EFFECT OF HEAVY METALS CONTAMINATION IN GROUND WATER OF RURAL AREAS OF BILASPUR CITY

Author name -Dr Smt Ambuj Pandey
Assistant Professor, (chemistry) Government Bilasa Girls Autonomous PG College Bilaspur.C.G

INTRODUCTION

Water is one of the essentials that supports all forms of plants and animal life.

Ground water is ultimate, most suitable fresh water source with nearly balanced concentration of salts for human consumption. Most important environmental issue today is ground water contamination. Over burden of pollution pressure, unplanned urbanization, unrestricted exploration policies and dumping of the polluted water at inappropriate places enhance the infiltration of harm full compounds to the ground water. Heavy metals receive particular concern considering their strong toxicity even at low concentration.

Heavy metals constitutes a natural components of the earth crust and these are not bio-degradable, hence are persist in the environment. Heavy metals may come from natural sources, leached from rocks and soils according to their geochemical mobility or come from anthropogenic sources, as a result of human land occupation and industrial pollution.

Heavy metals are ubiquitous, persistent and toxic pollutants at certain concentration. Some Heavy metals such as Fe, Cu , Zn_n, M_{gs}, ,Ni_l, etc are essential to health, where as other have no known biological function and have toxic effects.

The adverse effects of some heavy metals on human health are well documented. Each metal has its own peculiar chemistry and toxicity pattern, birth defects, cancer and number of chronic diseases have all been linked to heavy metals Arsenic, Chromium, Cadmium, Lead, Mercury, Selenium and silver have toxic effects on internal organ of human body, however Heavy metals like Arsenic, Barium, Hexavalent Chromium, Mercury, Selenium, and Silver are rarely found insignificant concentration in public drinking water.

The term heavy metals refer to any metallic elements that has a relatively high density and is toxic or poisonous even at low concentration (lenntech-2004). Heavy metals is a general collective term, which applies to the group of metals and metalloids with specific gravity greater than 4.o, i e at least 5 times greater than water (Hunton and Symon, 1986), batterbee et al 1988. Heavy metas include LEAD (Pb), CADMIUM, (Cd), MERCURY (Hg), ARSENIC (As), Silver (Ag), Selinium (Se), Chromium (Cr) , Aluminium (Al) and platinum group elements. They exist in water in colloidal particulate and dissolve phases (adepoju-bello et al) .

With their occurrence in water bodies being either of natural origin e.g. Eroded minerals with in sediments, leaching of ore deposits and volcanism extruded products. Or of anthropogenic origin i.e solid waste disposal, industrial or domestic effluents, harbour channel dredging marchovecchio et al 2007.

BIOLOGICAL ACTIVITY OF HEAVY METALS

Some of the metals are essential to sustain life. Calcium(Ca), Magnisium (Mg), Potassium(K) and Sodium(Na) must be present for natural body function. Also Cobalt (Co), Copper (Cu), Iron(Fe), Manganese (Mn), and Zinc (Zn) are needed at low level as catalyst for enzyme activities (adepoju-bello et al, 2009). However excess exposure to heavy metals can result in toxicity.

Heavy metals can cause serious health effects with varied symptoms depending on nature and quality of the metal ingested (Adepoju-Bello and Alabi 2005). They produce their toxicity by forming complexes with Proteins, in which carboxylic acid group (CooH), Amino group (NH_2) and Thiol (SH) group are involved. These modified biological molecules lose their ability to function properly and result in the malfunction or death of the cell. When metals bind to these groups, they inactivate important enzyme system or effect protein structure, which is linked to the catalytical properties of enzymes. This type of toxin may also cause the formation of radicals when are dangerous chemicals that cause the oxidation of biological molecules.

The most common heavy metals that humans are exposed are Aluminium(Al), Arsenic (As), Cadmium (Cd), Lead (Pb), and Mercury (Hg). Aluminium has been associated with ALZHEIMER's and PARKINSO's diseases. Arsenic exposure can cause among other illness or symptoms cancer, abdominal pain and skin lesions. Cadmium exposure produces kidney damage and hypertension. Lead is cumulative poison and possible human carcinogen (Baker-Odunola -2015). While for mercury, toxicity results in mental disturbance and impairment of speech, hearing, vision and speech. In addition Lead and Mercury may cause the development of autoimmunity in which person's immune system attacks its own cells. This can lead to joint diseases and ailment of the kidney, circulatory system and nervous system. At higher concentration, Lead and Mercury can cause irreversible brain damage.

The quality of ground water sources are affected by the characteristics of the media through which the water passes on its way to the ground water zone of saturation. (Adeyeni et al 2007), thus the heavy metals discharged by the industries, traffic, municipal wastes, hazardous waste sites as well as from fertilizers and pesticides from agricultural purpose can result in steady rise in contamination of ground water (vodela et al 1997, Igwilo et al 2006).

There is thus the need to assess the quality of ground water sources of some villages near by the BILASPUR city to assess the effect of the fertilizers and pesticides on the Heavy metal concentration in ground water.

MATERIALS AND METHODS.

1- C0LLECTION OF SAMPLES.

Special Precaution were taken during sampling and analysis of heavy metals. Before collecting the sample the sample containers are soaked overnight in 2% HNO3 and washed with double distilled water. All the samples were collected in 1 litre polythene containers and immediately acidified to Ph -2 with HNO3 IN Order to keep metals in solution and prevent them from adhering to the walls of bottles. All the samples were transported to the laboratory in the ice boxes and refrigerated at 4^0 c, until analysed. Sampling protocol designed in such way that sample collected in one sampling schedule were analysed in the shortest possible time.

2- SAMPLE ANALYSIS

Samples were analysed for heavy metals (Ni, Cr, Cd, As, Pb, Co) using S series ATOMIC SPECTROPHOTOMETER (A.A.S.). This was critical in order to destroy the organic matrix capable of trapping the Heavy metals and making them unavailable for the instrumental analysis. Calibration solution of the target metal ion were prepared from standard stock by serial dilution.

3 - QUALITY ASSURANCE AND QUALITY CONTROLE PROGRAMME.

To assess the precision and accuracy of results replicate analysis of blank, standard and sample was done. The relative standard deviation was determined to find the precision of analysis.

Recovery results were calculated for the determination of accuracy. Experiments were repeated till an accuracy of 95- 100 % and precision of +_5% were obtained . One standard with one set of sample was analysed routine.

STUDY AREA

Our study area are eight villages of KOTA and TAKHATPUR block of BILASPUR district..these are

TAKHATPUR BLOCK

1. **SAIDA**
2. **AMSENA.**
3. **CHORMA.**
4. **KOTA BLOCK**
5. **SHIVTARAII,**
6. **KANCHANPUR ,**
7. **NAVAGAON .**
8. **BITCULI.**
9. **8-BAHTARAI –KOTA BLOCK;**

Major sources of water for these villages are mainly ground water. So we study the effect of fertilizers, pesticides, agricultural wastes, domestic effluents and sewage run off on ground water.

TABLE-

CONCENTRATION OF METALS IN DIFFERENT SAMPLING STATIONS-

	S1	S2	S3	S4	S5	S6	S7	S8

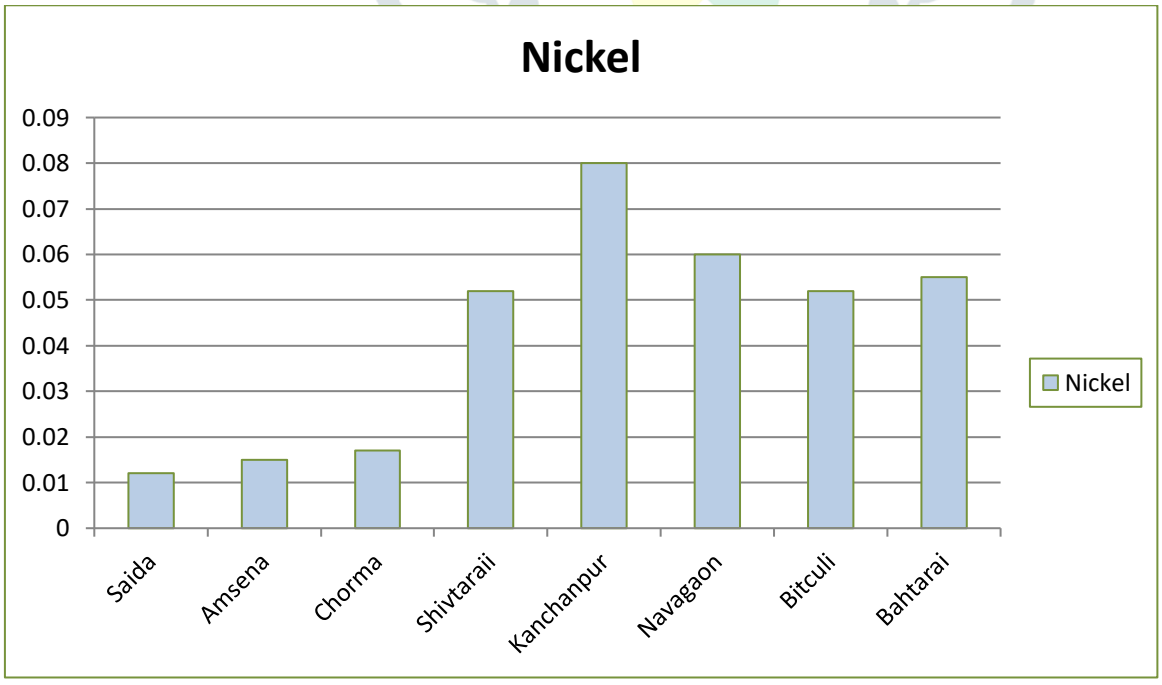
Metal conc. In mg/lt	Saida	Amsena	Chorma	Shivtaraii	Kanchan -pur	Navagaon	Bitculi	Bahtarai
Ni	.012	.015	.017	.052	.08	.06	.052	.055
Cr	.009	.010	.012	.035	.015	.052	.021	.008
Al								
Cd	.008	.009	.01	.032	.042	.038	.018	.011
Pb	.003				.004	.005	.002	.001
As	.005	.006	.005	.007	.008	.005	.003	.004
Co	.017	.045	.062	.072	.016	.021	.017	.013

RESULT AND DISCUSSION

ATOMIC ABSORPTION SPECTROPHOTOMETRY Is a useful technique for the determination of heavy metals up to parts per billion levels. Conductivity in the samples of most of the study location found less than 500µs/cm, therefore we suspect that there may be metal contamination in the selected samples of ground water.

GRAPH – 1

CONCENTRATION OF NICKEL AT EIGHT DIFFERENT SAMPLING STATIONS



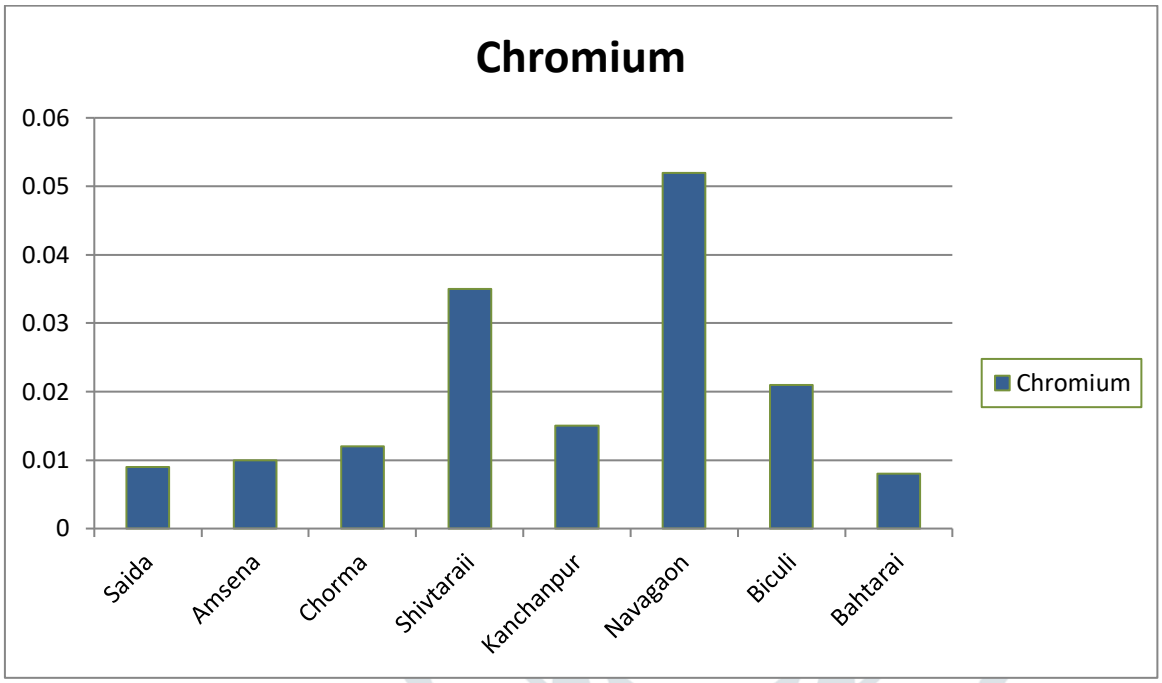
NICKEL-the minimum and maximum concentration of nickel were found to be .012 mg/lit to .o8 mg /lit respectively , whereas maximum allowed limit of Ni as per WHO GUIDE line is 0.05 mg /lit. In all studied samples except s1,S2 and S3 are exceeding than compared WHO standards .The concentration level of Ni in all the samples are shown in table 1 and 2 and comparison levels of Ni study graph area is shown in graph 1

Minimum concentration of Ni was found in village SAIDA Is .012 mg/lit

Maximum concentration of Ni was found in village Navagaon is .08 mg/lit

GRAPH – 1

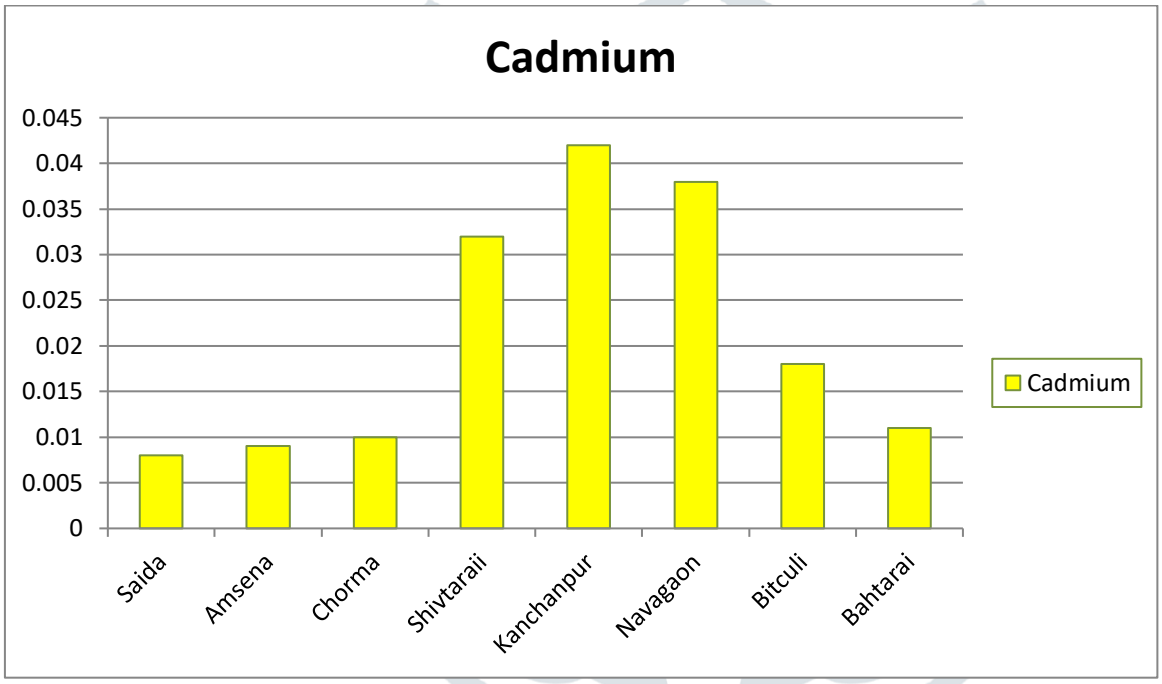
CONCENTRATION OF CHROMIUM AT EIGHT DIFFERENT SAMPLING STATIONS



CHROMIUM—Minimum and maximum concentration of chromium were found to be .o1 to .032 mg /lit respectively. All samples except sampling station S4 and S6 chromium concentration were found to be with in MPL. The MPL of chromium according to WHO is .05 mg /lit. The concentration levels of chromium in all the samples are shown in table 1 and 2, and comparison levels of Cr in study area is shown in graph ii. The minimum concentration of chromium was found in village AMSENA is .01 mg/lit and maximum concentration of Ni was found in village NAVAGAON is .o52 mg /lit.

GRAPH -2

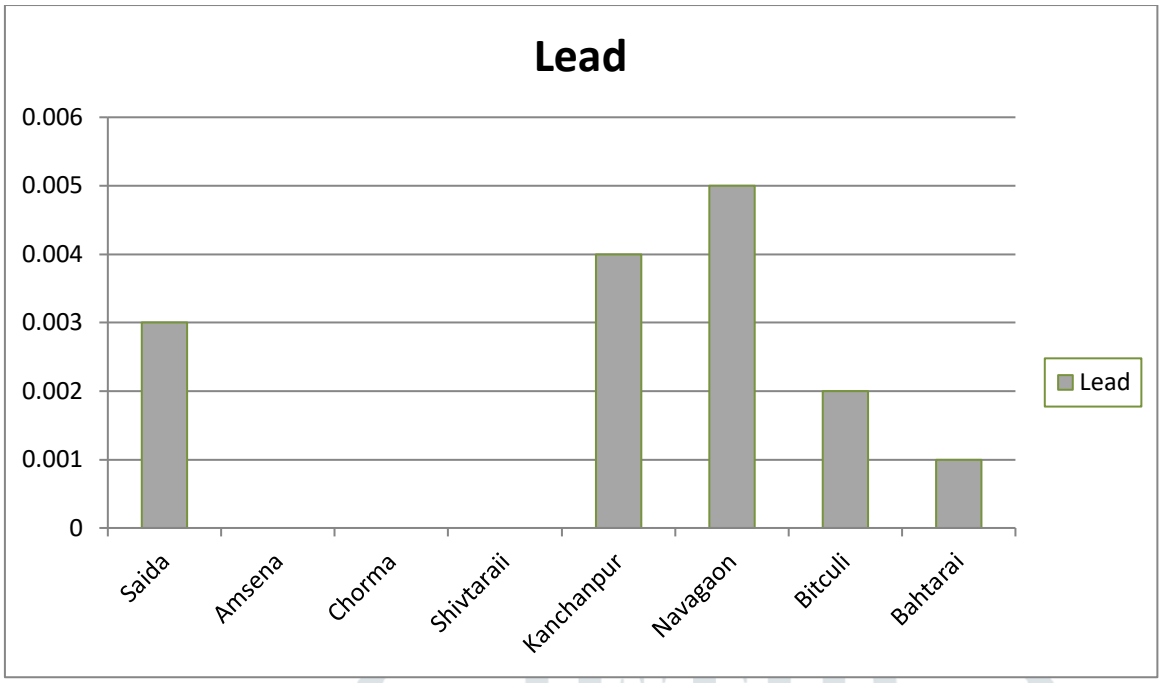
CONCENTRATION OF CADMIUM AT EIGHT DIFFERENT SAMPLING STATIONS



CADMIUM- The minimum concentration of cadmium was found in village BEHTARAI is .01 mg/lit and maximum concentration of Cd was found in village KANCHANPUR is .042 mg/lit , whereas maximum allowable limit for Cd as per WHO guideline is .03 mg/lit. Cd concentration levels in all studied samples except S5 and S6 are within MPL as per WHO level. The concentration levels of Cd in all the samples are shown in table 1and 2 and the comparison levels of Cd in study area are shown in graph

GRAPH -3

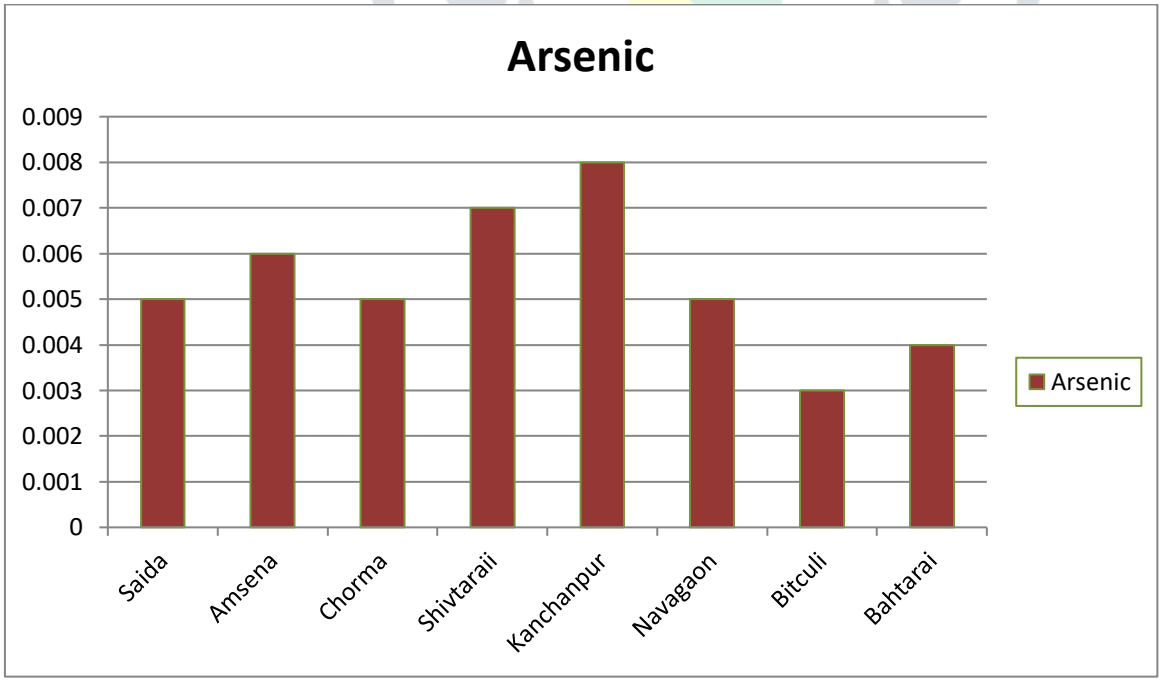
CONCENTRATION OF LEAD AT EIGHT DIFFERENT SAMPLING STATIONS



LEAD—Minimum and maximum concentration of lead(Pb) varied between .oo1 to .oo5 mg /lit. In all selected samples the Pb concentration lies within MPL i.e.01 mg /lit as per WHO standards. Measurable concentration values of Pb are shown in table 1 and 2 , The comparison levels of Pb in study area shown in graph- 5.

GARPH -4

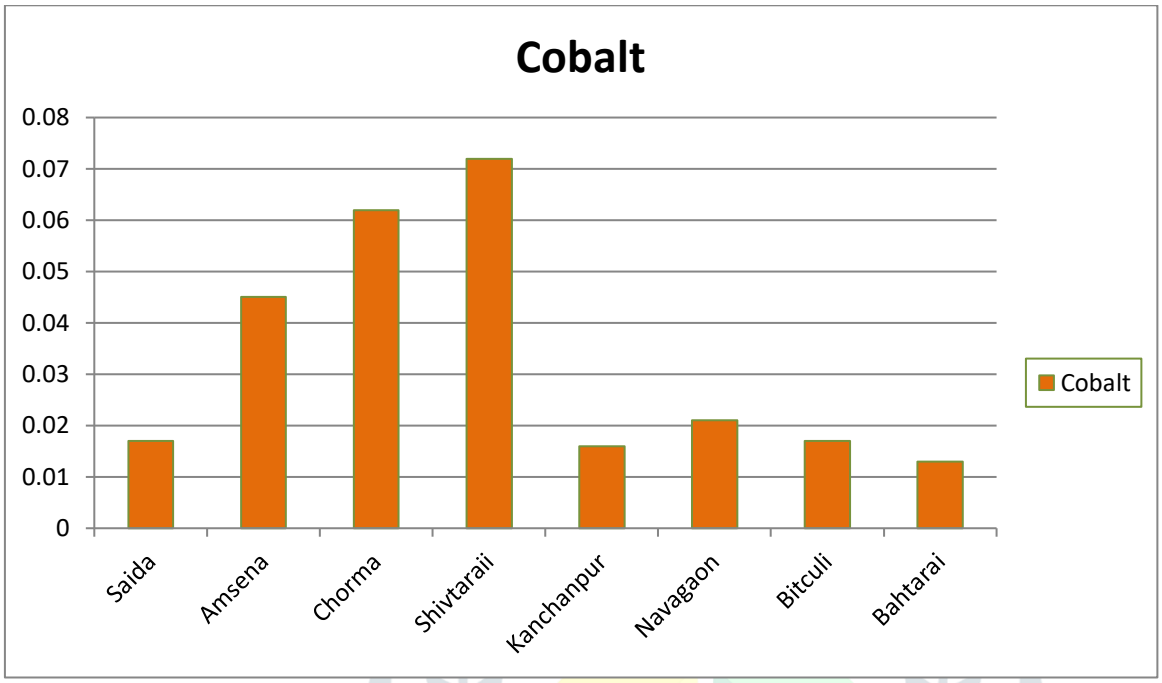
CONCENTRATION OF ARSENIC AT EIGHT DIFFERENT SAMPLING STATIONS



ARSENIC—the minimum and maximum ARSENIC (As) concentration varied between .003 mg/lit to .oo8 mg/lit. Measurable concentration of metal as were found in all eight samples with in MPL as per WHO standard limit i.e .o5 mg /lit. The concentration levels of As in all the samples are shown in table 1 and 2 and the comparison levels of As in study areas is shown in graph -6

GRAPH-5

CONCENTRATION OF COBALT AT EIGHT DIFFERENT SAMPLING STATIONS



COBALT- Cobalt (Co) is commonly found at low concentration in all the samples and is generally well below the WHO Guideline for drinking water quality. Measurable values shows in table 1 and 2, and comparison level s of cobalt in study area is shown in graph-7

CONCLUSION

The present study was aimed to assess the Heavy metal concentration of various water samples of eight villages of nearby the Bilaspur city in March 2016 and to determine their suitability for drinking and also in the field of Agriculture. Result of present investigation indicates that As ,Pb , Co , Cr content in the ground water of eight sampling stations are well below the maximum permissible limit as per WHO standards. However heavy metals like Ni, Cr , and Cd exceeds the MPL in water sample of village -4, i e SHIVTARAI, and village 5-i.e KANCHANPUR. Slight excess concentration of Ni, Cr, and Cd may attribute to these metal containing rocks and soil which dissolve into water sources and contaminate these ground water sources.

RECOMMENDATION

It is therefore suggested that the ground water of village Shivtaraii and Kanchanpur should be given much precaution before these are used for drinking purpose . It is recomonded to adopt some kind of inexpensive treatment to reduce the level of these Heavy metals like Ni,Cd and Pb in areas of above maintained village .Agricultural practices , specially

cultiuation, fertilization and pesticide application in farm lands are principle cause of higher Heavy metal concentration on the regional scale.

REFERENCES: -

1. WHO, guidelines for drinking water quality recommendations, Geneva, 30 (1984).
2. NEERI, manual on water and waste water analysis (WHO guidelines for drinking water constituents) 1988.
3. Soylak, M. And L Elci, 2000. Solid phase extraction of Heavy metal ions in drinking water samples from kayseri, Turkey, J. Heavy & Microprobe techniques, 18(3): 397-407.
4. Nga, T.T.V., M Inoue, N.R. Khatiwada and S. Takizava. 2003. Heavy metal Heavys for the analysis of ground water contamination : case study in Hanoi city, Vietnam, water science and Technol. Water supply, 3(1-2) : 343-350.
5. WHO/UNICEF (2012). Estimated data from WHO/UNICEF joint monitoring progress on sanitation and drinking water. 2012 update.
6. Osibanjo. O and Majolagbe, A.O. (2012). Physicochemical quality assessment of ground water based on land use in Lagos city South west Nigeria, Chemistry journal, 2(2) 79-86.
7. Ergul, H.A. & Varol, T. Ay, U. (2013) investigation of heavy metal pollutants at depth in the gulf Lzwit. Marine pollutants bulletin 73, 389-393.
8. Kayode, O.T. (2011). Occurrence & health implications of high concentration of cadmium & Arsenic in drinking water sources in selected towns of Ogun state, South West Nigeria, Journal of toxicology & Environmental health sciences 3(15). 385-391.
9. EPA (2013) Consumer fact sheet on copper retrieved on march 25,2013 from http://water epa.gov/drink/concentration/ index cfm.
10. Ikejmba, C.C. & Sakpa, S. (2014). Comparative study of some heavy metals concentration in water & tympanotonus fascatus var redula samples of Egbokodo river, Warri, Nigeria. International journal of modern biological research , 2, 7-15.
11. Newcomb, W.D. & J.D. Rimstidt, 2002 Heavy elements distribution assessment using public domain data applied geochemistry.
12. APHA - Standard methods for examination of water and waste water . AMERICAN PUBLIC HEALTH ASSOCIATION. 21st edition, Washington DC, USA 2005.
13. ICMR – Manual of standards of quality of drinking water supplies New Delhi (1975).
14. WHO; Guidelines for drinking water quality recommendations, Geneva ; 30 (1984).