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RESEARCH ARTICLE

HEAVY METALS IN THE GROUNDWATER OF MEDAK AND HYDERABAD DISTRICTS OF TELANGANA, INDIA

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ABSTRACT

This paper deals with heavy metal concentration in the ground waters of Medak and Hyderabad districts located in Telangana, India. Four bore wells, SI, SII, SIII and SIV located in Medak and Hyderabad districts were identified and analyzed for a period of one year. Groundwaters from all these stations were used for drinking as well as other domestic purposes. In the groundwaters of Medak, Pb and Cd were analyzed while at Hyderabad, Zn, Pb and Cr. Pb was below detectable limits i.e., BDL at SI, II and III while at SIV it was 0.027 mg/l which is below the permissible limits given by WHO 1984 and BIS 1983. Cd concentration at SI and SII were 0.13mg/l and 0.10mg/l which was higher than the permissible limits. The concentration of Zn was 0.017mg/l at SIII and BDL at SIV which once again was below the permissible limits. Cr concentration which was 0.027mg/l and 0.037 mg/l at SIII and SIV respectively was well within the permissible limits. Interestingly, the ground water samples from SI and SII exceeded the permissible limits in Cd. Hence, unfit for human consumption. Alternate measures must be made for drinking purpose like supply of potable water or bottled water etc. Potable water protects the health of the individual which leads the progress of the state and nation at large.

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INTRODUCTION

Heavy metal contamination of groundwater remains unnoticed and hidden from the general public. Today it has raised concern not only in different parts of the world but particularly in India. In Denmark Clousen and Rastogi (1977) worked on heavy metal pollution among autoworkers. In Stockholm work on heavy metals in groundwater was carried by Aastrup and Thunholm (2000), in Malayasia the distribution of heavy metal profile in ground water was investigated by Samuding *et al.* 2009. In Egypt, Nassef *et al.* 2006; In Iran, Noori *et al.* 2006; In Ohio, USA Zon *et al.* 2008 worked on the heavy metals in groundwater. Petkov *et al.* (2002) worked on Plovdiv – Assenovgrad, Bulgaria. Manoranjini and Johnson (2012) worked on Cadmium contamination in ground water of Patancheru industrial area, Medak District A.P., Indi. Borah *et al.* 2009 studied the heavy metal contamination of groundwater in Assam. Singh *et al.* (2008), assessed Arsenic, F, Fe, NO3 and heavy metals in north eastern states of India. Buragohain *et al.* 2009, seasonal distribution of trace metals in groundwater of Dhemaj district, Assam, India. Reza *et al.* 2009, investigated Angul-Talcher region of Orissa, India. Dakate and Singh 2008, worked on Sukinda valley of Orissa. Shailaja and Johnson, 2006 worked on the heavy metals in groundwater of some areas of Hyderabad city. Ramesh *et al.* 1995, worked on the problem of groundwater pollution from Madras city, India. In developing countries like India, and specially in the southern region, in the regions beyond the municipal limits, people depend on groundwater for drinking purpose. Hence in the paper groundwater quality was assessed to see how safely the groundwater can be used for drinking purpose.

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MATERIALS AND METHODS

Four borewells, one situated at Ramachandrapuram (Station I) located at a distance of 50 km from Hyderabad city, second borewell at Patancheru (Station II) at a distance of 52 km, third borewell situated at ESI (Station III) – 9 from Hyderabad city and fourth situated at Koti (Station IV) 1.5 km from it were selected and analysed for one year fortnightly.

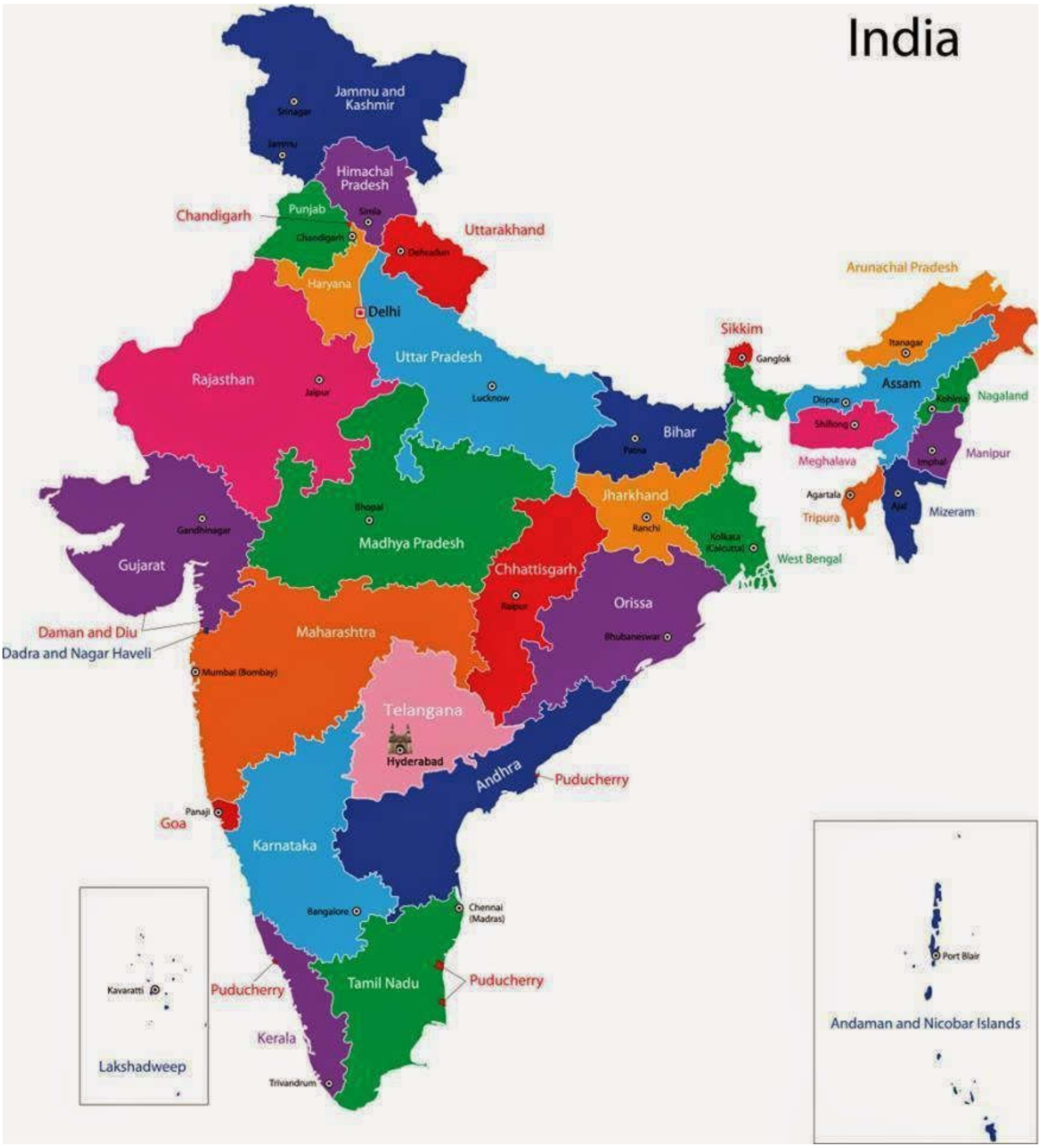


Fig. 1. Map of India

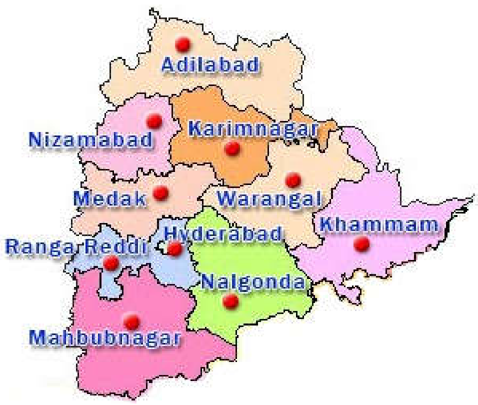


Fig. 2. Map of Telangana state with districts

Fig. 3. Medak Map showing SI(Ramachandrapuram) and SII(Patancheru)

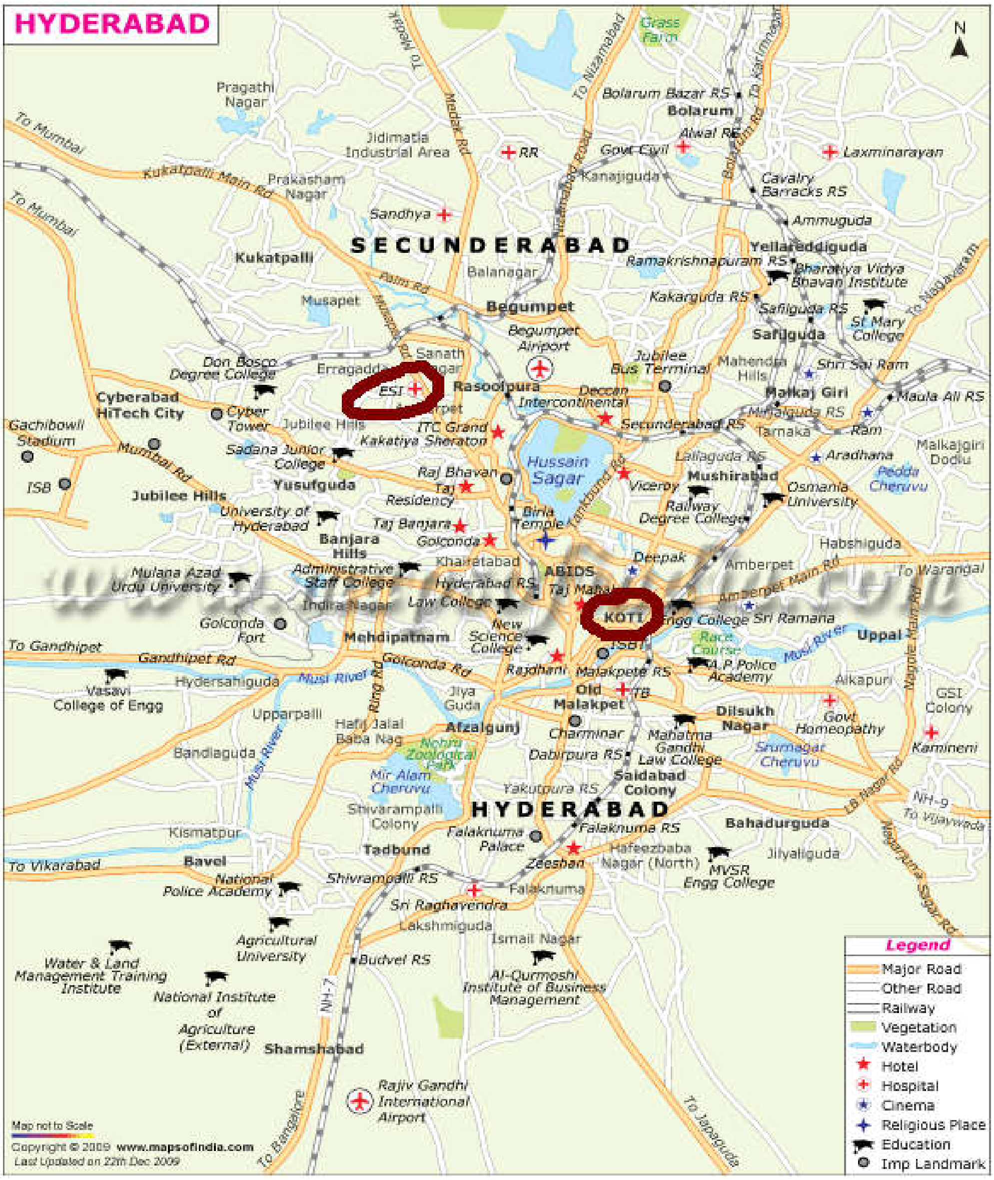


Fig. 4. Hyderabad Map showing SIII (ESI) and SIV(Koti)

Station I and Station II are located in the Medak district of Telangana while Station III and IV are located in Hyderabad district of Telangana. At Station I and II Pb and Cd were analyzed while at Station III and IV Zn, Pb and Cr. The depth of the borewells at Station I,II,II,IV were 150ft, 150ft, 140ft and 170ft respectively. Standard Methods (APHA 1995, Trivedi *et al*., 1987) were followed using Atomic Absorption Spectrophotometer. 100ml of water sample was preserved by adding 5ml nitric acid and later estimated for Pb, Cd, Zn and Cr. Statistical analysis was done according to Sukhatme and Amble (1978). Station I and Station II are two residential colonies in the Industrial area of Ramachandrapuram and Patancheru of Medak district of Telangana. These colones do not have municipal drinking water supply and underground drainage systems. The residents of theses colonies use groundwater (borewell) for drinking as well as other domestic purpose. These areas were earlier used for agriculture purposes which are now converted to residential colonies. Station III and Station IV located at ESI and Koti are in the Hyderabad district of Telangana. Station III is an industrial cum residential area while Koti is a commercial cum residential area. The residents of Station III and Station IV use groundwater i.e. borewell for drinking, cooking, washing and bathing only, When there is shortage of potable water supplied by the Greater Hyderabad Metro Water Works Department.

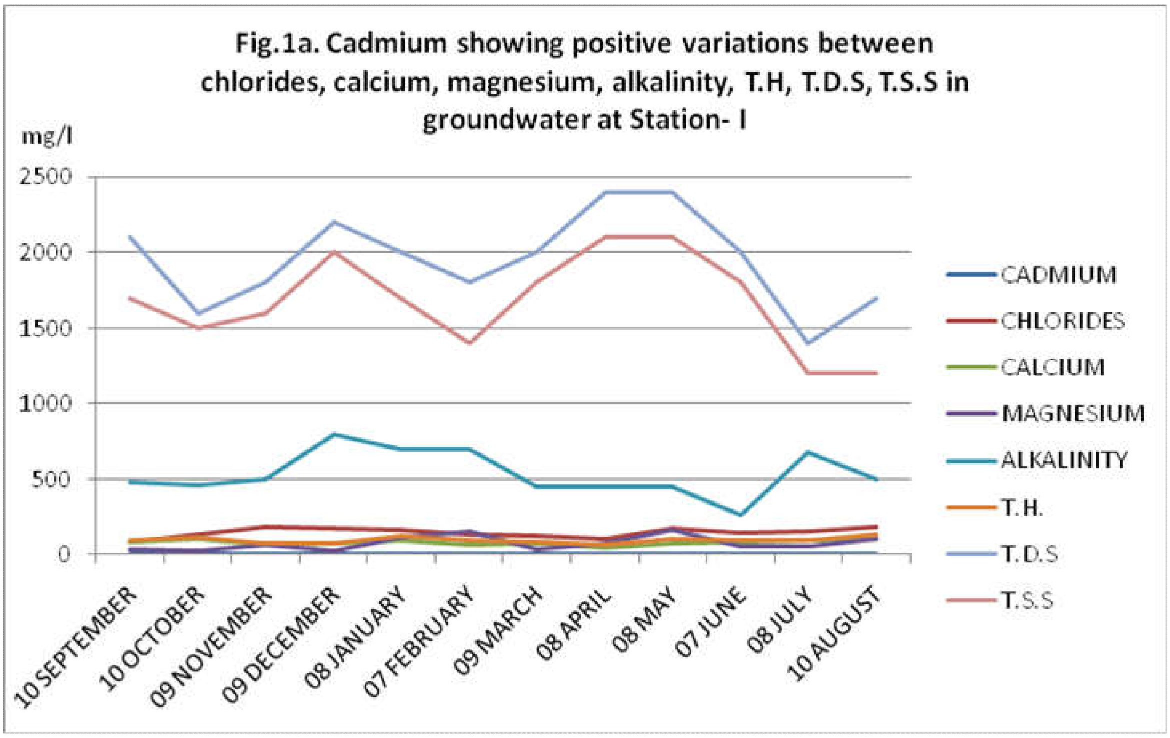
RESULTS AND DISCUSSION

Cadmium

Cadmium is uniformly distributed in trace amounts in the earth's crust. The use of this element is increasing steadily. The principle uses of cadmium are in the fabrication of alloys and solders, metal plating as principle pigments, as stabilizers in plastic materials and in batteries. In the present study Cadmium ranged from 0.01mg/l to 0.28mg/l in Station I and 0.02 mg/l to 0.26 mg/l with an average of 0.01 mg/l and 0.06mg/l in Stations I and II respectively. Similar report was given by Prasad *et al*. (1999) from Ranga Reddy and Medak districts. Cadmium was not estimated in Stations III and IV. The seasonal variations observed during the pre-monsoon and post-monsoon were 0.01 mg/l and 0.15 mg/l for Station I and 0.06 mg/l and0.11 mg/l for Station II respectively. There was an increase in the Cadmium concentration during the post-monsoon season indicating leaching of Cadmium from the soil to the underground water. Cadmium concentration 0.04 mg/l to 0.01mg/l was reported by Prasad *et al*. (1999) from the leachate samples of Ranga Reddy and Medak districts. Cadmium of Station I and Station II samples showed positive correlation with Chloride (r=0.87 and 0.99), Calcium (r=0.89 and 0.99),

Table 1. The range, seasonal variations, average and standard limit of WHO and ISI values for Cadmium, Chromium, Zinc and Lead (mg/l) in the groundwaters of Telangana

Parameter	Station	Range	Pre-Monsoon	Post-Monsoon	Average	WHO (1984)	ISI (1983)
Cadmium	I	0.01-0.28	0.01	0.15	0.13	0.005	0.01
Cadmium	II	0.02-0.26	0.06	0.11	0.10	0.005	0.01
Chromium	III	BDL-0.08	0.027	0.022	0.027	0.05	0.05
Chromium	IV	0.01-0.08	0.032	0.035	0.037	0.05	0.05
Zinc	III	BDL-0.04	0.030	0.005	0.017	5.0	5.0
Zinc	IV	BDL	BDL	BDL	BDL	5.0	5.0
Lead	I	BDL	BDL	BDL	BDL	0.05	0.05
Lead	II	BDL	BDL	BDL	BDL	0.05	0.05
Lead	III	BDL	BDL	BDL	BDL	0.05	0.05
Lead	IV	BDL-0.08	0.027	0.022	0.027	0.05	0.05



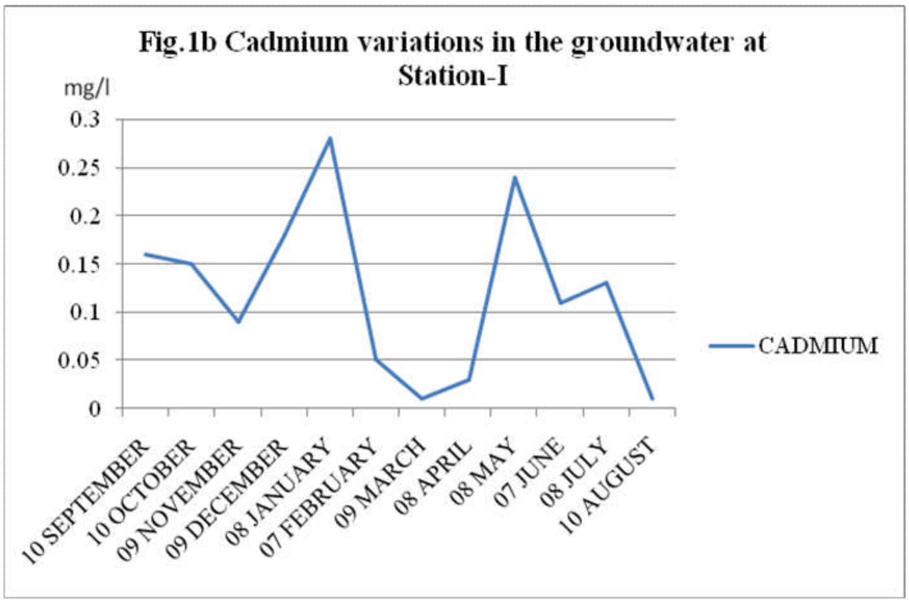


Fig.1b Cadmium variations in the groundwater at Station-I
mg/l
0.3
0.25
0.2
0.15
0.1
0.05
0
10 SEPTEMBER
10 OCTOBER
09 NOVEMBER
09 DECEMBER
08 JANUARY
07 FEBRUARY
09 MARCH
08 APRIL
08 MAY
07 JUNE
08 JULY
10 AUGUST
CADMIUM

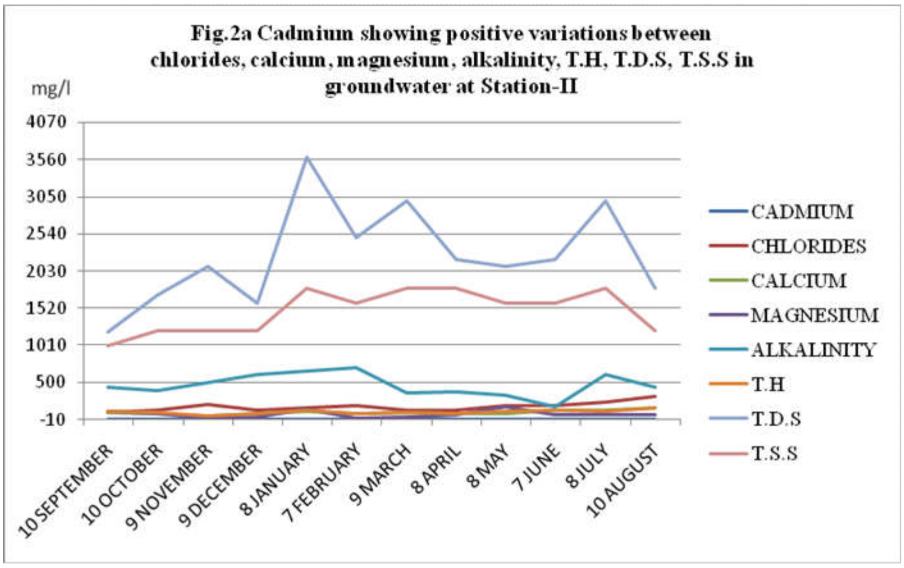


Fig.2a Cadmium showing positive variations between chlorides, calcium, magnesium, alkalinity, T.H, T.D.S, T.S.S in groundwater at Station-II
mg/l
4070
3560
3050
2540
2030
1520
1010
500
-10
10 SEPTEMBER
10 OCTOBER
9 NOVEMBER
9 DECEMBER
8 JANUARY
7 FEBRUARY
9 MARCH
8 APRIL
8 MAY
7 JUNE
8 JULY
10 AUGUST
CADMIUM
CHLORIDES
CALCIUM
MAGNESIUM
ALKALINITY
T.H
T.D.S
T.S.S

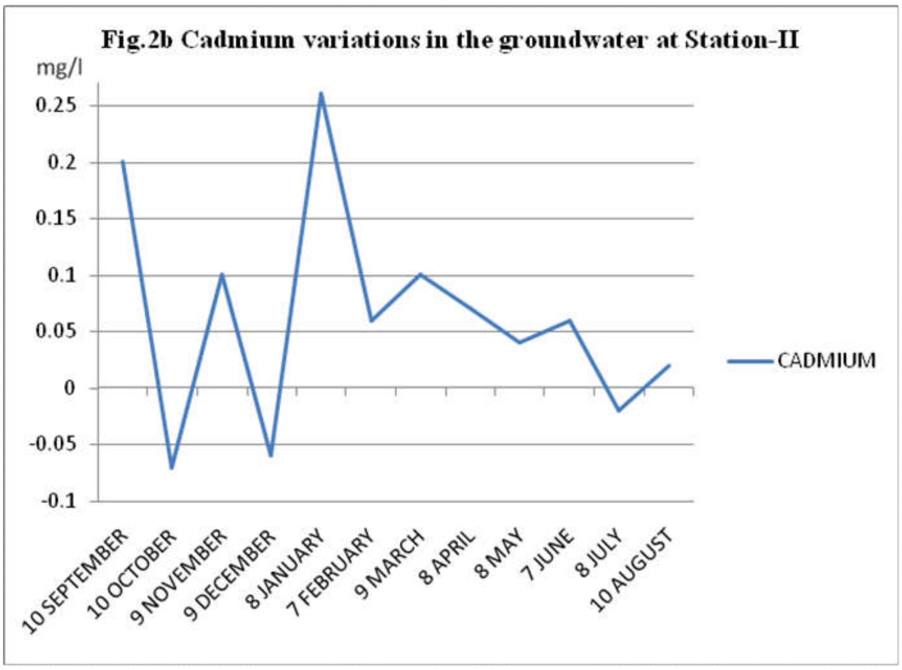


Fig.2b Cadmium variations in the groundwater at Station-II
mg/l
0.25
0.2
0.15
0.1
0.05
0
-0.05
-0.1
10 SEPTEMBER
10 OCTOBER
9 NOVEMBER
9 DECEMBER
8 JANUARY
7 FEBRUARY
9 MARCH
8 APRIL
8 MAY
7 JUNE
8 JULY
10 AUGUST
CADMIUM

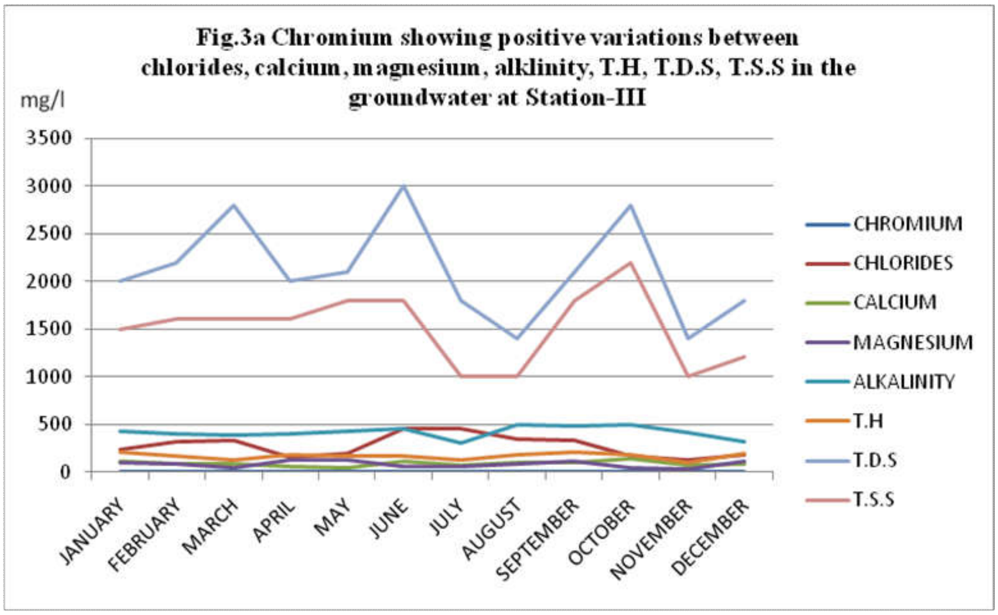


Fig.3a Chromium showing positive variations between chlorides, calcium, magnesium, alklinity, T.H, T.D.S, T.S.S in the groundwater at Station-III
mg/l
3500
3000
2500
2000
1500
1000
500
0
JANUARY
FEBRUARY
MARCH
APRIL
MAY
JUNE
JULY
AUGUST
SEPTEMBER
OCTOBER
NOVEMBER
DECEMBER
CHROMIUM
CHLORIDES
CALCIUM
MAGNESIUM
ALKALINITY
T.H
T.D.S
T.S.S

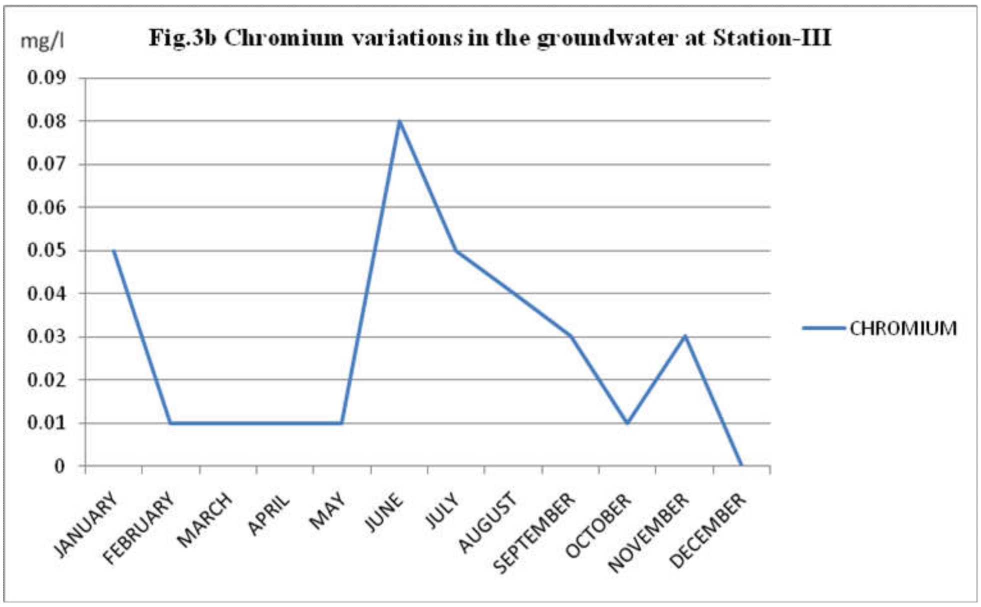


Fig.3b Chromium variations in the groundwater at Station-III
mg/l
0.09
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
JANUARY
FEBRUARY
MARCH
APRIL
MAY
JUNE
JULY
AUGUST
SEPTEMBER
OCTOBER
NOVEMBER
DECEMBER
CHROMIUM

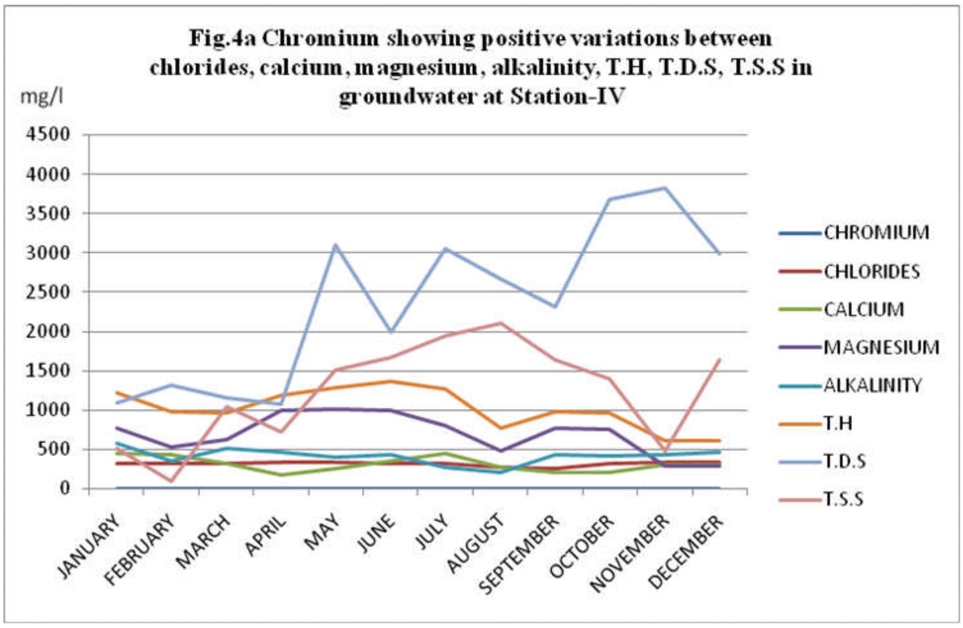


Fig.4a Chromium showing positive variations between chlorides, calcium, magnesium, alkalinity, T.H, T.D.S, T.S.S in groundwater at Station-IV
mg/l
4500
4000
3500
3000
2500
2000
1500
1000
500
0
JANUARY
FEBRUARY
MARCH
APRIL
MAY
JUNE
JULY
AUGUST
SEPTEMBER
OCTOBER
NOVEMBER
DECEMBER
CHROMIUM
CHLORIDES
CALCIUM
MAGNESIUM
ALKALINITY
T.H
T.D.S
T.S.S

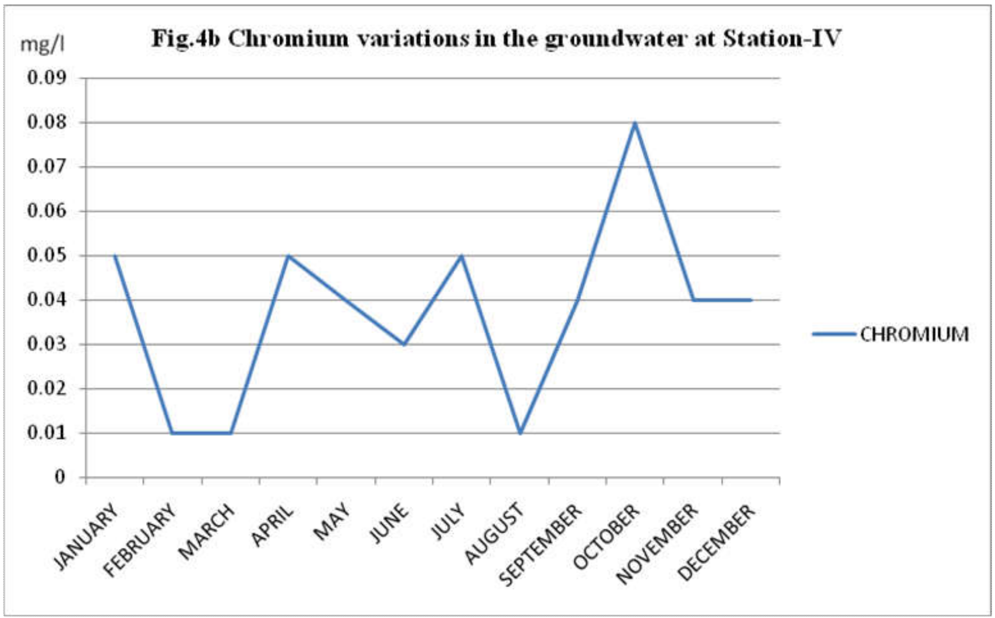


Table 2. Cadmium and Chromium showing positive correlation with certain chemical parameters in the groundwaters of Telangana

Parameter	Station	Cl	Ca	Mg	Alkalinity	Total Hardness	TDS	TSS
Cadmium	I	0.87	0.89	0.93	0.86	0.89	0.99	0.91
Cadmium	II	0.99	0.99	0.99	0.96	0.98	0.99	0.99
Chromium	III	0.66	0.46	0.15	0.24	0.40	0.20	0.05
Chromium	IV	0.23	0.33	0.08	0.15	0.07	0.45	0.05

Magnesium (r=0.93 and 0.99), Alkalinity (r=0.86 and 0.96), Total Hardness (r=0.89 and 0.98), Total Dissolved Solids(r=0.99 and 0.99) and Total Suspended Solids (r=0.91 and 0.99) respectively. Shrivastava and Choudhary (2000) reported the Cadmium<0.1 mg/l from Maharashtra. Nayak and Sawant (1996) reported heavy metal content in drinking water of Mumbai city. The range of Cadmium concentration at Station I and Station II can be compared to the range of Cadmium concentration given by Singh *et al*.(2008) non-monsoon (0.01mg/l -0.38 mg/l) for state Arunachal Pradesh given by Singh *et al*. (2008) Cadmium is natural constituent of groundwater and may be in inorganic and organic forms. Cadmium in groundwater may arise from industrial discharge, mining activities, weathering and erosion of bed rock (Stanley, 1993).

Chromium

Most rocks and soils contain small amounts of chromium. The commonest ore is chromite in which the metal exists in the trivalent form. Chromium occurs naturally in a highly insoluble form. However, weathering, oxidation and bacterial action can convert it into a slightly more soluble form. In this investigation Chromium ranged from BDL to 0.08 mg/l with and average of 0.027 mg/l in Station III and 0.01 mg/l to 0.08mg/l with and average of 0.037 mg/l in Station IV, Chromium was not estimated in Stations I and II. During the pre-monsoon and post-monsoon seasons Chromium content were 0.027 mg/l and 0.022 mg/l in Station III and 0.032mg/l and 0.035 mg/l for Station IV respectively. At Station III during the post-monsoon season the Chromium concentration decreased but at Station IV it was vice-versa. The increase in Chromium concentration in the post monsoon season can be attributed to the leaching effect of soil and rock materials. Chromium at Station III and Station IV showed positive correlation with Chlorine(r=0.66 and 0.23), Calcium (r=0.46 and 0.33), Magnesium (r=0.15 and 0.08), Alkalinity (r=0.24 and 0.15), Total Hardness (r=0.40 and 0.07), Total Dissolved Solids(r=0.20 and 0.45) and Total Suspended Solids (r=0.05 and 0.05) respectively. This positive correlation between Chromium and the above chemical parameters can be attributed to the leaching effect from the soil. Similar observations were made by Manoranjini (2001), Shailaja and Johnson (2006).

Zinc

Zinc is an abundant element and constitutes approximately 0.04g/kg of the earth's crust. The most common Zinc mineral is Spalerite (ZnS) which is often associated with the sulfides of other metallic elements. Zinc is essential for all living forms. Zinc acts as a stabilizer of the structure of membrane and cellular components. At Station III Zinc ranged from BDL – 0.040 mg/l with an average of 0.017 mg/l while at Station IV Zinc was below detectable limits all through the study. During the pre-monsoon and post-monsoon seasons the Zinc content was 0.030 mg/l and 0.005 mg/l at Station III. There was a marked decrease in the concentration of Zinc in the post-monsoon season. This can be attributed to the heavy rainfall dilution factor and increase in the groundwater level. Zinc at Station III was lower than the north-eastern states of India i.e. Assam, Arunachal Pradesh, Manipur, Meghalaya, Mizoram, Nagaland, Sikkim and Tripura as reported by Singh *et al*. (2008).

Lead

Lead sulphide or Galena is a main source of lead. It is widely used in pipes battery cases, paints as petrol addictive has resulted in the contamination of aquatic environment and groundwater. By the industrial discharges from smelters, battery manufacturing units run off from contaminated land areas, atmospheric fallouts and sewerage. Use of pipes and plastic pipes contribute to higher level of Pb in drinking water. Consequently Lead is present in air, food, soil and dust. Unlike other heavy metals, toxicity of Lead was known to man for several hundred years. It is one of the most important heavy metal that has been studied extensively. Pb is not known to be essential for the functioning of biological systems. But Lead is recognized as a cumulative metabolic poison. Lead was below detectable limits BDL all through the study period at Stations I, II and III. At Station IV lead ranged BDL – 0.08 mg/l and averaged to 0.027 mg/l. During the pre-monsoon season its concentration was 0.027 mg/l and decreased to 0.022 mg/l at the post-monsoon season. This decrease can be attributed to the increase in the groundwater level due to heavy monsoons.

Conclusion

At Station I and II presence of Cadmium can be attributed to the previous agricultural practices and present industries located around them. The presence of Chromium, Zinc and Lead at Station III and IV can be attributed to urbanization and industrialization. The quality of ground water varies from place to place. The suitability of ground water has to be tested before human consumption and domestic application. When groundwater is unfit for human consumption, alternate measures must be made for drinking purposes. Potable water protects the health of the individual which leads to the progress of the state and ultimately the nation at large.

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