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# Investigation of some trace elements in ground water of Tirupati and its surrounding, Chittoor District

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**ABSTRACT**

*The paper deals with short review and the determination of seven trace metals namely. CU, Fe, Mn, Zn, Ni, Cr and Pb in the ground water of different sites of chittoor district of Andhra Pradesh. All activities carried out on the ground surface have direct or indirect impact on the ground water whether associated with urban ,industrial or agricultural activities large scale concentrated source of pollutants, such as industrial discharges and sub surface injection of chemicals and hazardous are obvious source of ground water pollutants. This study was carryout in the month of during April and May 2012. The samples were collected from seven different source of chittoor district of tirupati town. The results obtained are compared with safe limits in ppm for heavy metals laid down by BIS, WHO, ICMR, APHA.*

**Key Words:** Heavy metals, Trace metals, Ground water, pollution, Industrial discharge.

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## INTRODUCTION

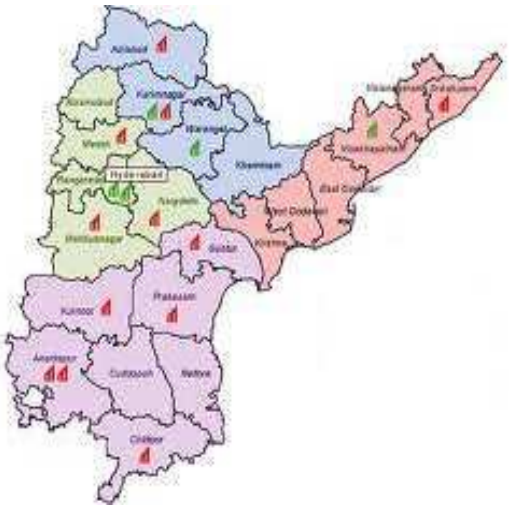
Water is one of the very precious substances on the earth, it is very essential for the existence and survival of the life. As population grows in their need for water increases the pressure, the pressure on our ground water resources also increases. In many areas of the world, ground water is now being over extracted, in some places massively. So, the result is falling wafer levels and declining well yield, land subsidence and ecological damage, such as the drying out of wetland.

The trace metal in water behaves in a typical manner. No single mechanism is sufficient to explain the process that are undergoing in the water. Trace metals like Fe, Mn, Cu, Zn, Co, Ni,etc., are very important for the proper functionary of the biological system and their deficiency or excess in the human system can lead number of disorders [1], [2]. Other trace metals like Pb, As, Hg, etc., are not only biologically non essential but definitely toxic [3]. The potential toxic metal elements, such as Cr, Pb, Cu, Zn, etc., are identified to cause health hazards in animal [4], [5], [6]. In case of many heavy metals, bio-magnification occurs through food chain [7]. So, it is necessary to discuss the theoretical aspects of trace metals for easy understanding of their metabolic activities.

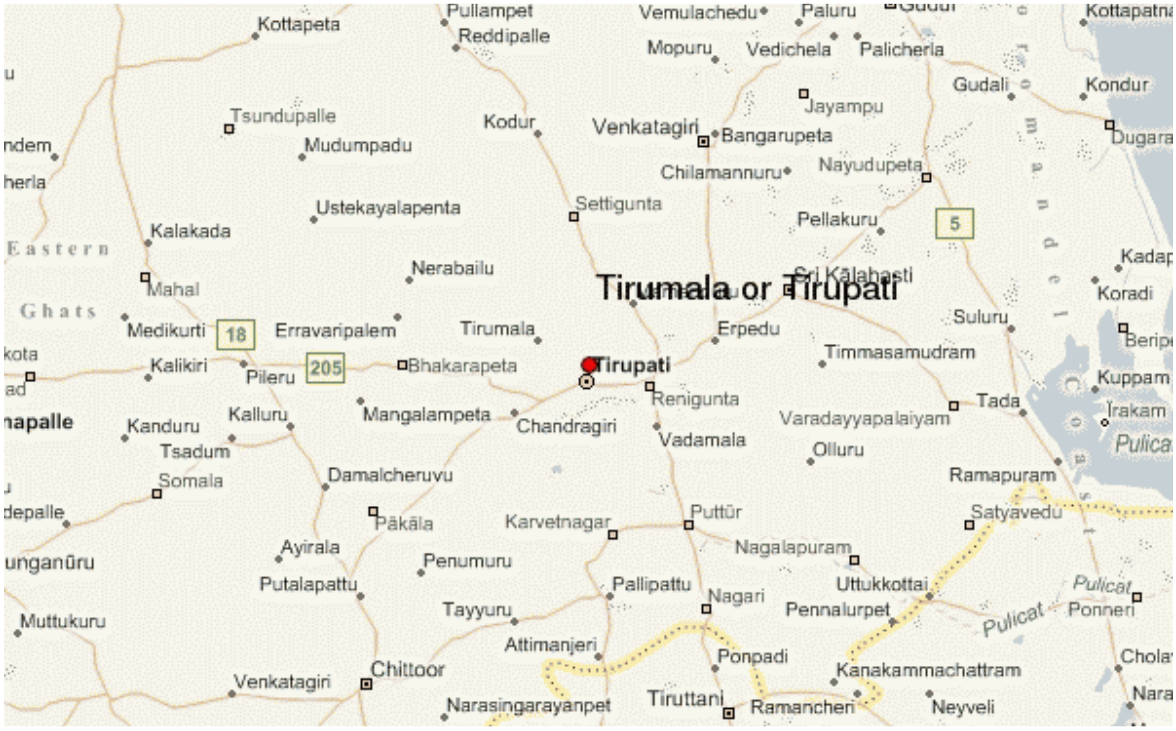
Cu and Fe is mixed in groundwater by rocks bearing iron and copper bearing ores, namely cuprites, malachite, azurites, hematite, magnetite and iron pyrite. Fe in surface water is generally present in the ferric (Fe III) state. Concentrations of Fe greater than 1 mg/L have been reported to occur in groundwater [8]. The average daily

requirements of iron is considered to be 10 mg. Mn plays a role in the proper functioning of flavoroteins and in the synthesis of sulphated mucopoly-saccaharides, cholesterol, hemoglobin and in many other metabolic processes [9].

**ANDHRA PRADESH:**



**TIRUPATHI LOCATION MAP:**




Leaching of zinc from galvanized pipes, brass and zinc containing fittings plays a serious role in groundwater pollution, but in required quantity it is very essential for human metabolism. Dye and tannery industries pollute the water through chromium and other harmful chemicals. Many nickel salts are water soluble there contamination can arise. The level of nickel usually found in food and water are not considered a serious health hazards. Because of low solubility of chromium the levels found in water are usually low (9.7 mg/L) [10]. Lead comes in water by corrosion in lead alloys made pipes and without treating car and motors batteries. Many industries prepared litharge and lead peroxide pollute the groundwater by their effluents.

The levels in drinking water, however, can be much higher owing to the use of lead services pipes and lead lined storage tanks [11]. Moreover, the domestic sewage and sewage of many chemicals laboratories play an important role in pollution of groundwater. They discharge detergents, chemically treated wastewater and spoilt vegetables, fruits and used chemicals.

**Trace elements in groundwater**

Pollution of groundwater is an impairment of water quality by chemicals, heat or bacteria to a degree, that does not necessarily create and actual public health hazards, but does adversely affect such water for domestic, farm, municipal or industrial use [12]. Many trace elements are essential nutrients, however, certain trace elements, such as As, Cd, and Hg is known to be persistent environment contamination and toxic to most form of life. Trace elements are generally present in small concentration in natural water system. Their occurrence in groundwater and surface water can be due to natural sources, such as dissolution of naturally occurring minerals containing trace elements in the soil zone or the aquifer material or to human activities, such as mining, fuels, smog smelting of ores and improper disposal of industrial wastes.

**TABLE 2: Concentration of heavy and trace metals in chittoor district.**

| HEAVY METALS | CONCENTRATION,PPb | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | S1 | S2 | S3 | S4 | S5 | S6 | S7 | S8 | S9 | S10 |
| Cu | 3.61 | 7.63 | 0.80 | 1.83 | 0.92 | 24.11 | 19.87 | 29.59 | 12.87 | 13.23 |
| Fe | -16.38 | -22.49 | -6.99 | -20.67 | 39.07 | -33.19 | 35.38 | -30.46 | -20.49 | -13.77 |
| Mn | 120.91 | 2.81 | 0.41 | -0.06 | 49.38 | 1.20 | 55.21 | 1.77 | 0.95 | 0.01 |
| Zn | 7.03 | 1.75 | 1.93 | 0.43 | -0.41 | 0.51 | 0.49 | 2.45 | 0.22 | 0.69 |
| Ni | 1.60 | 1.51 | 0.05 | 0.35 | 4.40 | 5.26 | 2.49 | -0.02 | 0.95 | 0.57 |
| Cr | -0.71 | 3.09 | 0.69 | 15.18 | 5.09 | -0.43 | 3.42 | -1.25 | -1.00 | -1.16 |
| Pb | -0.07 | 0.27 | 0.99 | 0.24 | 0.02 | 34.03 | 0.58 | 1.12 | 2.54 | 0.01 |

**Table 3: Safe limits (as per APHA, WHO, BIS, ICMR) and minimum acceptable and maximum acceptable limits for drinking purpose use of ground water adverse effect on wring bodies, in ppm.**

| **Heavy metal** | **Ground water** Max Min | **Effect on lifting** |
|---|---|---|
| LEAD | 0.05 | Toxic plumb solvency diseases, burning in mouth, several inflammations in gastro intestinal track, causes paralysis mental confusion, visual disturbance anemia, etc., |
| CHROMIUM | 0.05 | Carcinogic acuity (cancer), can produce coetaneous and nasal mucous membrane ulcer and dermatitis, hexavalent Cr causes lung tumors. |
| COPPER | 1.5 - 0.05 | Astringent taste but essential elements for metabolism, deficiency results is anemia in infants, excess may results in liver damage. |
| NICKEL | 0.02 | May be carcinogenic, can react with DNA. Resulting in DNA damage. |
| MERCURY | 0.001 | Causes minimata disease also causes blue baby disease in infants the colour of skin in baby is turn into blue. Paralysis. |
| IRON | 0.3-1.0 | Promote iron bacteria in water, bad taste, In trace is nutritional |
| MANGANESE | 0.5 - 0.05 | Produce bad taste, essential as cofactor in enzyme system and metabolism process. Excess causes reduced metabolism of iron to form hemoglobin |
| ZINC | 15 -5 | Causes astringent taste and opalescence in water, essential elements in human metabolism. |
| SELENIUM | 0.01 | Toxic, leads to hair and finger loss, numbness in fingers or toes, causes circulatory problems |
| ARSENIC | 0.05 | Beyond this limit water become toxic, causes skin damage circulatory problem increase risk of skin cancer. |

## MATERIALS AND METHODS

**Selected sites:**

Ten water samples were collected from chittoor district in different sites in polyethylene containers which were thoroughly cleaned with 1:1 HNO3 rinsed several times with distilled water and dried in electric oven. The collected water samples were grouped under categories S1,S2,S3,S4,S5,S6,S7,S8,S9,S10. (CHITTOOR DISTRICT).

**Reagents:**

Only analytical reagent grade chemical were used.

**Analytical procedure:**

ICPMS (Method were used for determination of all the trace metals)

| S.NO | Water samples | Areas in tirupathi surroundings |
|---|---|---|
| 1. | S1 | Karakambadi area |
| 2. | S2 | Yerpedu area |
| 3. | S3 | Srikalahasthi |
| 4. | S4 | Renigunta area |
| 5. | S5 | Putalapattu |
| 6. | S6 | Industrial park |
| 7. | S7 | Gagulamandyam area |
| 8. | S8 | Chandragiri |
| 9. | S9 | Srinivasamangapuram area |
| 10. | S10 | Thiruchanoor |

## RESULTS AND DISCUSSION

The distribution of some trace metals in TIRUPATI and CHITTOOR districts dug wells water samples have been depicted in tables 1 and 2, respectively. Safe limits in ppm (as per BIS, WHO, ICMP, APHA ) and minimum acceptable and maximum acceptable limits for drinking purpose use of groundwater and adverse effect on living bodies are show in table 3.

**Discussion of result:**
The occurrence of trace elements in natural and ground water is affected both by hydro chemical factors, like mineral composition of the rocks, soil characteristics, etc., as well as by anthropogenic activities and likely to show both temporal and spatial variation.

**Copper:** According to limits prescribed by various authorities (WHO, ICMR, APHA, BIS) it was found that all the samples collected from the sources were free from copper, the average value of copper in all water samples are much below the permissible limits but copper is excess in S6 sample.

**Iron:** According to BIS and ICMR the maximum allowable concentration and the permissible concentration in drinking water in 1.0 ppm and 0.3 ppm, respectively. It is content of hemoglobin, so it is very necessary for all living organism but in excess promote iron bacteria in water. Iron is excess in S5, S7, Samples of Tirupathi surroundings, chittoor district.

**Manganese:** The maximum allowable concentration and permissible concentration of Mn in drinking water is 0.5 ppm and 0.05ppm, respectively according to WHO, BIS and ICMR (Satyanarayana and Shastri, 1983). Most of the water samples analyses had less than 100 ppb (0.1 ppm).

**Zinc:** Zinc is an essential plant and human nutrient. The maximum allowable concentration and permissible concentration of zinc in drinking water are 15 ppm and 5 ppm, respectively. According to WHO, ICMR, APHA the average value of zinc in all the water samples are below the permissible limit. The concentration of zinc in all water samples is below 1000 ppb (1 ppm). Hence all the samples collected from all sources are below from maximum permissible limit for Zinc.

**Nickel:** The permissible concentration of nickel in groundwater is 0.02 ppm. Remaining samples are within the permissible limit. S5, S6, samples are out of the limit.

**Chromium:** The maximum permissible limit of chromium in drinking water according to WHO and ICMR is 0.05 ppm. Small amount of chromium is essential to mammals but in excess it produces harmful effects. The obtained data shows that chromium content in water is within limits prescribed by the various authorities except slightly higher in S4, S5, S7 in chittoor district.

**Lead:** It is very toxic element, which accumulates in the skeletal structure of man and animal. The maximum permissible concentration of lead in drinking water is 0.05 ppm. According to WHO and ICMR almost all the water samples had less than50 ppb of lead.

## CONCLUSION

Systemic study of the chemical data obtained as results of analysis of ground water samples from chittoor dist and Andhra Pradesh are affected by one or more of ten studied trace metals. At least 60% of the population is still dependent on ground water sources for drinking purpose, especially in outer city and distant villages. According to the analysis of some water samples of chittoor district of Andhra pradesh, the manganese, lead and zinc are not found beyond limit, while copper, iron and chromium are found towards little higher sides on some places and nickel is found higher only in some areas of Tirupathi,Renigunta surroundings ,but these metals are essentials for our body metabolism. They play role of co-factor in activity of enzyme. Thus to keep ground water free from Cr, Fe, Mn, Pb, etc., and other ions the following recommendation should be taken in to account.

1. Chromium enriched refuge should be properly treated and then disposed off. Construction of ground water structure on dumping sites or its immediate vicinity should be avoided as Cr pollution relates to point source.
2. Industries should be set up their effluents treatment plants (ETP) independent or jointly as per norms and should remain effectively operational in order to safeguard the ground water for future generation.
3. In agricultural excessive use of nitrogenous and phosphates fertilizers should be avoided so that it does not leach down to ground water and deteriorates its quality.
4. Mass awareness should be generated about the over use of pesticides, its harmful effects on quality of water and human health.

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