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Seasonal variation of heavy metal contamination of ground water in and around Uyyakondan channel Tiruchirappalli district, Tamil Nadu

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ABSTRACT

A total of 20 ground water and 2 surface water samples were collected from in and around Uyyakondan channel during monsoon, and post monsoon season during the year of 2010-2011. The concentration of trace metals such as zinc, copper, lead, nickel, and chromium were determined using atomic absorption spectrophotometer and the results were compared with the World Health Organization (WHO 2003) standard values. This study revealed the presence of some heavy metals in few ground water samples and hence refers heavy metal contamination of water sources. This study suggests that the preventive measures which are to be adopted to control the contamination of excess lead and nickel present in the water samples collected on either sides of the channel.

Key Words: Uyyakondan channel, heavy metal, ground water

INTRODUCTION

Water is required by all living things for cell metabolism. Water is also a vital resource for agriculture, manufacturing, transportation and many other human activities. Despite its importance, water is the most poorly managed resource in the world. Groundwater is the water that percolates downward from the surface through the soil pores. Ground water is generally an excellent source of drinking, cleaning, bathing, irrigation and industrial purposes [1]. The heavy metals are present in both surface water and ground water. Heavy metals are important environmental pollutants and their toxicity is a problem of increasing significance for ecological, evolutionary and environmental reasons [2]. Heavy metals arise from un organized industrial growth and are considered as major pollutants of natural water bodies. Anthropogenic activities like industrial production unsafe disposal of industrial wastes, agricultural wastes and domestic sewages release heavy metals into the environment. Once released in large amounts, they are soluble in water either as ions or as compound forms and thus contaminate water. Heavy metals are playing a vital role in the normal functioning of body. But their in excess than the permissible limit may harms to the vital function of the organs. The main source for the heavy metal entry in to the human body is through water resources. Hence the present study mainly aims to study the impact of uyyakondan channel on the heavy metal contamination of ground water sources.

MATERIALS AND METHODS

Study Area

Tiruchirappalli is one of the most important industrial cities in Tamilnadu and situated on the river bank of the Cauvery. Uyyakondan channel is about 65.5 km long, running through the heart of Tiruchirappalli as a tributary of

river Cauvery. The channel starts from Petavaithalai located about 25 km from the heart of Trichy and flows across many villages. The channel water is used for domestic and irrigation purposes and it irrigates around 35000 hectares. It receives enormous amount of effluent from industry and domestic sewage. Most of the people residing along the banks of the channel depend upon this water for bathing, domestic irrigation and other purposes. The typical sewage comprising of domestic and other waste are discharged directly in to the channel without any proper treatment. The garbage dumping sites of Cantonment and palakarai areas located around the Uyyakondan channel. Hence the present investigation has been attempted to study the seasonal variation of heavy metal contamination in and around Uyyakondan channel.

Collection of samples

The ground water samples were collected from different location including open and tube wells, to evaluate the heavy metal contamination during monsoon and post monsoon seasons. The sampling locations were selected on the basis of residential areas; details of sampling locations are illustrated table1. Samples were collected in polyethylene bottles (2.5lit) which had been thoroughly washed and filled with distilled water and then taken to the sampling site. The heavy metal such as Cu, Zn, Pb, Ni, and Cr were determined using atomic Absorption spectrometer and the results were compared with WHO standard values (2003).

Map showing Location map of the Study area

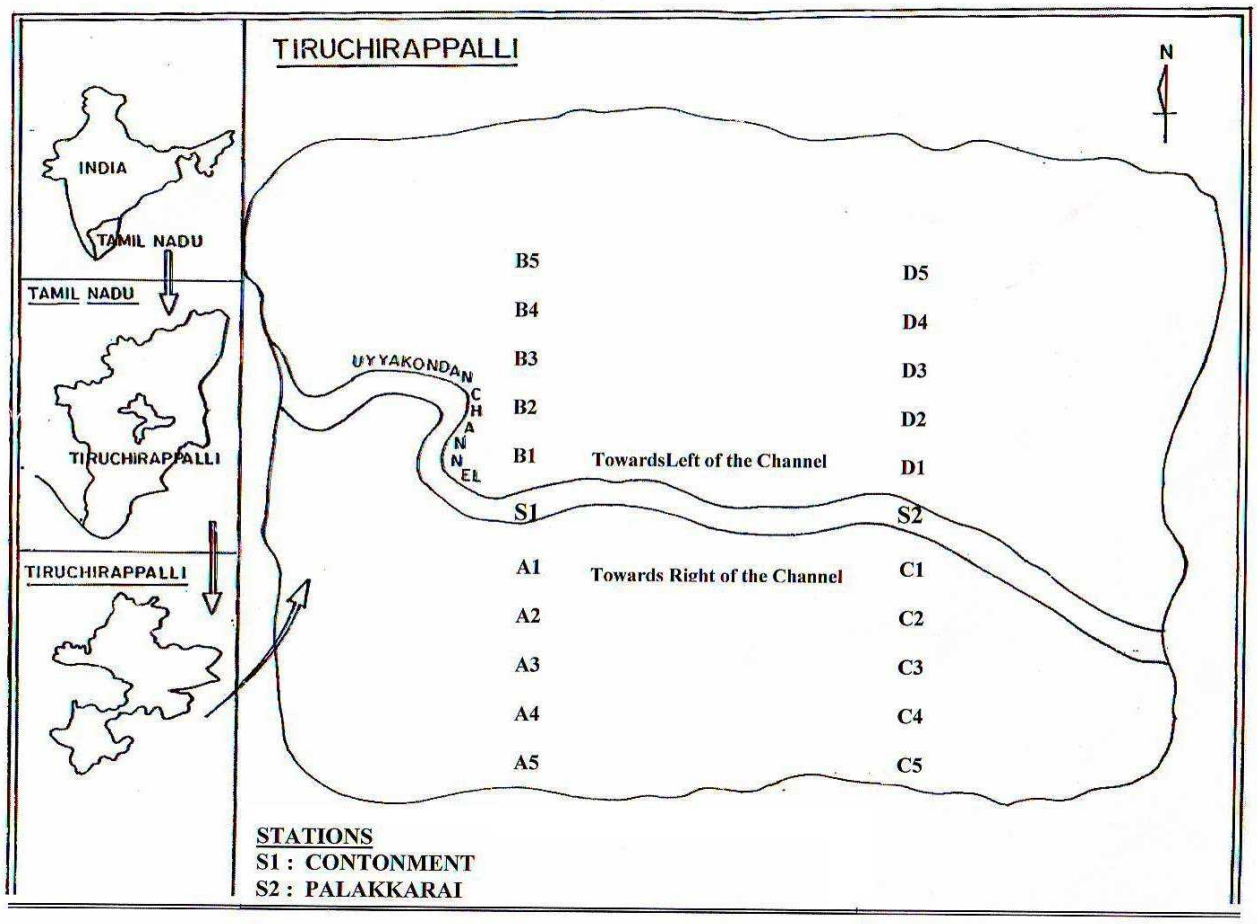


Table 1 : Water sampling locations and sources

Code no	Sampling Station	Source
AS1	Starting point of Contonment(S1)	Channel Water
AA1	Towards right of the Channel(S1)	Bore Well
AA2	Towards right of the Channel(S1)	Bore Well
AA3	Towards right of the Channel(S1)	Bore Well
AA4	Towards right of the Channel(S1)	Bore Well
AA5	Towards right of the Channel(S1)	Bore Well
AB1	Towards left of the Channel (S1)	Bore Well
AB2	Towards left of the Channel (S1)	Bore Well
AB3	Towards left of the Channel (S1)	Bore Well
AB4	Towards left of the Channel (S1)	Bore Well
AB5	Towards left of the Channel (S1)	Bore Well
S2	Sampling from Palakarai (S2)	Channel Water
AC1	Towards right of the Channel(S2)	Bore Well
AC2	Towards right of the Channel(S2)	Bore Well
AC3	Towards right of the Channel(S2)	Bore Well
AC4	Towards right of the Channel(S2)	Bore Well
AC5	Towards right of the Channel(S2)	Bore Well
AD1	Towards left of the Channel (S2)	Bore Well
AD2	Towards left of the Channel (S2)	Bore Well
AD3	Towards left of the Channel (S2)	Bore Well
AD4	Towards left of the Channel (S2)	Bore Well
AD5	Towards left of the Channel (S2)	Bore Well

RESULTS AND DISCUSSION

The findings of the present investigation are shown in tables and figures below

Table: 2 Seasonal Variation of Zinc in samples collected towards left and right of the channel

Samples	Monsoon (ppm)	Post-monsoon (ppm)
Zn (R)	0.05	0.02
S (Channel Water)	0.09	0.04
Zn (L)	0.04	0.02

Fig : 1 Variation in mean values of zinc Concentration collected from different sampling stations towards left and right of the channel in different seasons

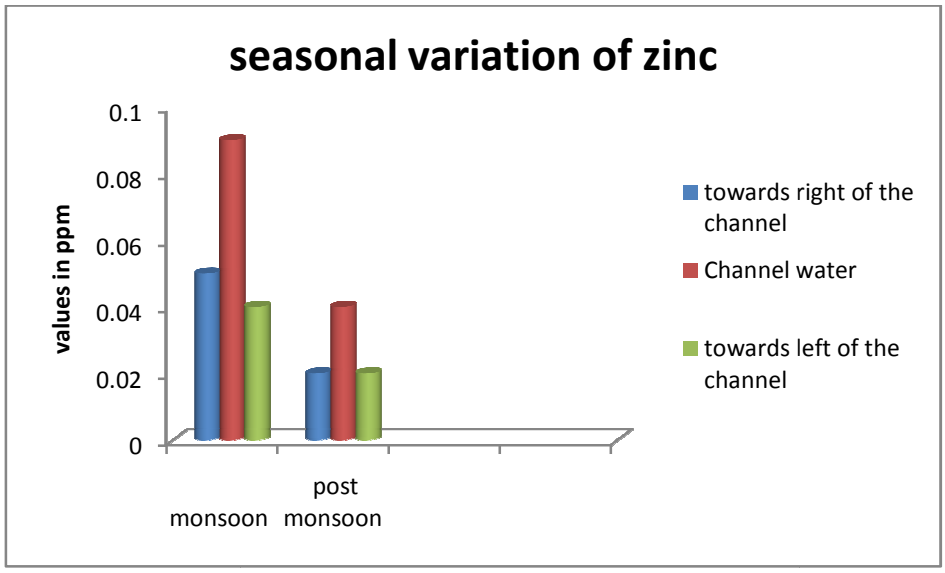


Table: 3 Seasonal Variation of Copper in samples collected towards left and right of the channel

Sample	Monsoon (ppm)	Post-monsoon (ppm)
Cu(R)	0.03	0.01
S(Channel Water)	0.02	0.03
Cu(L)	0.02	0.01

Fig : 2 Variation in mean values of copper Concentration collected from different sampling stations towards left and right of the channel in different seasons

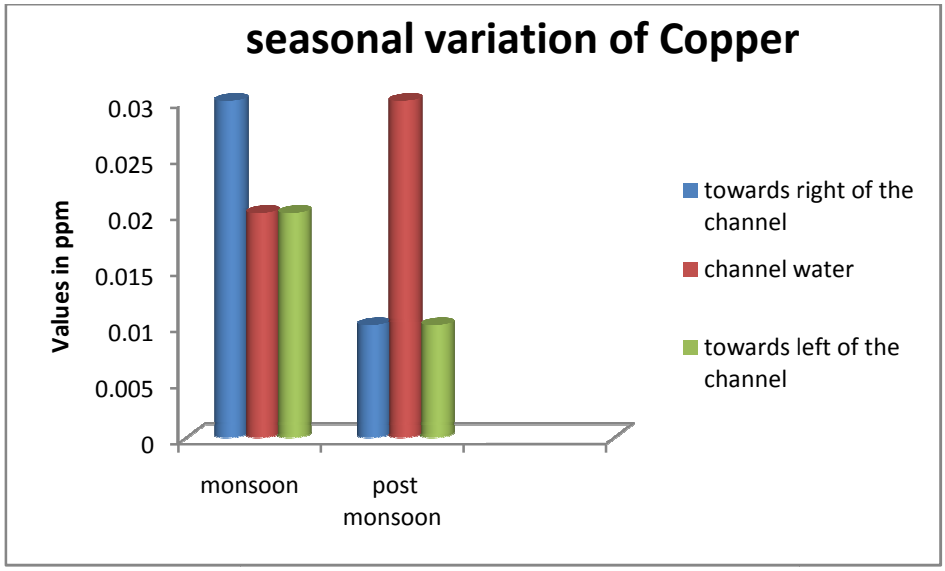


Fig : 3 Variation in mean values of lead Concentration collected from different sampling stations towards left and right of the channel in different seasons

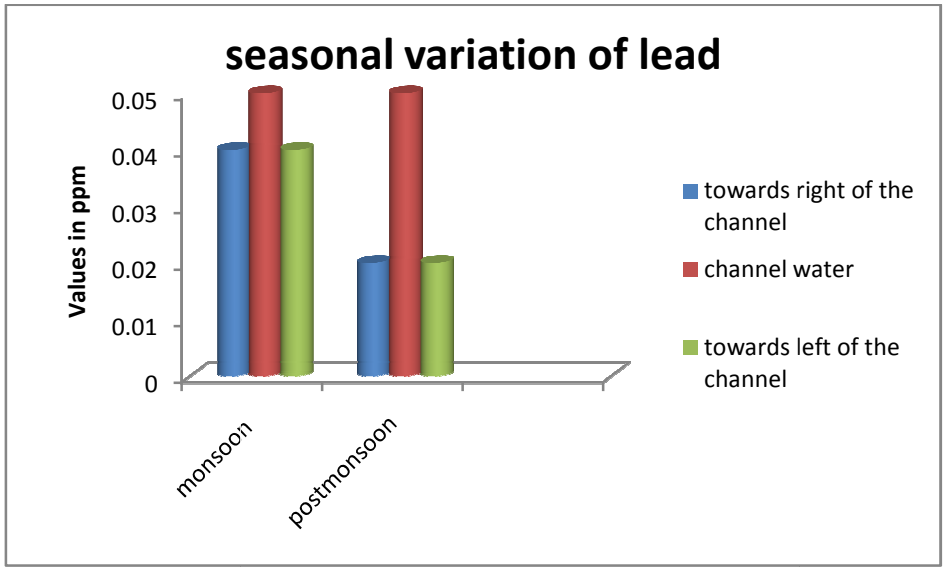


Table: 4 Seasonal Variation of Lead in samples collected towards left and right of the channel

Samples	Monsoon (ppm)	Post-monsoon (ppm)
Pb (R)	0.04	0.02
S (Channel Water)	0.05	0.05
Pb(L)	0.04	0.02

Table:5 Seasonal Variation of Nickel in samples collected towards left and right of the channel

Samples	Monsoon (ppm)	Post-monsoon (ppm)
Ni (R)	0.04	0.02
S (Channel Water)	0.04	0.03
Ni (L)	0.04	0.02

Fig 4 Variation in mean values of nickel Concentration collected from different sampling stations towards left and right of the channel in different seasons

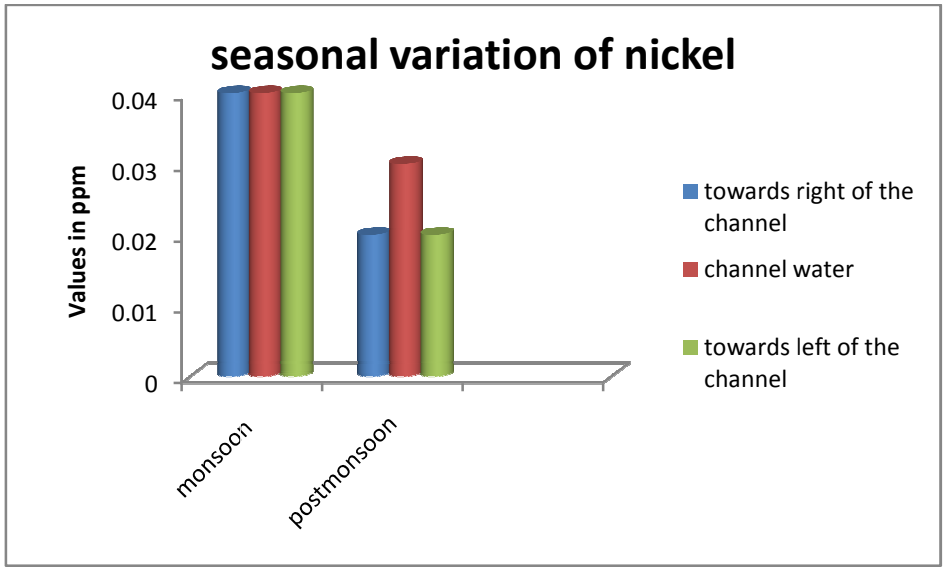


Table: 6 Seasonal Variation of Chromium towards Left and Right of the channel

Samples	Monsoon (ppm)	Post-monsoon (ppm)
Cr (R)	0.03	0.01
S (Channel Water)	0.04	0.04
Cr (L)	0.04	0.03

Zinc

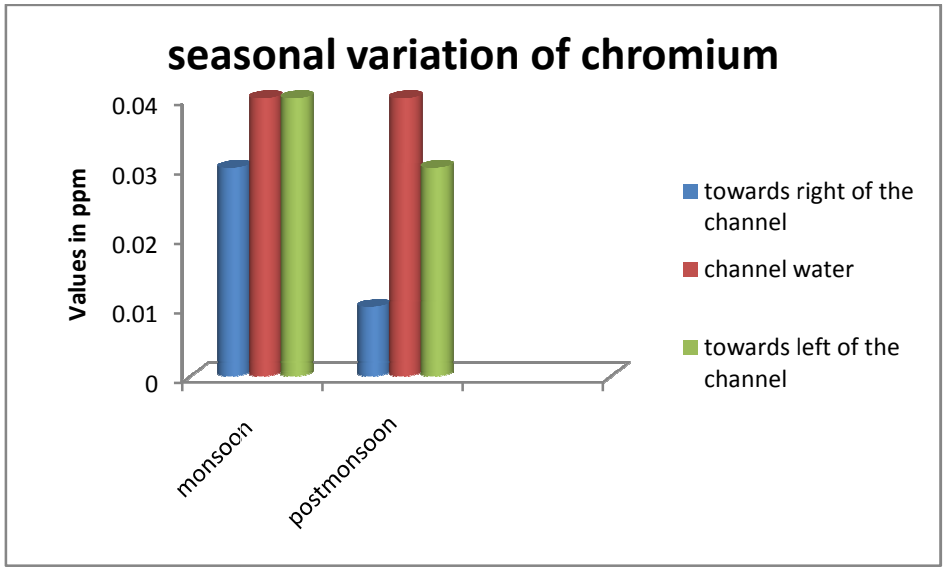
Zinc is one of the important trace elements that play a vital role in the physiological and metabolic process of many organisms. Nevertheless, at higher concentration, zinc can be toxic to the organisms [3]. It plays an important role in protein synthesis. In the present study the concentration of zinc ranged between 0.04 – 0.09 ppm in monsoon and 0.02-0.04 ppm in post monsoon season on either sides of channel. The values of zinc are showed within the limit of WHO (3ppm) standards.

Copper

It is one of the essential elements for human beings. It is widely distributed metal in nature. Copper can exist in aquatic environment in three forms namely soluble, colloidal and particulate. It is found in less quantity as an essential element for organisms. In our study the copper concentration ranged from 0.02-0.03 ppm in monsoon and

from 0.01-0.03 ppm in post monsoon seasons on either side of channel. In the present study the copper content of the water samples in both sides of the channel are found within the permissible limit of WHO (2ppm).

Fig : 5 Variation in mean values of chromium Concentration collected from different sampling stations towards left and right of the channel in different seasons



Lead

Lead occurs naturally in the environment. It is an undesirable trace metal less abundantly found in earths crust. Read 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. In the present investigation the lead concentration ranges from 0.04- 0.05 ppm in monsoon and 0.02-0.05 ppm in post monsoon.

All the values of lead are showed higher than the permissible set by WHO (0.01ppm).The main sources of lead are industrial activities, household sewage, battery and alloy [4]. Lead is highly toxic and responsible for several cases of poisoning through food, small quantities of lead cause adverse changes in the arteries of human kidney and causes high blood pressures, kidney damage and etc [5].

Nickel

Nickel occurs in natural water as a divalent cation with pH range between 5–9. Nickel is a nature element of the earths crust, therefore small amount are found in food, water and soil [6]. In the present study the nickel is found to be 0.02 – 0.04 ppm in monsoon and between 0.02- 0.03 ppm in post monsoon. Nickel values in all the water samples are showed above the permissible limit prescribed by WHO(0.01ppm). The high level of nickel may be due to mixing of variety of wastes including automobiles repair shops, electroplating unit and sewage run off [7] [8]. Excess of nickel in human body is toxic and causes hypertension and produces pathological changes in brain tissues [9].

Chromium

It is an essential micronutrient for animals and plants. Chromium is considered as a relative biological and pollution significance clement [10]. In the present investigation the concentration of chromium range is 0.03- 0.04 ppm in monsoon and 0.01- 0.04 ppm in post monsoon. In our study the chromium concentration is recorded well within the permissible limit set by WHO (0.05 ppm).

CONCLUSION

Seasonal variations are evident in all the heavy metals examined during the year 2010-2011of the study. The heavy metal contents towards left and right of the channel indicate the variations at different sampling sites in different seasons. Heavy metals, if present beyond permissible limits in water are toxic to human beings, aquatic flora and fauna. In the present study, we found that Pb and Ni are present in relatively higher concentrations as compared to their permissible limits of WHO. Whereas Zn, Cu and Cr concentration is below the permissible limit prescribed by WHO. Ground water samples showed that all the heavy metals in either sides of channel were within the safe limit except for Pb and Ni. It is quite evident that these heavy metals may enter the food chain, and through bioaccumulation and bio-magnifications. Regular monitoring of the water quality is thus required to assess the heavy metal contents in water so that remedial measures can be adopted to save the ground water from heavy metal pollution.

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