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GIS Mapping and Determination of Heavy Metals (Ca, Cr, Fe, Pb) in (Pre-Monsoon) Surface and Ground Water Samples in Arang Block, Dist- Raipur (C.G.)

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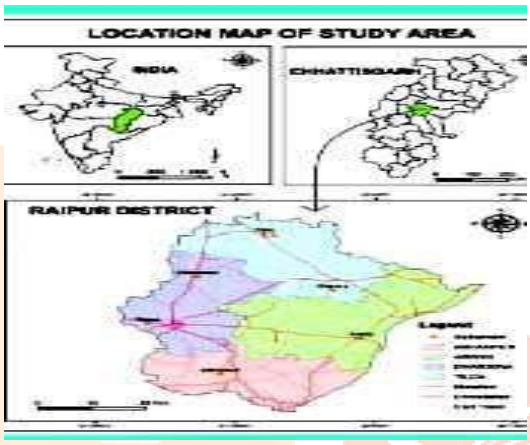
Abstract

In the present study, GIS maps are used to investigate the water sources in Arang Block. The study was carried out to assess the surface and groundwater quality of the (Arang Block) Raipur District, Chhattisgarh. The study area is located between latitude 21.195 and longitude 81.967. Water quality is one of the most important concerns. The heavy metals up to ppm. levels in drinking water quality may because genuine health Complication and also cause cancer. In this study we make a venture to know the concentration of Four heavy metals in ground water and surface water in different places of (Arang Block). For this study, water tests were collected in pre-monsoon May-Jun. These tests were subjected to analysis for four elements like Ca, Cr, Fe, and Pb by using UV-VIS-NIR. A spectrophotometer is the most modern technique for the determination of find metal concentration. The concentration of these metals was differentiated with drinking water quality limits given by the World Health Organization (WHO) 4th edition in 2011.

Keywords- Groundwater, Surface water, GIS Mapping (Pre-Monsoon), UV-VIS-NIR Spectrophotometer, WHO, Arang Block, Raipur District.

Introduction

These days heavy metals are among the most principal pollutants in source and give treatment to water and are becoming a severe common health issue. Industrial and municipal misuse waters habitually fulfilled metal ions. Industrial misuse constitutes the crucial source of numerous kinds of metal pollution in natural water.[1-4] Recently, the implementation of sorption in environmental therapy has become a noteworthy research area. Heavy metal ions are reported as prime concern contaminants, due to their ability to move in natural water ecosystems and due to their noxious.[5-6]



The word ‘‘heavy metal’’ mentions to any metal and metalloid element that has enough high density ranging from 3.5 to 7 g cm^{-3} and is noxious or poisonous at low concentrations, Although ‘‘heavy metals’’ is an extensive term explained in the literature, it is widely archive and all the time put into the widespread contaminant of soils and water figures.[7] These metals are found harum-scarum in the earth’s crust and are enduring in nature. They enter the human body via air, water, and food. A small number has a necessary role in the metabolism of humans and animals in very find amounts but their higher concentration may cause noxious and health dangers. The dangerous nature of heavy metals has been allowed because of their bioaccumulative nature in living systems. They can get in the environment through mining activities, factory release, and from household applications, into nearby figures of water. Groundwater and surface water is a principal and major source of drinking water in both urban and rural areas in India. Determination of water standards is one of the most important facts in-ground studies [8]. Groundwater is highly evaluated because of certain things not possessed by surface water [9-10]. People on every side of the world have used groundwater as a source of drinking water, and even today additional than half the world’s inhabitants depend on groundwater for continuity. The Value of groundwater is situated not only in its broad spread phenomenon and availability,

but also in its compatible good quality, which makes it a perfect source of drinking water. In current times growing focus is being given to studies on groundwater defilement. Since groundwater is face to face in contact with soil, rock, and plateaus, the components of this source might defilement the ground water[11-12.] Find elements constitute a natural part of the earths crust and they are not biodegradable, hence preserve in the environment. Find metals may come from a natural source, leached from rocks and soils according to their subsurface ability to move, or come from anthropogenic sources, as the result of human cost habitation and Industrial Pollution [13].

Uplifted concentrations of heavy metal in soils may cause mycotoxin, face to face risk to human health, indirect effects due to communication through the food chain, or defilement of ground Surface water [14].

The data of the present study shows the diffusion of heavy metals content like Cr, Pb, and Ca in surface and groundwater in Arang Block of Raipur district Chhattisgarh. Even though misuse water is the probable source of defilements it is being used for irrigation and vegetation growing. This study is bringing out to assess the grade of surface and groundwater used for agricultural and household purposes.

Material and Methods

Sampling and Preservation

The water samples were drawn during pre-monsoon (May-Jun). The ground and surface water were collected from different wards of Arang Block in Raipur District (C.G.). Samples collected were analyzed within two days to avoid special preservation required.

These samples were subjected to analysis by using UV-VIS-NIR Spectrophotometer based on Beer-Lambert's Law.

$Log_{10} I_0/I_t = abc$

RESULT AND DISCUSSION

Mapping and Determination of Heavy Metals (Ca, Cr, Fe, Pb) in (Pre-Mansoon) Surface and Ground Water Samples in Arang Block, Distt.-Raipur (C.G.)

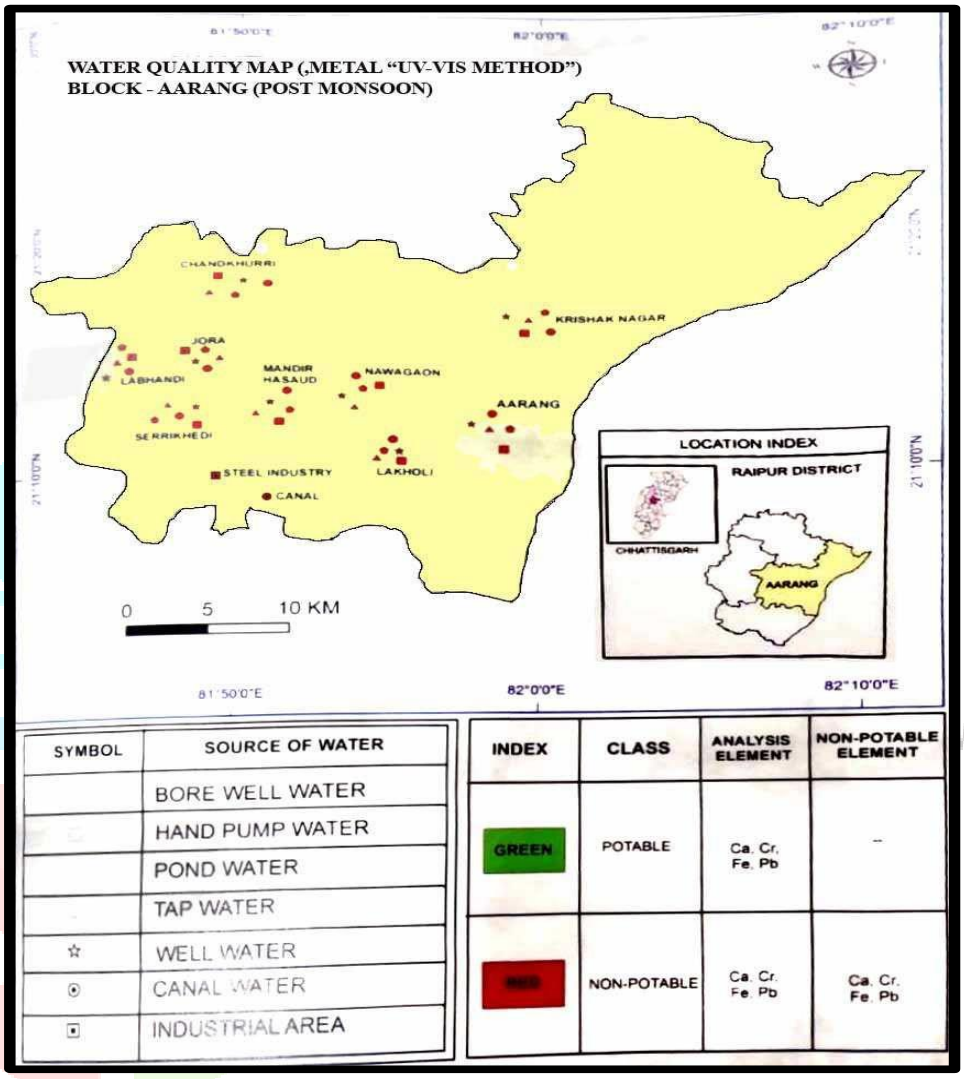


Figure: Arang Block (Pre-Monsoon) WaterQuality Map by UV-VIS

Table 1: Pre-Monsoon data of heavy metals ofARANG (Groundwater)

Metal →	Ca	Cr	Pb	Fe
WHO (Standard Value)	75mg/l	0.05mg/l	0.01mg/l	3mg/l
Labhandi HW1	105.41	0.141	0.049	0.044
Krisak Nagar HW2	161.774	0.367	0.115	0.009
Jora HW3	190.288	0.040	0.113	0.040
Chandrakhuri HW4	177.294	0.062	0.036	0.016
Sheri Kheri HW5	171.477	0.610	0.597	0.038
Mandir hasud HW6	150.005	0.286	0.133	0.087
Nawagon HW7	155.850	0.285	0.086	0.019
Lakholi HW8	211.403	0.165	0.204	0.035
Arang HW9	237.182	0.001	0.177	0.111
Labhandi BW1	105.100	0.141	0.048	0.003
Krisak Nagar BW2	161.700	0.366	0.115	0.001
Jora BW3	190.280	0.040	0.113	0.016
Chandrakhuri BW4	177.300	0.061	0.036	0.016
Sheri khri BW5	171.500	0.610	0.059	0.019
Mandir hasud BW6	150.000	0.286	0.133	0.014
Nawagoan BW7	155.850	0.284	0.086	0.029
Lakholi BW8	211.400	0.016	0.204	0.026
Arang BW9	237.180	0.001	0.177	0.023
Labhandi WW1	82.950	0.060	0.085	0.130
Krisak Nagar WW2	159.200	0.043	0.053	0.205
Jora WW3	162.930	0.034	0.097	0.302
Chandrakhuri WW4	139.200	0.049	0.118	0.174
Sheri Kheri WW5	163.400	0.024	0.179	0.212
Mandir hasud WW6	243.940	0.034	0.142	0.042
Nawagon WW7	167.060	0.050	0.217	0.203
Lakholi WW8	153.120	0.323	0.134	0.216
Arang WW9	185.100	0.018	0.143	0.095

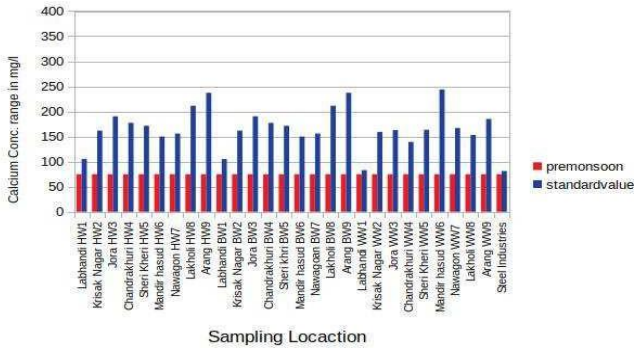
Steel Industries	81.182	0.026	0.015	0.030

Note: HW = Hand Water , BW = Bore Well Water , WW = Well Water

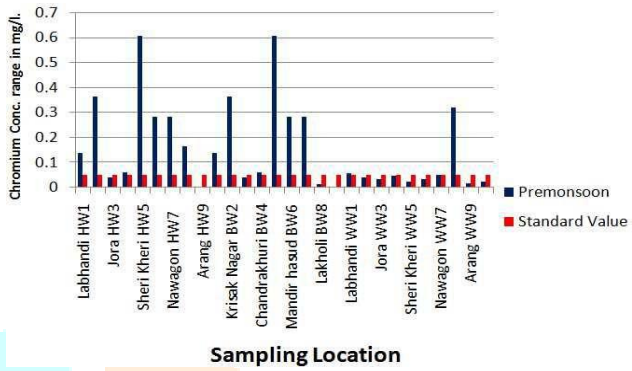
Table 2: Pre-monsoon data of heavy metals ofARANG (Surface water)

Metal →	**Ca**	**Cr**	**Pb**	**~Fe**
WHO (Standard Value)	75mg/l	0.05mg/l	0.01mg/l	3mg/l
Labhandi TW1	146.170	0.173	0.063	0.019
Krisak Nagar TW2	122.300	0.110	0.064	0.003
Jora TW3	139.560	0.132	0.012	0.053
Chandrakhuri TW4	236.100	0.131	0.001	0.026
Sheri Kheri TW5	197.600	0.435	0.041	0.015
Mandir hasud TW6	315.270	0.260	0.098	0.014
Nawagon TW7	143.447	0.512	0.106	0.019
Lakholi TW8	79.340	0.046	0.175	0.015
Arang TW9	419.000	0.120	0.083	0.007
Labhandi PW1	170.500	0.019	0.230	0.027
Krisak Nagar PW2	119.900	0.053	0.299	0.037
Jora PW3	30.970	0.103	0.143	0.015
Chandrakhuri PW4	151.800	0.065	0.206	0.006
Sheri khri PW5	128.700	0.150	0.299	0.036
Mandir hasud PW6	96.570	0.180	0.095	0.016
Nawagoan PW7	50.890	0.070	0.234	0.013
Lakholi PW8	37.920	0.141	0.248	0.017
Arang PW9	87.920	0.182	0.141	0.023
Canal	99.783	0.021	0.025	0.057

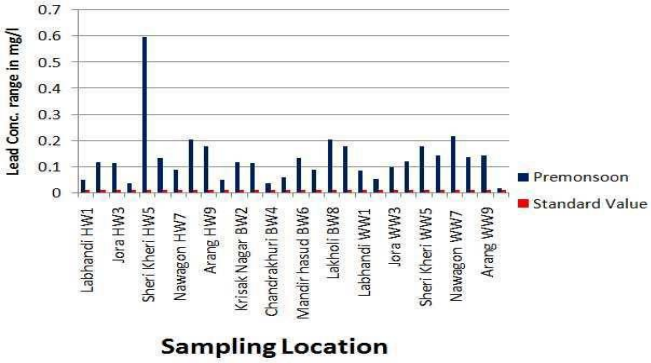
Note – TW = Tap Water, PW = Pond Water



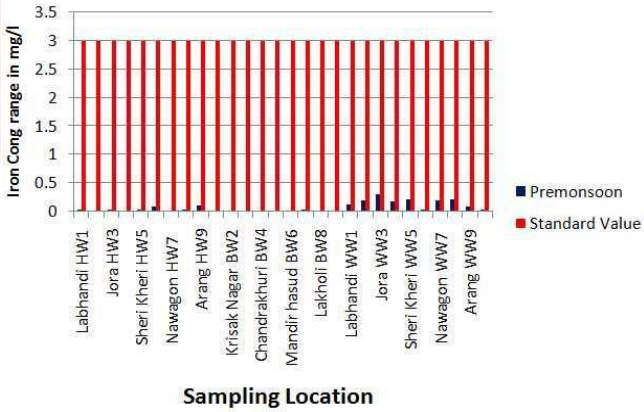
Graph 5.1 (A) Graph showing the Calcium in gm/l thedifferent sampling location during the Pre Monsoon



Graph 5.2 (B) Graph showing the Chromium in gm/lamong the different locations during the Pre-Monsoon



Graph 5.3 (C) Graph showing the Lead in gm/l thedifferent sampling location during the Pre Monsoon



Graph 5.4 (D) Graph showing the Lead in gm/l thedifferent sampling locations during the Pre-Monsoon

UV-VIS-NIR spectrophotometers is the mostuseful techniques for the determination of trace metals up to part per million. Therefore suspect that four may be metals contamination in the selected samples of groundwater and surface water.

GROUNDWATER

1. CALCIUM (Ca) :

The value of Ca concentration determined by present study area Arang block Groundwater (Pre-monsoon season) samples ranges from 105.141 to 81.182mg/l. The maximum and minimum calcium concentrations varied Hand Pump water samples no. 9 & 1, 237.182 to 105.141 mg/l., Borewell water samples no. 9 & 1, 237.108 to 105.100 mg/l., and Well water samples no. 6 & 1, 82.950 mg/l. and pond water samples no. 1 & 9, 0.019 to 0.182 mg/l. respectively. All the selected samples concentration is higher of the maximum (75 mg/l.) WHO standards. Measurable concentrations values are shown in Table-1 the comparisons levels of Calcium in the study area is shown in Graph-1.

2. CHROMIMUM (Cr):

The value of Cr concentration determined by present study area Arang block Groundwater (Pre-monsoon season) samples ranges from 0.141 to 0.026mg/l. The maximum and minimum chromimum concentrations varied Hand Pump water samples no. 5 & 9, 0.610 to 0.001 mg/l. Borewell water samples no. 5 & 9, 0.610 to 0.001 mg/l., and Well water samples no. 8 & 9, 0.323 & 0.018 mg/l. respectively. All the selected samples concentration is higher of the maximum (0.05 mg/l.) WHO standards. Measurable concentrations values are shown in Table – 1 the comparisons levels of Calcium in study area are shown in Graph-2.

3. LEAD (Pb):

The value of Pb concentration determined by present study area Arang block Groundwater (Pre-monsoon season) samples ranges from 0.49 to 0.015mg/l. The maximum and minimum Lead concentrations varied Hand Pump water samples no. 5 & 4, 0.597 to 0.036 mg/l. Borewell water sample no. 8 & 4, 0.204 to 0.036 mg/l.,and Well water samples no. 7 & 2, 0.217 & 0.052 mg/l.respectively. All the selected samples concentration is higher of the maximum (0.01 mg/l.) WHO standards. Measurable concentrations values are shown in Table-1 the comparisons levels of Lead in the study area is shown in Graph-3.

4. IRON (Fe)

The value of Fe concentration determined by present study area Arang block Groundwater (Pre-monsoon season) samples ranges from 0.044 to 0.030mg/l. The maximum and minimum Iron concentrations varied Hand Pump water samples no. 9 & 2, 0.111 to 0.009 mg/l. Borewell water sample no. 7 & 2 , 0.029 to 0.001 mg/l., and Well water samples no. 3 & 9, 0.302 & 0.095 mg/l.respectively. All the selected samples concentration is lower of the minimum (3 mg/l.) WHO standards. Measurable concentrations values are shown in Table – 1 the comparisons levels of Calcium in the study area is shown in Graph- 4.

SURFACE WATER

1. CALCIUM (Ca):

The value of Ca concentration determined by the present study area Arang block Surface water (Pre-monsoon season) samples ranges from 146.170 to 99.783mg/l. The maximum and minimum calcium concentrations varied Tap water samples no. 9 & 8, 419.000 to 79.340 mg/l., and Pond water samples no. 1 & 3, 170.500 to 30.970 mg/l., respectively. Calcium concentration level in allstudied samples except in Pond water samples no. 3,All the selected samples concentration is higher of the maximum (75 mg/l.) WHO standards. Measurable concentrations values are shown in Table-2 the comparisons levels of Calcium in the study area are shown in Graph-1.

2. CHROMIMUM (Cr):

The value of Cr concentration determined by the present study area Arang block Surface water (Pre-monsoon season) samples ranges from 0.173 to 0.021mg/l. The maximum and minimum Chromium concentrations varied Tap water samples no. 7 & 8, 0.512 to 0.046 mg/l. and Pond water samples no. 9 & 1, 0.182 to 0.019 mg/l. respectively. All the selected samples concentration is higher of the maximum (0.05 mg/l). WHO standards. Measurableconcentrations values are shown in Table-2 the comparisons levels of Chromium in the study area are shown in Graph-2.

LEAD (Pb)

The value of Pb concentration determined by the present study area Arang block Surface water (Pre-monsoon season) samples ranges from 0.063 to 0.025mg/l. The maximum and minimum Lead concentrations varied Tap water samples no. 8 & 4, 0.175 to 0.001 mg/l. and Pond water samples no. 2, 5 & 6, 0.299, 0.299

to 0.095 mg/l. respectively. All the selected samples concentration is higher of the maximum (0.01 mg/l.) WHO standards. Measurableconcentrations values are shown in Table – 2 the comparisons levels of Lead in the study area are shown in Graph-3.

3. IRON (Fe)

The value of Fe concentration determined by the present study area Arang block Ground water (Pre-monsoon season) samples ranges from 0.019 to 0.057mg/l. The maximum and minimum Iron concentrations varied Tap water samples no. 3 & 2, 0.053 to 0.003 mg/l. and Pond water samples no. 2 & 4 , 0.037 to 0.006 mg/l. respectively. All the selected samples concentration is lower of the minimum (3 mg/l). WHO standards. Measurable concentrations values are shown in Table – 2 the comparisons levels of Iron in the study area are shown in Graph- 4.

Conclusion

The Groundwater and surface water sampleswere collected from various locations of Arang Block, Raipur dist., Chhattisgarh. In pre-monsoon May-Jun. 2013 for the determination of Ca, Cr, Pb, and Fe by spectrophotometer concentration of the above-listed element were found to be ranged between Groundwater Ca in Hand Pump water 105.141-237.182 mg/l., Borewell water 105.100-237.180 mg/l., Well water 82.950- 185.100 mg/l. Chromium (Cr) in Hand Pump water 0.141- 0.001mg/l. Borewell water 0.141 – 0.001 mg/l. and Well water 0.141-0.001mg/l. Lead (Pb) in Hand Pump water 0.049-0.177 mg/l. Borewell water 0.048-0.177 mg/l. and Well water0.085-0.143 mg/l. Iron (Fe) Hand Pump water in 0.044-0.111mg/l, Bore well water 0.036- 0.046mg/l, and Well water 0.021 -0.033mg/l. Calcium, Chromium, Lead concentration levels in all studied samples except in Iron Hand Pump water samples no.1to 9, Borewell water samples no. 1 to 9, Well water samples no. 1 to 9 , Surface water in Calcium (Ca) 146.170 – 99.783mg/l. Chromium (Cr) 0.173 – 0.021mg/l. Lead (Pb) 0.063 – 0.025mg/l. Iron (Fe) 0.019 – 0.057mg/l. Calcium Concentration levels in all studied samples except in Pond water samples no. 3, 30.970mg/l. and Iron (Fe) All the selected samples concentration is lower of the comparedWHO standards are exceeding then compared WHO standards.

Ca, Cr, and Pb in all the samples are exceeded WHO limits for drinking water. The excess presence of Calcium causes Hypercalcemia disease, hardness of water & adverse effect on domestic use. Chromium presence excessamount may be Encrustation in water supply structure and adverse effect on domestic use.

The excess presence of lead causes damages the nervous system and causes brain disorder. From the results of the present study, we can suggest that the Government should be adopted some treatment technologies in the following study areas to minimize these heavy metals in ground and surface water for safe drinking water to the public.

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