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A Study into Trace Metals Profiles in Ground Water of Bilaspur City

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Abstract: *In Present study we analyses Trace metals Contents from Ground Water of Bilaspur City. The Trace metals covered are Fe (Iron), Zn (Zinc), Cu (Copper) and Ni (Nickel). Natural Trace Metals concentration in Ground Water due to erosion and weathering of parent rocks. Trace metal analysis was done on A.A.S. (Atomic Absorption Spectrophotometer) by direct aspiration method. Sixty Water sample were collected from ten hand pumps of Bilaspur city in different location during the period March 2012 to March 2014.*

The finding from the analysis indicated that in all the samples Cu, Zn and Ni concentration have been shown below the standard permissible limit but concentration of Iron in five Water samples were higher than the permissible limit.

Keywords: *Trace Metals, A.A.S. permissible limit, Ground Water.*

1. INTRODUCTION

The recent survey of United Nations indicate that over 980 per cent of diseases in the developing countries are water borne due to poor quality of drinking water and inadequate sanitation facilities. Ground water is a major source of water for most of the rural population. This is probably because of its accessibility, scattered nature of settlements and other factors which inhibit the provision of treated water to such areas. Usually ground water is not treated but is found in raw in its original forms. It is usually taken for granted that water is clean because it is found deep below the earth, since pathogenic bacteria and other visible disease causing organism cannot survive at very great depth below the earth and therefore the water is considered safe for consumption. Even though these pathogens may not be available at these depths, there are other substances which may not depend on depth of ground water but are equally dangerous when taken in excess. These substances include inorganic elements which are either metals or non-metals and are derived from the rocks or soils with little contribution from the air. Some trace metals are priority toxic pollutants that severely limit the beneficial use of water for domestic or industrial application (Petrus et al 2005) Trace metals like Cu, Zn and Fe are necessary in low concentration for all living organism. While most of them cause toxicity hazards, when present in high concentration (Merian 1991). Urbanization, (Harrison and Wilson, 1985, Gracica et al 1996; pit 1996, Pagatto et.al 2001, Ransivek and Jekel 2005). Industrial activity (Brantley and Townsend 1999) and agricultural practices (Fertilizers and Pesticides application to farmlands) have environmental adverse effect (e.g. ground water contamination with trace metals) because fertilizers are usually not sufficiently purified during the process of manufacture for economic reasons, they usually contain several impurities, among these trace metals. Also heavy metals often form a part of active compounds of pesticides.

A surplus of trace metals in ground water is frequently caused by using fertilizers, unetallo-pesticides and sewage sludge. Among the fertilizers that used in farmlands superphosphates contains the highest concentration of Cd, Co, Cu and Zn Copper Sulphate and Iron Sulphate have the highest contents in Pb and Ni (Eugnia et al 1995) urban runoff (Allen et al 2002) and industrial activities that can be transport to ground water with recharged waters.

The industrial development and the fact that most contaminants penetrate into soil and eventually ground water have caused pollution increases all acting as a threat to present world. Information on the water sources quality is of great importance in water quality management and water supplies field.

2. METHODS AND MATERIALS

The water samples were collected from ten sampling stations. Hand pumps of various locations of Bilaspur city were collected in the first week of every three months continuously for two years (2012-13) in pre-cleaned 2.5 liters capacity polythene bottles. Water samples acidified to pH < 2 with conc. HNO_3 on collection sites, transport to laboratory and then stored in refrigerator at approximately 4° to prevent change in volume due to evaporation.

The analysis of trace metals was carried out with the help of AAS (Atomic Absorption Spectrometry) AAS is well known and reliable technique; it is preferred method of element analysis. In this technique light beam is directed through the flame, into a monochromator and on to a detector that measures the amount of light absorbed by the atomized element in the flame. AAS exhibits superior sensitivity because each metal has its own characteristic absorption wavelength.

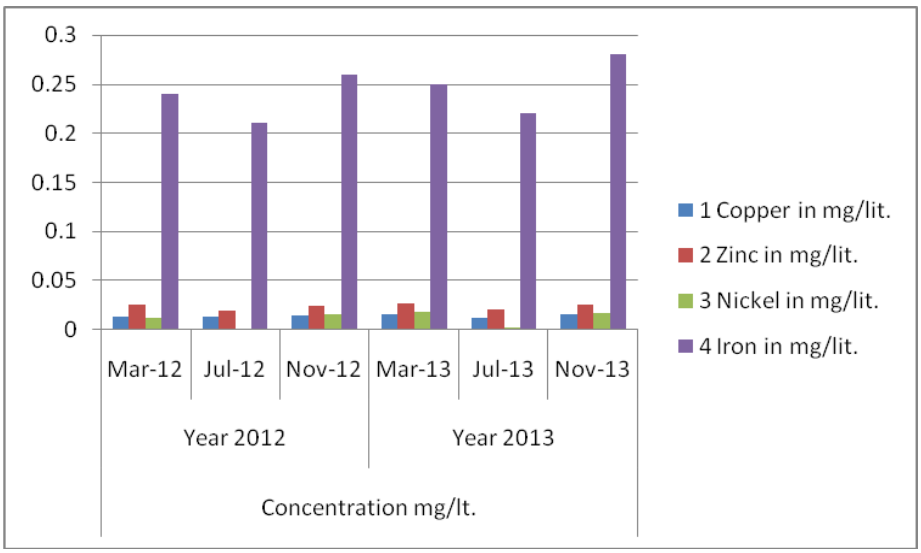
The amount of energy of the characteristic wave length absorbed in the flame is proportional to the concentration of the element in the sample.

3. TABLES AND GRAPHS

Table No. 1. *Trace metals concentration present in the ground water of Bilaspur City during Year 2012-13*

Supplying Station – 01 (Nehru Nagar)

S.No.	Metal	Concentration mg/lt.					
		Year 2012			Year 2013		
		March 2012	July 2012	Nov 2012	March 2013	July 2013	Nov 2013
1.	Copper in mg/lit.	.013	.013	.015	.016	.012	.016
2.	Zinc in mg/lit.	.026	.020	.025	.027	.021	.026
3.	Nickel in mg/lit.	.0120	.001	.016	.018	.002	.017
4.	Iron in mg/lit.	.240	.210	.260	.250	.220	.280



Graph 1. *Trace metals concentration present in the ground water of Bilaspur City during Year 2012-13*

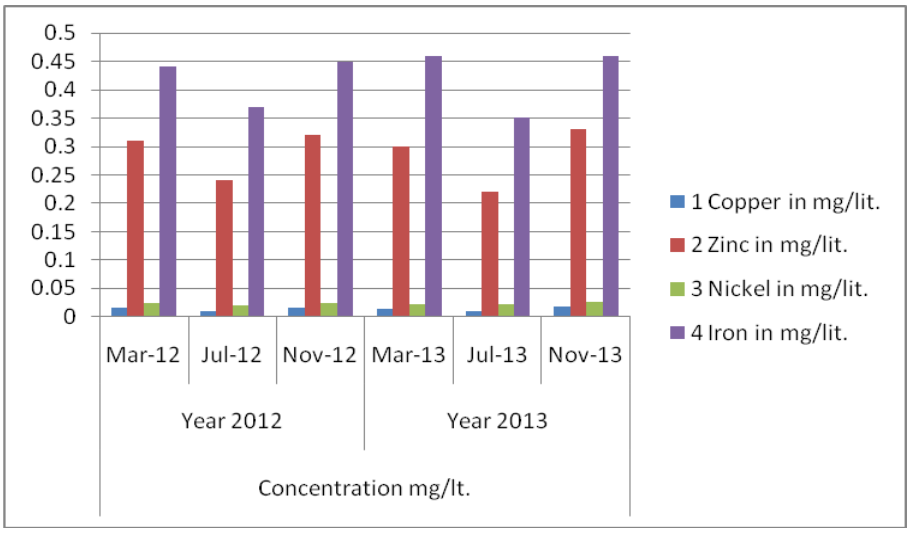
These samples were collected from Nehru nagar sampling station, Bilaspur. The table shows that the water quality is up to the Indian standards.

Table No. 2. *Trace metals concentration present in the ground water of Bilaspur City during Year 2012-13*

Supplying Station - 02 - S_2 (Ameri)

S.No.	Metal	Concentration mg/lt.					
		Year 2012			Year 2013		
		March 2012	July 2012	Nov 2012	March 2013	July 2013	Nov 2013
1.	Copper in	.017	.011	.016	.015	.010	.018

	mg/lit.						
2.	Zinc in mg/lit.	.310	.240	.320	.300	.220	.330
3.	Nickel in mg/lit.	.024	.020	.025	.022	.023	.026
4.	Iron in mg/lit.	.440	.370	.450	.460	.350	.460



Graph 2. *Trace metals concentration present in the ground water of Bilaspur City during Year 2012-13*

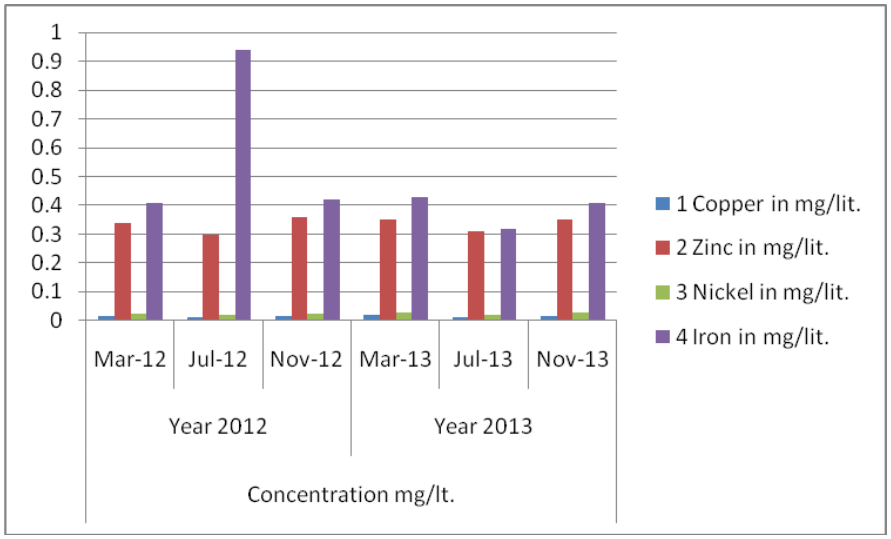
Supplying Station - 02 - S_2 (Ameri)

These samples were collected from Ameri sampling station, Bilaspur. The table shows that the water quality is not up to the Indian standards as Iron exceeds the prescribed limit of 0.3 mg/l

Table No. 3. *Trace metals concentration present in the ground water of Bilaspur City during Year 2012-13*

Supplying Station - 03 - S_3 (Uslapur)

S.No.	Metal	Concentration mg/lt.					
		Year 2012			Year 2013		
		March 2012	July 2012	Nov 2012	March 2013	July 2013	Nov 2013
1.	Copper in mg/lit.	.017	.012	.017	.019	.012	.018
2.	Zinc in mg/lit.	.340	.300	.360	.350	.310	.350
3.	Nickel in mg/lit.	.025	.019	.026	.027	.019	.028
4.	Iron in mg/lit.	.410	.940	.420	.430	.320	.410



Graph 3. *Trace metals concentration present in the ground water of Bilaspur City during Year 2012-13*

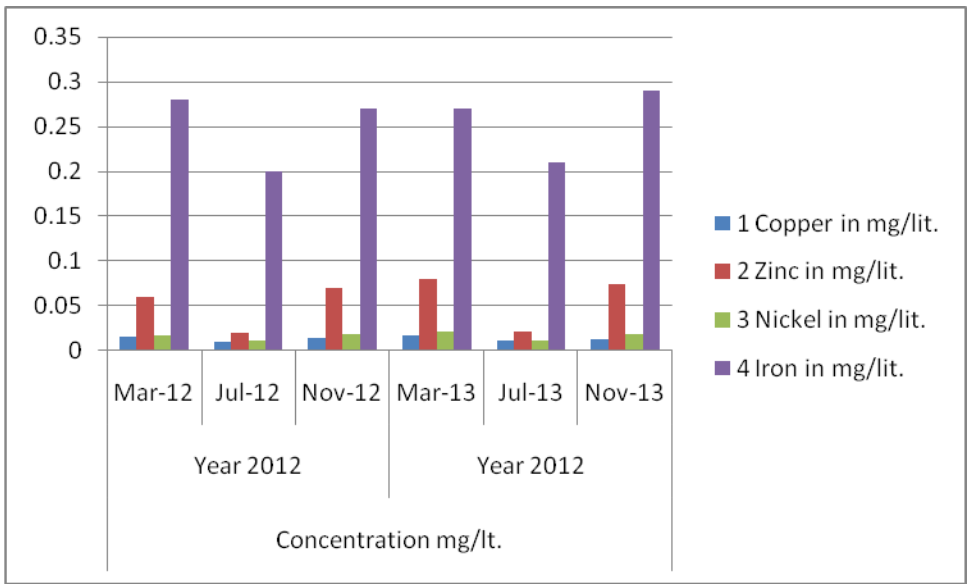
Supplying Station - 03 - S_3 (Uslapur)

These samples were collected from Ushapur sampling station, Bilaspur. The table shows that the water quality is not up to the Indian standards as Iron exceeds the prescribed limit of 0.3 mg/l

Table No. 4. *Trace metals concentration present in the ground water of Bilaspur City during Year 2012-13*

Supplying Station - 04 - S_4 (Mangala)

S.No.	Metal	Concentration mg/lt.					
		Year 2012			Year 2012		
		March 2012	July 2012	Nov 2012	March 2013	July 2013	Nov 2013
1.	Copper in mg/lit.	.016	.010	.015	.017	.011	.013
2.	Zinc in mg/lit.	.060	.020	.070	.080	.021	.074
3.	Nickel in mg/lit.	.017	.012	.019	.022	.011	.018
4.	Iron in mg/lit.	.280	.200	.270	.270	.210	.290



Graph 4. *Trace metals concentration present in the ground water of Bilaspur City during Year 2012-13*

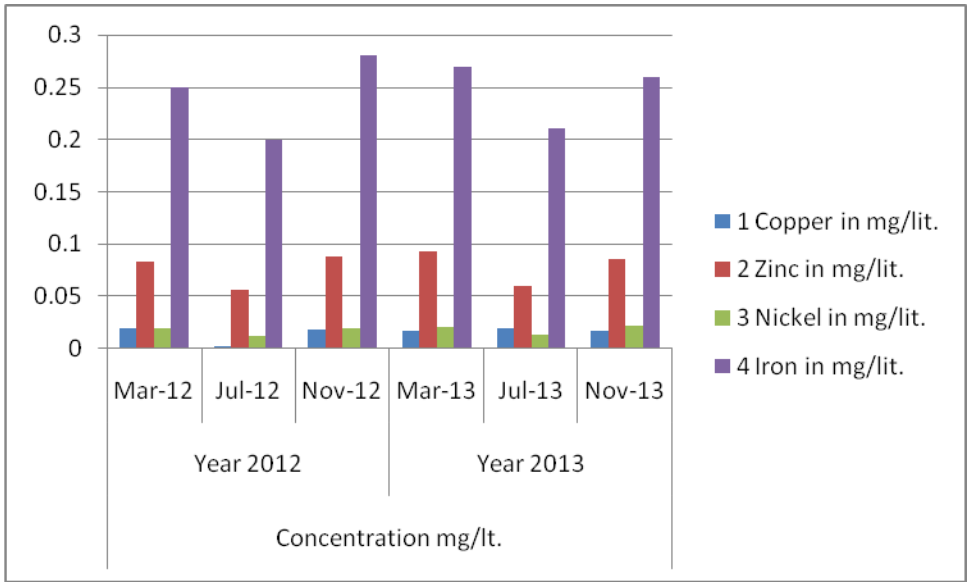
Supplying Station - 04 - S_4 (Mangala)

These samples were collected from Mangla sampling station, Bilaspur. The table shows that the water quality is up to the Indian standards but Iron contents are on border line and close to the prescribed limit of 0.3 mg/l

Table No. 5. *Trace metals concentration present in the ground water of Bilaspur City during Year 2012-13*

Supplying Station - 05 - S_5 (Tarbahar)

S.No.	Metal	Concentration mg/lt.					
		Year 2012			Year 2013		
		March 2012	July 2012	Nov 2012	March 2013	July 2013	Nov 2013
1.	Copper in mg/lit.	.019	.002	.018	.017	.019	.017
2.	Zinc in mg/lit.	.083	.056	.088	.093	.060	.086
3.	Nickel in mg/lit.	.019	.012	.019	.0210	.013	.022
4.	Iron in mg/lit.	.250	.200	.280	.270	.210	.260



Graph 5. *Trace metals concentration present in the ground water of Bilaspur City during Year 2012-13*

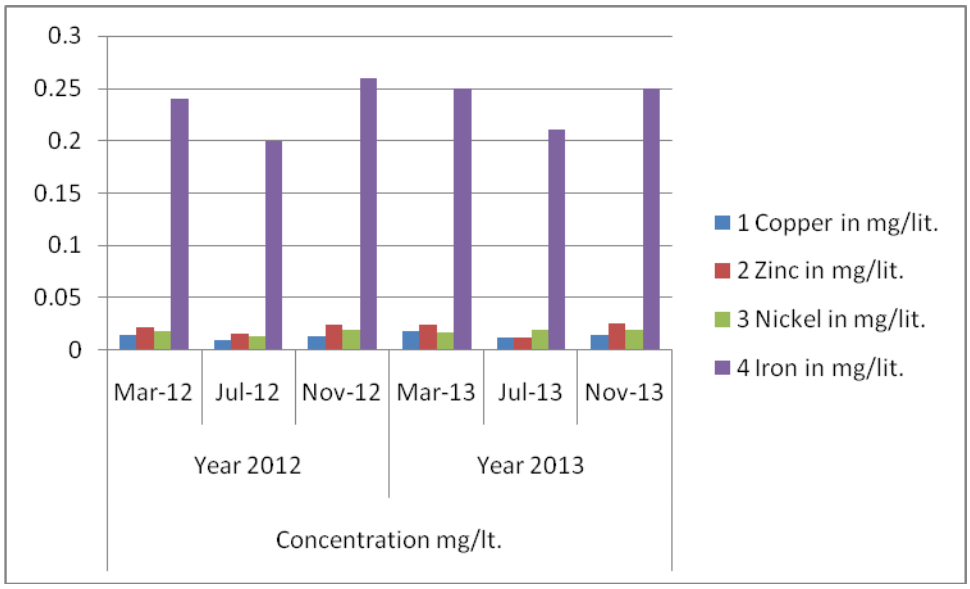
Supplying Station - 05 - S_5 (Tarbahar)

These samples were collected from Tarbahar sampling station, Bilaspur. The table shows that the water quality is up to the Indian standards but Iron contents are on border line and close to the prescribed limit of 0.3 mg/l

Table No. 6. *Trace metals concentration present in the ground water of Bilaspur City during Year 2012-13*

Supplying Station - 06 - S_6 (Vinoba Nagar)

S.No.	Metal	Concentration mg/lt.					
		Year 2012			Year 2013		
		March 2012	July 2012	Nov 2012	March 2013	July 2013	Nov 2013
1.	Copper in mg/lit.	.015	.010	.013	.018	.012	.015
2.	Zinc in mg/lit.	.022	.016	.024	.025	.012	.026
3.	Nickel in mg/lit.	.018	.013	.019	.017	.019	.019
4.	Iron in mg/lit.	.240	.200	.260	.250	.210	.250



Graph 6. *Trace metals concentration present in the ground water of Bilaspur City during Year 2012-13*

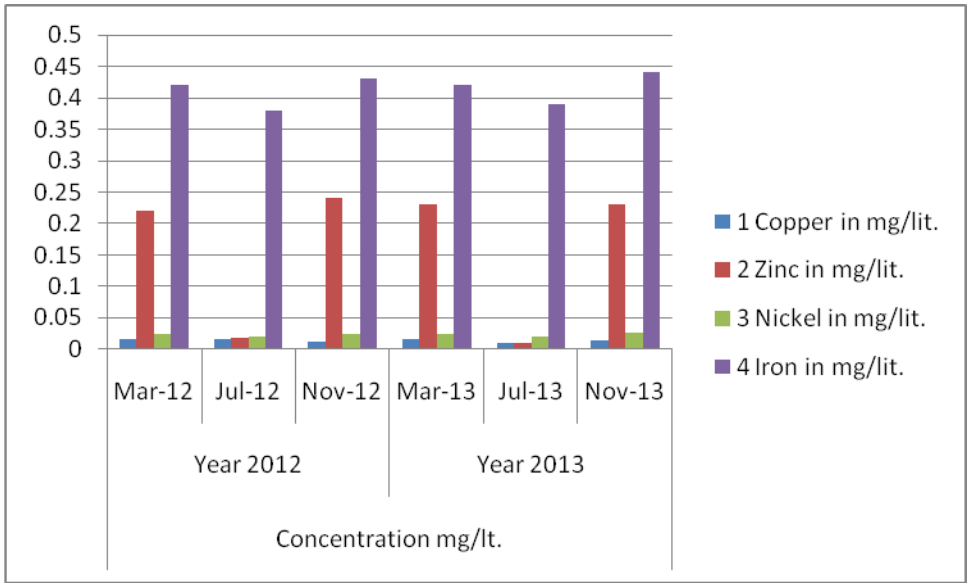
Supplying Station - 06 - S_6 (Vinoba Nagar)

These samples were collected from Vinoba Nagar sampling station, Bilaspur. The table shows that the water quality is not up to the Indian standards as Iron contents are on border line and close to the prescribed limit of 0.3 mg/l

Table No. 7. *Trace metals concentration present in the ground water of Bilaspur City during Year 2012-13*

Supplying Station - 07 - S_7 (Tikara Para)

S.No.	Metal	Concentration mg/lt.					
		Year 2012			Year 2013		
		March 2012	July 2012	Nov 2012	March 2013	July 2013	Nov 2013
1.	Copper in mg/lit.	.017	.016	.013	.017	.0100	.015
2.	Zinc in mg/lit.	.220	.019	.240	.230	.011	.230
3.	Nickel in mg/lit.	.024	.020	.024	.025	.021	.026
4.	Iron in mg/lit.	.420	.380	.430	.420	.390	.440



Graph No. 7. *Trace metals concentration present in the ground water of Bilaspur City during Year 2012-13*

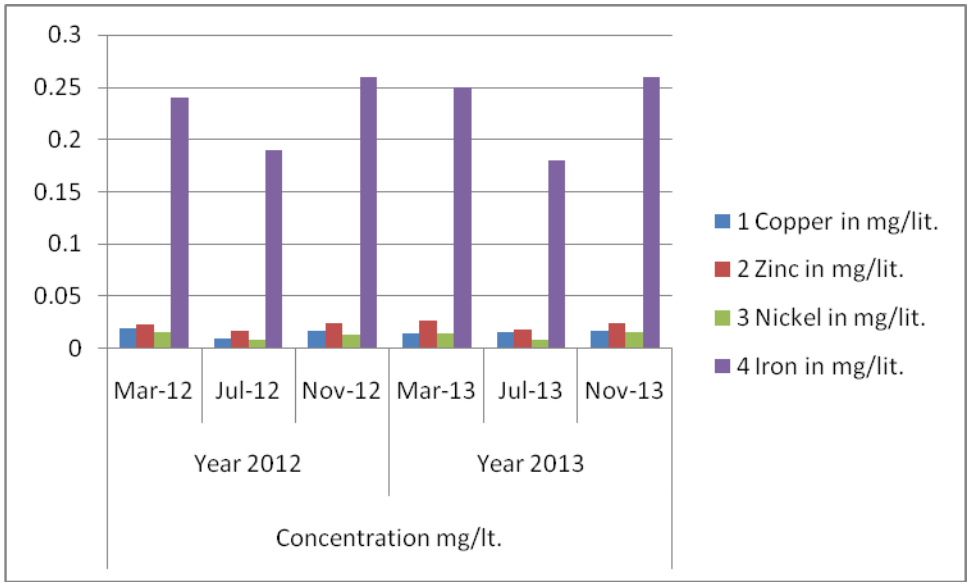
Supplying Station - 07 - S_7 (Tikara Para)

These samples were collected from Tikara para sampling station, Bilaspur. The table shows that the water quality is not up to the Indian standards as Iron contents are exceeding the prescribed limit of 0.3 mg/l

Table No. 8. *Trace metals concentration present in the ground water of Bilaspur City during Year 2012-13*

Supplying Station - 08 (Gole Bazar)

S.No.	Metal	Concentration mg/lt.					
		Year 2012			Year 2013		
		March 2012	July 2012	Nov 2012	March 2013	July 2013	Nov 2013
1.	Copper in mg/lit.	.019	.010	.017	.015	.016	.017
2.	Zinc in mg/lit.	.023	.017	.025	.027	.018	.025
3.	Nickel in mg/lit.	.016	.009	.013	.015	.008	.016
4.	Iron in mg/lit.	.240	.190	.260	.250	.180	.260



Graph No. 8. *Trace metals concentration present in the ground water of Bilaspur City during Year 2012-13*

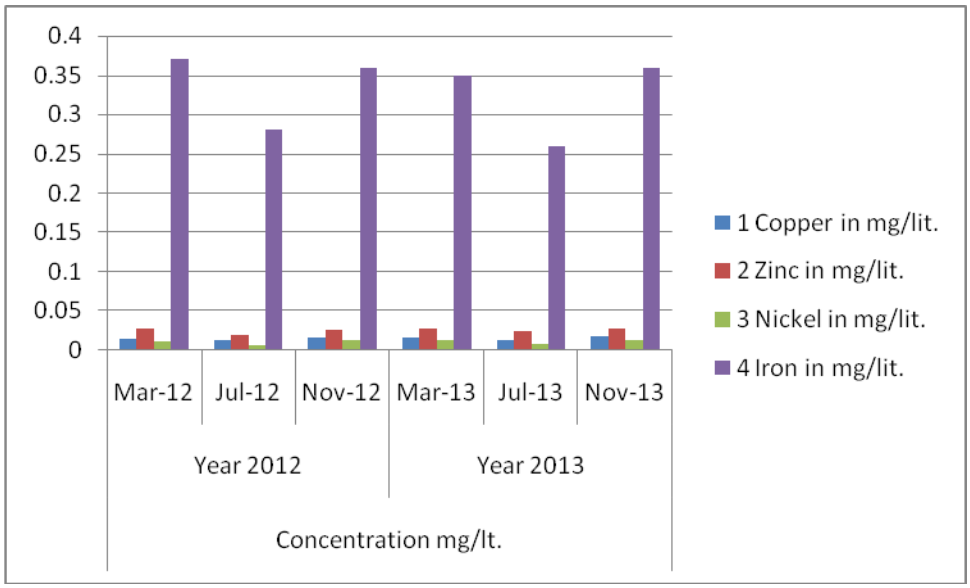
Supplying Station - 08 (Gole Bazar)

These samples were collected from Gole bazarsampling station, Bilaspur. The table shows that the water quality is up to the Indian standards but Iron contents are pretty close to the prescribed limit of 0.3 mg/l

Table No. 9. *Trace metals concentration present in the ground water of Bilaspur City during Year 2012-13*

Supplying Station - 09 - S_9 (Railway Colony)

S.No.	Metal	Concentration mg/lt.					
		Year 2012			Year 2013		
		March 2012	July 2012	Nov 2012	March 2013	July 2013	Nov 2013
1.	Copper in mg/lit.	.015	.013	.016	.017	.013	.018
2.	Zinc in mg/lit.	.028	.020	.026	.027	.024	.027
3.	Nickel in mg/lit.	.012	.006	.013	.013	.008	.013
4.	Iron in mg/lit.	.37	.28	.36	.35	.26	.36



Graph No. 9. *Trace metals concentration present in the ground water of Bilaspur City during Year 2012-13*

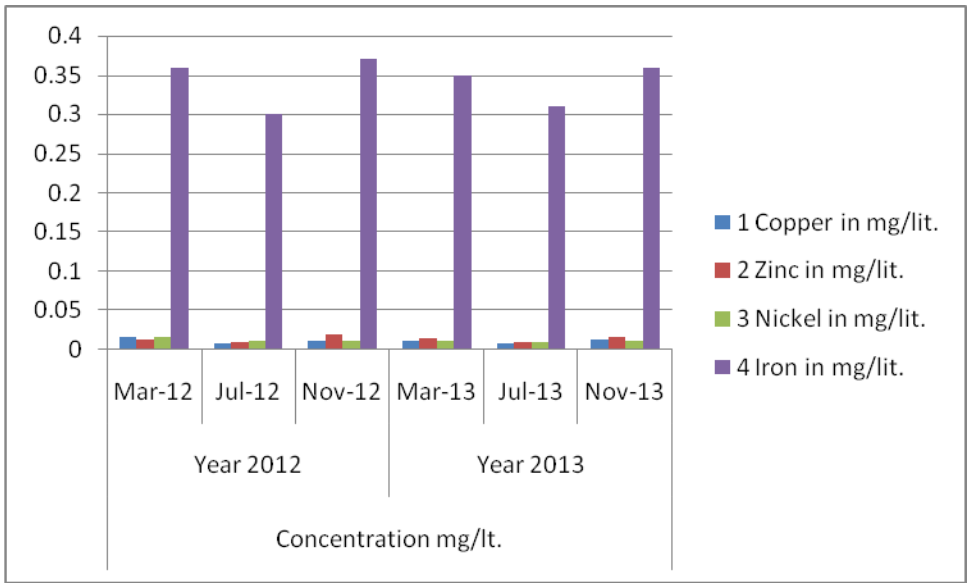
Supplying Station - 09 - S_9 (Railway Colony)

These samples were collected from Railway colony sampling station, Bilaspur. This is yet one more case that shows that the water quality is up to the Indian standards

Table No. 10. *Trace metals concentration present in the ground water of Bilaspur City during Year 2012-13*

Supplying Station - 10 - S_{10} (Rajkishore Nagar)

S.No.	Metal	Concentration mg/lt.					
		Year 2012			Year 2013		
		March 2012	July 2012	Nov 2012	March 2013	July 2013	Nov 2013
1.	Copper in mg/lit.	.016	.008	.012	.011	.008	.013
2.	Zinc in mg/lit.	.013	.010	.019	.015	.010	.017
3.	Nickel in mg/lit.	.017	.011	.012	.012	.009	.012
4.	Iron in mg/lit.	.360	.300	.370	.350	.310	.360



Graph No.10. *Trace metals concentration present in the ground water of Bilaspur City during Year 2012-13*

Supplying Station - 10 - S_{10} (Rajkishore Nagar)

The samples were collected from Rajkishore Nagar sampling station, Bilaspur. The table shows that the water quality is not up to the Indian standards as Iron contents are exceeding the prescribed limit of 0.3 mg/l

4. Results and Discussions

1. Copper:

This is one of the essential elements for the humans; their daily requirement is about 2.0 mg. The permissible concentration of Copper in drinking water according to the Indian standard is 0.05 mg/lit., if the concentration of copper exceeds the MPL, it causes decolonization and corrosion of pipe fittings and utensils. In the present study the concentration of copper in various collected water samples ranged between 0.002 to .019 mg/lit. These values of copper are much below the permissible limit.

2. Zinc:

The permissible concentration of Zn in drinking water according to Indian standard is 5.0 mg/lit. However, concentration above 5.0 mg/lit., causes astringent taste and opalescence in water. In the present study, the Zn concentration in various water samples collected from different sampling stations ranged between 0.010 and .46 mg/lit., which are below the permissible limit fixed for Zinc concentration in drinking water

MPL - 5.0 mg/lit.

3. Nickel:

Nickel is relatively non toxic element. It is essential for animal and human nutrition. The allowable concentration of Nickel in drinking water has not been fixed according to Indian standards, however WHO has fixed a tolerance limit of 0.05 mg/lit. For Nickel to be present in drinking water. Consumption of water having higher concentration of Nickel is harmful to human health. Concentration of Nickel in water samples studied ranged between 0.001 and 0.028 mg/lit., which are below the permissible limit fixed for Zinc concentration in drinking water.

MPL - .05 mg/lit

4. Iron:

Iron is an essential element for both plants and animals metabolism. WHO and Indian standards recommended a permissible limit of 0.3 mg/lit. And an excessive limits of 1.0 mg/lit. Iron has been recommended in drinking water. The concentration of Iron in the water samples from different sampling stations ranged between .10 and .48 mg/lit. Water samples from the sampling stations S2, S3, S7, S9 and S10 contained Iron concentration more than the permissible limit i.e. .03 mg/lit. In all other water samples (from remaining sampling stations) the Iron concentration was below the permissible limit. Long time consumption of drinking water with high concentration of Iron can lead to liver diseases (Homosiderosis) High concentrations of iron is not suitable for processing of food, beverages and many other items.

5. CONCLUSIONS

These results of present investigations indicate that copper, zinc and Nickel contents are well below the permissible limits as prescribed by WHO. However sampling stations S2, S3, S7, S9 and S10 contained comparatively higher concentration of Iron than MPL by WHO. Remaining other stations did not contain excess concentration of Iron. Hence its suggested that the water samples of S2, S3, S7, S9 and S10 stations should be priority treated before these are used for drinking purpose. It is also evident that presence of Zinc, Nickel and Copper do not cause any adverse effect on the water quality. Agricultural practices, especially cultivation, fertilization and pesticides applications in farm lands are principle cause of trace metal concentration over a regional scale.

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