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Assessment of Heavy Metal Concentration of Groundwater in Veppanthattai Block, Perambalur District, Tamil Nadu

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ABSTRACT

The current study was aimed to find out the heavy metal concentration of groundwater in the Veppanthattai block. Here, 45 water samples from different sites were collected during the year 2015 at post monsoon, and Cd, Cr, Cu, Fe, Ni, Pb and Zn heavy metal content was analyzed using an atomic absorption spectrophotometer (AAS). The obtained results were then compared with the WHO standard for the specific highest pollution level. Accordingly, some or all water samples are above the permissible limit, particularly for Cd metal (all samples). The elevated concentration of cadmium in water samples of the study area may be due to agricultural runoff, as pesticides and cadmium-containing fertilizer have been used. The study showed that without proper treatment, the groundwater of the study area is not suitable for domestic applications.

***Keywords*:** Groundwater, Heavy metal, Veppanthattai, AAS, WHO

1. INTRODUCTION

Water is the universal substances that maintain plant and animal being. Groundwater from borewells and open wells polluted with heavy metal as a result of human activities, some of these activities include the production of fuel, pesticides getting in an unprocessed sewage, chemical fertilizers, throwing away of waste and industrial effluents lead into streams running and rivers close into the housing area, as well as indiscriminate disposal of garbage, pharmaceutical products and wastes of automobiles[1].

Heavy metals are mostly present in groundwater and play a significant role in determining the quality of water for drinking uses. Metals are believed toxins and they start causing injury when they enter the water body more than the prescribed limit[2]. Heavy metals such as As, Cd, Cr, Cu, Ni, and Pb have been predictable as hazardous elements for the environment[3]. Though, metals like Cu, Fe, Mn, and Ni are important as micronutrients for plants while metals like Cd, Cr, and Pb are proved harmful beyond a certain limit[4]. World Health Organization (WHO) has specified maximum pollutant level of heavy metals in groundwater. The present study was carried out to evaluate the heavy metal concentration of groundwater in Veppanthattai block, Perambalur district, Tamil Nadu, by AAS and the result is compared with WHO values.

Study Area

Perambalur locates in the central part of Tamil Nadu, and about 270 km from the state capital Chennai (**Figure 1**). The district boundary is between 78°40' and 79°30' of the east longitudes and 10°54' and 11°30' of the North Latitudes. It is surrounded by Ariyalur district in the east, Salem district in the west, Cuddalore district in the north, and Trichy district in the south. The district area is about 1757 km^2. It has four Taluks, namely Alathur, Kunnam, Perambalur, and Veppanthattai,. Perambalur was bisected from the previous merged Tiruchirappalli district and was created on 1st November 1995.

As per 2011 Census, the population of the district is 5,65,223. The district founds 74.32% of literacy rate. 908 mm is the average rainfall of the district. The study area gets about 52% annual rainfall during Northeast Monsoon, about 14% in the winter and summer season, and 34% in the Southwest monsoon season. About 61.3% of land in the district is used for agricultural activities to produce Cashew nut, Cotton, Groundnut, Maize, Onion, Paddy, and Sugarcane. At present, in Tamilnadu the Perambalur district is the top in Onion and Maize producer. Public Sector Unit of Perambalur Sugar Mills is placed at Eraiyur with a squishing capacity of 3,000 tonnes per day.

Veppanthattai is the important block in Perambalur district of the state of Tamilnadu. This town is positioned about 13 km west of Perambalur. The town faces Valikandapuram on the east side Krishnapuram on the north side and Esanai on the south side.

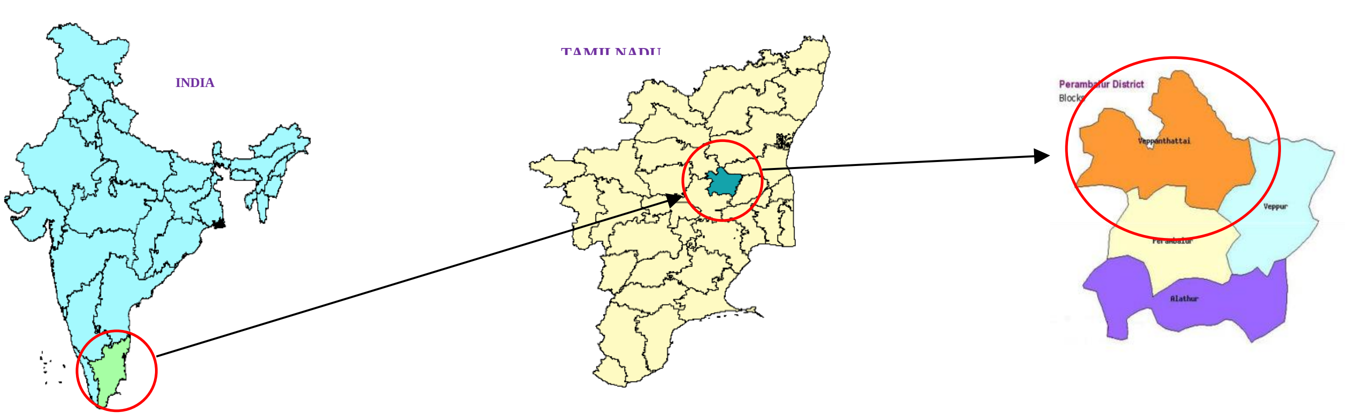

Figure 1. Site chart of the Study Region

2. MATERIALS AND METHOD

45 groundwater samples were collected from the variable region of the study area during the year 2015. Models were collected in previously cleaned 2 L polyethene bottles. Each bottle was rinsed with distilled water to avoid any possible contamination. They were desiccated, cooled, and named. All essential precautions were taken during sampling investigation and transit of water samples to the laboratory[5].

The sample was analyzed for heavy metals Cd, Cr, Cu, Fe, Ni, Pb, and Zn following standard procedure[6] using atomic absorption spectrophotometer (Perkin Elmer, model 2380). All reagents used were of analytical status and apparatus was pre-calibrated accurately with standard solutions, previous to measurement. Repeated analyses were carried out for each determination to verify concordantly and quality assurance. And the results obtained were compared with the WHO standard for the specified maximum impurity level.

3. RESULTS AND DISCUSSION

The results of heavy metals are formulated in **Table 1**. The results are discussed and compared with standard values.

Cadmium was found in 20 samples (other samples are blowing the detectable limit) with a range of 0.03 ppm to 0.18 ppm and exceeded permissible limit[7]. Cadmium arises naturally in ores collectively with copper, lead, and zinc. Cadmium compounds are used as a colour pigment, stabilizers in PVC products, and numerous alloys, at present most commonly, in rechargeable nickel–cadmium batteries. It is also present in phosphate fertilizers as a toxin. The high concentration of cadmium is may be due to these reasons.

Table 1. Heavy metal concentration of groundwater in ppm in the study area.

	Cd	**Cr**	**Cu**	**Fe**	**Ni**	**Pb**	**Zn**
Minimum	0.03	0.02	0.05	0.06	0.02	0.03	0.04
Maximum	0.18	0.07	0.18	0.46	0.15	0.16	0.24
Average	0.083	0.042	0.111	0.263	0.116	0.091	0.147

Cadmium-consisting products are barely recycled but often discarded together with domestic waste, thus polluting the environment, particularly if the dissipate is ignited[8]. It is exceedingly toxic even in low concentration and bio-accumulates in creature and environment, and it has a long biological half-life ranging from 10 to 33 years in the human body [9]. Excessive cadmium disclosure may diminish the body immune system and cause lung cancer[10]. And long-period exposure to cadmium may produce renal damage[11].

Chromium was found in 9 samples (other samples are below the detectable limit) with a range of 0.02 ppm to 0.07 ppm. Except for 2 samples, all are within the permissible limit. The extraordinary content of Chromium may be due to various anthropogenic activities, tanneries, old plumbing, domiciliary discharges, and industrial effluents [12]. It also is found in dyes of waste plants, plastic and rubber factories, electrical panels and batteries[13]. Chromium element is toxic which causes lung carcinoma when is exposed to substantial concentrations[14].

Copper was found in 22 samples (other samples are below the detectable limit) with a range of 0.05 ppm to 0.18 ppm. All the values are not beyond the permissible limit. The average value of copper in all water samples are extremely under the permissible limits. The low level may be due to the soil absorption process, which lowers the concentration of the heavy metals in water[15]. Individuals with toxicity show an abnormally high level of copper in the bones, brain, eye, kidney and liver [16]. Intense toxicity of ingested copper is characterized by diarrhea, abdominal pain, vomiting and a metallic taste in the mouth[17].

Iron was found in all samples with a range of 0.06 ppm to 0.46 ppm and the values are within the permissible limit. Iron is one of the heavy metals which is indispensable for well-being. It plays a significant role in human nourishment. It is used in cellular metabolism and is found in body enzymes and helps in the formation of protein hemoglobin, which carriages oxygen to all cells of the body[18].

Nickel was found in 14 samples (other samples are below the detectable limit) with a range of 0.02 ppm to 0.15 ppm. Except for 3 samples, all exceeded the permissible limit. The high level of nickel may be due to the mixing of a diversity of wastes including that of domestic sewage, agricultural runoff, automobile wastages, electroplating units, and utensil manufacturing process[19]. Some amounts of nickel are useful to the human body, but redundant nickel may be toxic. About 2% of men and 10% of women are highly sensitive to nickel. The most severe effects occur when nickel is inhaled. This can lead to expanded risk of respiratory epidemic, asthma and sinus issues [20].

The lead was found in 24 samples (other samples are below the detectable limit) with a range of 0.03 ppm to 0.16 ppm. Except for 5 samples, all are within the permissible limit. Lead contamination of the ground water may be due to the usage of lead arsenate as the pesticide as well as its uses in pigments, paints and lead storage batteries. High levels of the disclosure may result in noxious biochemical effects in humans and it causes problems in the synthesis of hemoglobin, gastrointestinal tract, effects on the kidneys, joints and reproductive system, and sensitive or chronic damage to the nervous system[21].

Zinc was found in 35 (other samples are below the detectable limit) samples with a range of 0.04 ppm to 0.24 ppm. All the values are within the permissible limit. Zinc is necessary to plant and animal physiology, however excessive level in water can cause a problem of bitter, astringent taste and opalescent appearance[22].

4. CONCLUSION

The study was carried out for heavy metal analysis of groundwater and compared with the standard permissible values of WHO. The values of Cd, Cr, Ni and Pb are exceeding the permissible limit in most of the groundwater samples. Particularly Cd is present in all the groundwater samples. The high concentration of cadmium in water samples of the study area is due to the agricultural runoff and pesticides, as well as cadmium-containing phosphatic fertilizers, have been used. High concentration of other heavy metals is due to indiscriminated disposal of domestic and agricultural wastes. So this study reveals that without a proper handling, water is not appropriate for domestic applications[23-27].

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