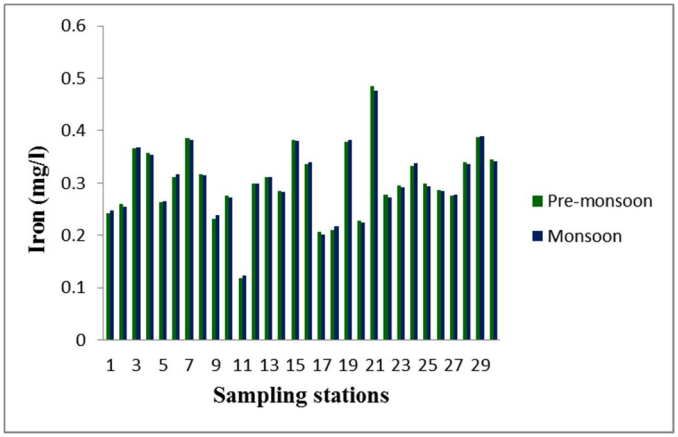

Fig 6: Iron concentration of ground water at sampling stations

Zinc (Zn^{2+})

The zinc content in analysed groundwater samples varied from minimum 2.00 mg/l at sampling station 19 (Monsoon) to maximum 3.99 mg/l at sampling station 9 (Pre-monsoon), shown in table 2 and figure 7. At all the sampling locations the zinc content was found below the desirable limit as prescribed by BIS.

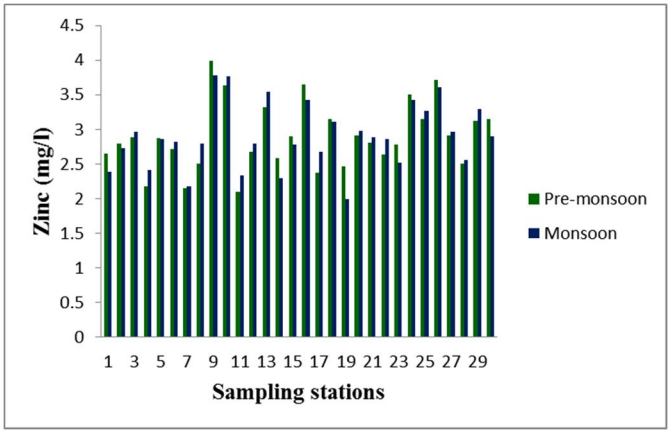

Fig 7: Zinc concentration of ground water at sampling stations

Table 2: Comparison of heavy metals content in groundwater of Barara Block area with drinking water quality standards (BIS)

Parameter	Observed Range of Samples		Bureau of Indian Standards	
	Minimum	Maximum	Desirable limit	Maximum limit
Cadmium	0.004 mg/l	0.010 mg/l	0.01 mg/l	No Relaxation
Chromium	0.020 mg/l	0.05 mg/l	0.05 mg/l	No Relaxation
Copper	0.216 mg/l	0.877 mg/l	0.05 mg/l	1.5 mg/l
Lead	0.033 mg/l	0.057 mg/l	0.1 mg/l	0.3 mg/l
Iron	0.118 mg/l	0.485 mg/l	0.3 mg/l	1.0 mg/l
Zinc	2.00 mg/l	3.99 mg/l	5 mg/l	15 mg/l

4. Conclusions

Groundwater samples were tested for assessment of six different heavy metals like cadmium, chromium, copper, lead, total iron and zinc present in them. Each parameter was compared with the standard limits prescribed by Bureau of Indian Standards (BIS). Based on the analysis results; the following conclusions have been made:

1) All heavy metals concentrations (Cd, Cr, Pb, Cu, Fe and Zn), are within the maximum permissible limit as prescribed by BIS at all the sampling stations.
2) The abundance of heavy metals content of ground water in Barara block of Ambala district is in the order of: Zinc > Copper > Iron > Lead > Chromium > Cadmium.

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