IMPACT OF HEAVY METALS ON GROUND WATER POLLUTION IN SOME TOWNS OF VELLORE DISTRICT, TAMIL NADU, INDIA

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Abstract

The present study has been attempt to analyze the status of heavy metal concentration of Arcot, Ranipet, wallajahpet, towns in vellore district. This study indicates that both urbanization and Industrialization have contributed to the large scale of pollutions currently observed. The result shows that most of the groundwater is deteriorated more than the permissible limit of WHO. In drinking water, presence of heavy metals is threat to human health. People exposed to heavy metals through water consumption are vulnerable to cancer and other risks. This research aims at reviewing the presence of heavy metals in drinking water and their possible health effects.

Key words: Groundwater, Heavy metals, vellore district.

I Introduction

Groundwater is ultimate, most suitable fresh water, resource with nearly balanced concentration of the salt for human consumption. Water is one the essential components for the sustenance of life on earth. Among the various source of water, ground water is considered to be the safe for drinking purposes. The water which is being used for industries, agriculture and human needs adds continuously contaminants to the ground water. Groundwater is used intensively for irrigation and industrial purposes, a variety of land and water-based human activities are causing pollution of this precious resource. Its over-exploitation is causing aquifer contamination in certain instances, people around the world are using ground water as a source of drinking water and even today, more than half of the world's population depends on it for survival.[1]

Ground water contamination is generally irreversible i.e. once it is contaminated; it is difficult to restore the original water quality of the aquifer. Excessive mineralization of groundwater degrades its quality and produces an objectionable taste, odour and excessive hardness. Although the soil mantle through which water passes acts as an adsorbent retaining a large part of colloidal and soluble ions with its cation exchange capacity, but ground water is not completely free from

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the menace of chronic pollution. Therefore, it is always better to protect ground water in the first place rather than relying on technology to clean up contaminated water at a later stage.

India is developing country which means infrastructure sector is growing on at a much higher rate, leads to the development of core industries like metals, chemicals, fertilizers, drugs and petroleum etc and other industries such as plastics, pesticides, detergents, solvents, paints, dyes, and food disposed their effluents and emissions on land and water bodies and polluting our environment. The disposal of solid and liquid wastes containing heavy metals like lead, nickel, chromium, molybdenum, and mercury in to the ecosystem, leads to heavy metal contamination of our natural habitat (i.e. soil, water and air ecosystems).[2]

Heavy metals are also known to be toxic to both humans and other living forms, with their accumulation over time causing damage to the kidney, liver and reproductive system in addition to cancer. Heavy metal pollution derives from a number of sources, including lead in petrol, industrial effluents and leaching of metal ions from the soil into lakes and rivers by rain. Heavy metals are basically present in groundwater but these play an important role in determining the quality of water for drinking purposes. Metals are considered toxics and when they enter the body more than the prescribed limit they start causing harm. In the same way many physicochemical parameters play an important role in determining the quality of water [3].

Hence there is a need for extensive monitoring of water pollution along the industrial zones over long periods of time in order to describe average metal precipitation [4] and its trend, which is an essential component of any pollution control management.

The day by day increasing tremendous pollution load along most of the towns in India has prompted us to carry the systematic and detail study of Heavy metal pollution in some towns of vellore district.

II Description of the study area

Study Area: The study area lies between Latitude N 12°52'30'' – 12°57'30'' and Longitude E 79°15'00''–79°25'00'' is located in North of TamilNadu in India, covering about 154.52 Sq.Km area (Fig.1). The area includes Ranipet, Walajapet, and Arcot . The drainage of the study area is mainly Palar River and Ponnai River. The Ranipet area is a chronic polluted area and one of the biggest exporting centers of tanned leather. Many small-scale tanneries are processing leather in the study area and discharging their effluents on the open land and surrounding water bodies [5].

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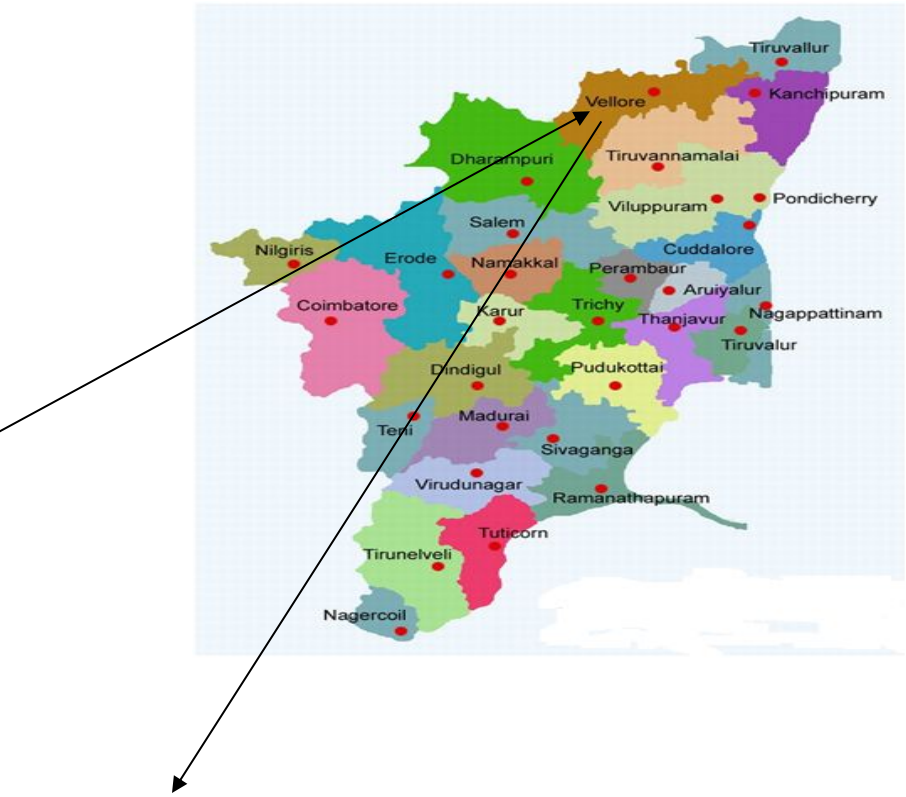
Study area map (Figure-1)



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ZONE-I

1.Shozhingarroad
2.GH road
3.TNHP colony
4.BelliyappaNagar
5. Kakithakara street

ZONE-II

6. Kalavai road
7. Arcot bus stand
8. Krishnapuram
9. Kaikara street
10.Dhandu bazzar

ZONE-III

11. Agrawaram 12. Ranipet bazzar 13. Ammour 14. Thendral Nagar 15. Maniyam pattu 16. New Agrawaram 17. Puliyankannu 18. Bharathi Nagar 19. Emorold Nagar20.Karai 21. Vedagal 22. Periya thangal 23. Puliyanthangal 24. Navalpur 25. Chettithangal 26. Vanapadai 27. RV Nagar 28. Mettuthangal 29. Manthangal 30. Vanapdai road

III Materials and methods

Collection of water samples

Groundwater samples were collected from 30 Locations within study area during month of June 2016, Sampling is done at each station in polythene bottles of two-litre capacity. The samples were analyzed various water quality parameters such as pH, electrical conductivity (EC),Total hardness(TH) and heavy metal such as Fe, Mn, Pb, Cr, Cd, were determined using standard method.[6] observed values were compared with WHO standards(2012).[7]

IV Result and discussion

Table – 1 Physico-chemical parameter & Heavy metal content of ground water during month of June 2016.

Sample No	pH	EC	TH	Fe	Mn	Pb	Cr	Cd
S1	6.4	3970	890	0.16	0.1	0.15	0.09	0.19
S2	7	950	264	0.16	0.07	0.13	0.07	0.16
S3	6.4	1080	267	0.27	0.27	0.1	0.1	0.12
S4	7.2	1030	245	0.27	0.59	0.09	0.12	0.18
S5	6	1960	267	0.38	0.5	0.06	0.09	0.17

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S6	6	2740	545	0	0.2	0.05	0.1	0.19
S7	6.1	3300	921	0.3	0.95	0.06	0.17	0.22
S8	6.3	1890	245	0	0.59	0.07	0.21	0.25
S9	6.2	1790	289	0.75	0.75	0.09	0.16	0.4
S10	6.2	2560	412	0.84	0.3	0.1	0.2	0.4
S11	6.7	1250	389	0.55	0.2	0.18	0.24	0.42
S12	7.1	1070	245	0.57	0.2	0.25	0.37	0.45
S13	6.2	3270	996	0.39	0.25	0.2	0.26	0.34
S14	6.2	3760	999	0.15	0.6	0.24	0.3	0.5
S15	6.5	2390	923	0.15	0.6	0.2	0.27	0.29
S16	6.5	2450	580	0.14	0.3	0.24	0.29	0.33
S17	6.3	2890	929	0.29	0.25	0.23	0.32	0.09
S18	6.7	1670	366	0.97	0.5	0.19	0.23	0.09
S19	7	1190	262	0.46	0.52	0.16	0.32	0.19
S20	7.3	1280	342	0.86	0.7	0.25	0.35	0.12
S21	6.5	2260	361	0.74	0.3	0.19	0.31	0.19
S22	6.5	3390	945	0.69	0.2	0.18	0.3	0.27
S23	6.4	3175	986	0.67	0.31	0.2	0.32	0.35
S24	6.8	2295	789	0.14	0.2	0.08	0.26	0.43
S25	6.9	1380	573	0.24	0.22	0.09	0.28	0.52
S26	6.7	3785	890	0.02	0.1	0.08	0.15	0.08
S27	6.4	1435	372	0.34	0.2	0.09	0.1	0.09
S28	6.9	981	253	0.15	0.23	0.09	0.07	0.12
S29	7	1295	362	0.15	0.32	0.1	0.1	0.04
S30	6.9	1555	482	0.24	0.28	0.09	0.12	0.05

Table-2 Results of water analyzed in comparison with WHO standards

Parameters	**Permissible limit as per , WHO 2012**	**No of samples exceeding permissible limit**	**Percentage %**
PH	7.0-8.5	24	30
EC	1000	28	93
Total Hardness	300	21	70
Iron	0.3	14	46
Manganese	0.1	29	96
Lead	0.05	30[All samples]	100
Chromium	0.05	30[All samples]	100
Cadmium	0.01	30[All samples]	100

All parameters are expressed in mg/l except pH and EC. EC in μS/cm

pH

pH is used to determine whether a solution is acidic or alkaline. The pH values of all groundwater samples are found to be in the range of 6.0 - 7.3. The highest value of pH7.3is observed at station S20 whereas the lowest value of pH 6.0 is observed at station S5,S6. The permissible limit of pH for drinking water is 7.0 - 8.5 (WHO). The most of groundwater sample

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exceed the acceptable limit of WHO. There is abnormal change of pH in the groundwater samples. If the pH is found beyond the permissible limit, it affects the mucous membrane of cells. [8].

Electrical Conductivity (EC)

Generally, electrical conductivity is a measure of the ability of water to pass on electrical current and is affected by the presence of dissolved solids. As the level of total dissolved solids (TDS) raises, the conductivity will also increases [9]. EC was found to be the range from950 mS cm-1 to 3970 mS cm-1. Water having high EC and TDS values can cause osmotic stress at the root zone of plants which makes it more difficult for a plant to absorb water for growth. Thus increased EC and TDS in irrigation water leads to lower crops production. EC itself is not a human or aquatic health concern but it can serve as an indicator of other water quality problems. [10]

Total hardness

Divalent metallic cations particularly $Ca^{2+,}$ Mg^{2+}, Sr^{2+}, and Fe^{2+} are responsible for hardness in textile effluents. Hardness of the samples were found to be varied from 245 to 999 mg/L. According to WHO, the maximum allowable limit of hardness is 300 mg/L. The high levels of hardness were observed in S14 sample. The amount of water pollution was found to be higher than the permissible limit (300 mg/L) as per EPA standard. [11]

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Iron (Fe)

Iron is the second most abundant metal in the earth's crust. The permissible limit for iron in ground water is approximately 0.3mg/L. Due to acute exposure, wide variations in toxicity have been reported for different iron salts. Iron content in the water samples crossed the permissible limit stipulated by WHO. The very high value of iron in this samples may be due to the result of Iron ore tailing from the metal workshops and mixing of untreated domestic and industrial wastes. Iron varied at different distances as well as in different seasons. [12]

Manganese (Mn)

The values of Manganese are recorded between the range of 0.069-0.95mg/L . All the values are exceed the permissible limit of 0.1 mg/L except sample S2. But according to WHO for drinking water, permissible limit for manganese is 0.1 mg/L. In this study, the groundwater is much polluted by manganese. However, High in its level may be accounted for by the influence of domestic waste, natural geological rocks [13].

Lead (Pb)

Lead is an undesirable trace metal less abundantly found in earth's crust. it is also found in soil, vegetation, animals and food. It is a serious cumulative body poison. Lead inhibits several key enzymes involved in the overall process of haemo-synthesis whereby metabolic intermediate accumulates [14]. The Pb values are found in the range of 0.056 mg/L to0.25 mg/L. In our study the high Pb values were observed for all water samples prescribed by WHO (0.05ppm). The Pb contamination of the ground water may be the result of entry from industrial effluents, household

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sewages, agricultural run-off containing phosphatic fertilizers and human and animal excreta. High Pb values may affect adverse changes in the arteries of human kidney and causes high blood pressure and kidney damage [15]

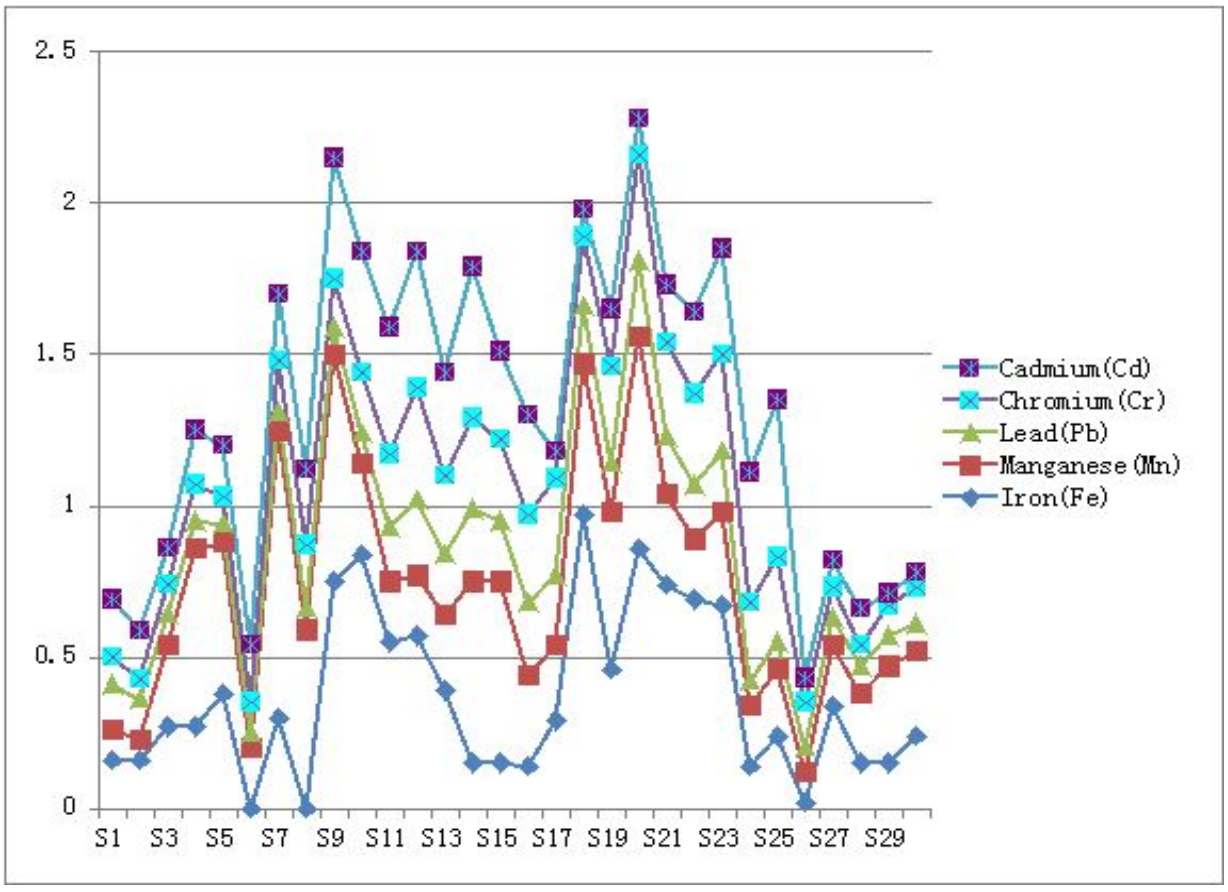
Chromium (Cr)

Chromium in water is in the form of trivalent or hexavalent state and is potentially toxic in dissolved form. The concentration of chromium in the study area ranges from 0.07 – 0.37 mg/L. Chromium is a specific pollutant providing evidence of industrial pollution like dye or leathering operations.[16] The highest concentration of chromium was recorded in S12. High content of Chromium may be due to various anthropogenic activities, industrial effluents, tanneries and old plumbing [17]

Cadmium (Cd)

Cd was found range from 0.04-0.5 mg/L, it may be due to effluent from metal alloys. The major source of Cd is the coal combustion, metal industry and waste incineration [18]. The maximum concentration Cd in the sample S14 was 0.5 mg/L. It may be due to coal- combustion which is very frequent in industries (Thermal Power Station) and domestic purpose.

Comparison of Heavy metals (Figure-2)



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V Conclusion

It is concluded that, given the presence of industrial activity that can release heavy metals into the environment, Ranipet, Arcot, Wallajah pet, may be at high risk of metal contamination. Even though, the condition is very bad at present, but if the same continues in future groundwater source will be completely polluted and become unfit for drinking and other purposes. This observation indicates contamination of the environment. Therefore, most of the water from these bore wells is not suitable for domestic use and its unlikely to pose a major health risk to consumers. Hence, it is high time to preserve and protect this valuable ground source. Thus dumping of industrial waste should be avoided .Hence lot of precaution should be done to avoid consequence.

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