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Analysis of Drinking Water Quality in Cuddalore-O.T

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Abstract: Cuddalore Old town is developing rapidly due to industrialization since recent years. It is considered being top most polluted town in Tamil Nadu. The present study was carried out with a view to have an understanding about the pollution status of Cuddalore district, particularly water quality in vicinity of industrial area. Water is an indispensable natural resource on this earth on which all life depends. About 97 percentage of the earth's surface is covered by water and most of animals and plants have 60% to 65 % in their body. Due to its unique properties water is of multiple uses for all living organisms. Human beings depend on water for almost every development activity. Uptake of nutrients, their distribution in the body, regulation of temperature and removal wastes are all mediated through water. So we are in need to analyse the drinking water quality by using standard methods. and their This thesis work deals with the drinking water quality in SIPCOT - Cuddalore. There are various water quality parameters such as, Turbidity, pH, Chloride, Total dissolved solids, Total hardness, Calcium, dissolved oxygen, and Iron are used to access the drinking water quality in that particular area has selected, in this manner two samples were collected in each area all the samples results has plotted by spatial distribution by using of Arc-GIS.

Key Words: Water Quality, Physical-Chemical Parameters, Arc-GIS.

1.1 GENERAL

Water resources are sources of water that are useful potentially useful to humans. Uses of water include agricultural, industrial, household, recreational, and environmental activities virtually all of these human use require fresh water.

97% of water on the earth is salt water leaving on only 3% as fresh water of which slightly over two thirds is frozen in glaciers and polar ice caps. The remaining unfrozen fresh water is mainly found as ground water, with only a small fraction present above ground water or in the air.

Fresh water is a renewable resource, yet the world's supply of clean, fresh water is steadily decreasing, water demand already exceeds supply in many parts of the world and as the world population continues to rise, so too does the water demand.

1.2 SOURCES OF WATER

Water is used for domestic, industrial and agricultural purposes are obtained from various sources. The major sources of water are as follows.

1. Surface water- ponds, river, stream and lake.
2. Sub-surface water- infiltration wells.
3. Ground water- springs and well.

Groundwater quality reflects inputs from the atmosphere, soil and water rock reactions as well as pollutant sources such as industrial discharge, agriculture, acid precipitation, and domestic and industrial wastes. Suitability of water for various uses depends on type and concentration of dissolved minerals and groundwater has more mineral composition than surface water.

The quality of groundwater is constantly changing in response to daily, seasonal and climatic factors. Continuous monitoring of water quality parameters is highly crucial because change in the quality of water has far reaching consequences in terms of its effects on human and biota.

In Sipcot, groundwater resources are under increasing pressure in response to threats of rapid industrial growth.

In this project we have to analyse the quality of drinking water.

1.3. GROUND WATER SITUATION IN SIPCOT

According to Sipcot residents, salinity intrusion and industrial pollution of ground water are the two keys reason for deterioration of water quality.

Currently, 10 industries operate in Sipcot and less than 4 units operate in the same geographical region, but outside Sipcot. The entire water requirements of these industries are met by ground water. Sipcot operates several mega bore wells at depth in excess of 200 meters. The Sipcot industries reportedly consume more than 20 million litres per day. Industries outside Sipcot have their own bore wells. An accurate estimate of total water extracted in Sipcot is not available. However it is likely to be in excess of 20 million given that a number of illegal bore wells exist, and the demands placed by new companies like Pondicherry alum etc have not been accounted.

The ground stress is a commonly acknowledge phenomenon. Indeed in 1999, semmankuppam panchayat issued a resolution prohibiting polluting and water – intensive industries from setting up within their jurisdiction, given the importance of agriculture to the local economy. Farmers and residents of Sipcot also report that NABARD issued circular advising loans for agricultural pump sets. This rule, ironically, did not apply to ground water extraction for industrial use.

1.3 Aim of the Project

To analyse the drinking water quality in Sipcot cuddalore.

1.4 Objectives of the Project

The main objectives of this study

- Assessment of drinking water quality in municipal water and bore well water
- Comparison of water quality with recommended water quality standards
- Assess whether the water is portable or not for drinking
- To analyse the significant health effects

Literature Review

2.1 Background

2.1.1 The Times of India (2014)[16]

The ground water in and around the state Industries Promotion Corporation of Tamil Nadu (SIPCOT) in Cuddalore contains carcinogenic chemical and is unfit for human consumption, according to an analysis by the Sipcot area Community Environmental Monitors (SACEM).

Many of the main parameters were found to be higher than permission levels, including total dissolved solids(TDS), total hardness , pH, turbidity, magnesium, calcium, sulphates and chlorides as prescribe by the Bureau of Indian Standard Tamil Nadu Pollution Control Board (TNPCB) analysed sample from 11 locations, including two outside the Sipcot complex between February 2013 and April,2014.

SACEM found sample had major toxin levels much higher than permissible limits and that the water was unfit for consumption. It released the analysis on (September,17), Cuddalore.

The SACEM analysis found that samples from four location, including overhead tanks that cater to drinking water needs, contained higher levels of carcinogens like cadmium and chromium and other toxin heavy metals like lead and iron. The levels of cadmium in samples collected from Sipcot project office and other location were three to 130 times above permission limits.

Similarly the levels of chromium were one to 1.88 times higher than the prescribed limits and the levels of lead one to 2.5 times higher than the prescribed limits in sample in and around Sipcot region.

Residents, who consume contaminant water, have been exposed to potential health hazards, warned SACEM. Continuous intake of cadmium will cause abdominal pain, nausea, vomiting and intestinal bleeding and will affect kidneys, bones, lungs, liver and nervous system and could lead to cancer.

Chromium intake causes irritation and ulcers in the stomach and small intestine and lead to anaemia while lead have slower growth rate and development Lead also affects the IQ and behavior of children.

“The supply of water to industries is dependent on ground water. Since the aquifer in the Cuddalore region is close to the coast and there is the danger of sea water intrusion in the severely deteriorated. Date show saline intrusion has occurred in the Cuddalore coastal area,” said in a report.

2.1.2 Groundwater Quality in SIPCOT Cuddalore– An Analysis of TNPCB Sample Results of Groundwater (2014) [6]

Since they were set up in the early 1980s, industries in Sipcot Cuddalore have operated without adequate or appropriate infrastructure for environmental production. Residents complain of falling water tables and constantly degrading water quality in the region. Water that was once available at the depth of 30 feet is now available at 800 feet or more. On the one hand, industrial extraction of ground water from the vulnerable coastal aquifer has led to salinity intrusion. On the other, indiscriminate discharge solid and liquid effluents from the industries has contaminated subsurface water.

Even today, Sipcot companies routinely dump their solid wastes and discharge there toxic effluents on to land within or outside their premises. Over the years, the ground water quality in villages around Sipcot has deteriorated, and people have been put to great hard ship. Impacts of the pollution in the region have been highlighted since 1998 when the state human rights commission headed by Retd. Justice Nainar Sundram investigated reported environment – related human rights violation in Sipcot. Justice Sundram, in his report, stated that the Sipcot cuddalore is over polluted and that people's health and the local environment cannot with stand the burden of any new chemical industries.

Members of Sipcot area community environmental monitoring SACEM have consistently monitored and reported the deteriorating quality of the ground water to the authority since 2004. SACEM's Demand all along has been provision of clean drinking water at the cost of Sipcot industries and remediation and restoration of contaminated ground water.

In early July, organizations working amongst pollution-impacted communities in Sipcot Cuddalore approach us and in visited we to serve on a panel of neutral experts assess the state of the environment and the well-being of communities in the chemical industrial estate. On July 29, 2006, we visited the industrial estate, interacted with the villagers and listened to testimonies from Cuddalore residents, trade unionists, local politicians, women and social activists at a public hearing held in Cuddalore town Hall. Prior to that, we had received and reviewed detailed briefing packs containing various report relating to pollution in Cuddalore, and the responsiveness of regulatory agencies.

We learnt through the reports and our interactions that residents of Sipcot industrial estate in Cuddalore have complained about pollution from chemical industries for at least 20 years. Industries in the estate manufacture chemicals, pesticides, pharmaceuticals, paints, dye stuff, dyes etc,. Over

Materials and Methods

3.1 P^H Meter

A **P^H meter** is an electronic device used for measuring the pH which is either the concentration of Hydrogen ions in an aqueous solution or the activity of the Hydrogen ions in an aqueous solution. The P^H will indicate if the solution is acidic or basic, but is not a measure of acidity or alkalinity. P^H meters work in liquids though special probes are sometimes used to measure the P^H of semi-solid substances. A typical P^H meter consists of a special measuring probe (a glass electrode) connected to an electronic meter that measures and displays the pH reading.

Fig. No. 3.1 P^H Meter

3.2 Nephelometric Turbidity Meter

A N**ephelometer** is an instrument for measuring concentration of suspended particulates in a liquid or gas colloid. A nephelometer measures.

3.3 TESTS AND PROCEDURE

3.3.1 Sampling Procedure

- Water for chemical examination should collect in a clean white 2 litre polythene container.
- The source from which water is collected should be in regular use otherwise the source should be adequately flushed before sampling. For hand pump sources, the water should be pumped and the wasted for at lost three to five minutes to clear all dirt, slime and turbidity. Water from wells should be taken in the middle at mid depth.
- Before collection of sample, the container should be wasted with the water to be sampled for at least 2 to 3 times.
- The water should be then filled completely in the container without leaving any air space.

- Label a container.
- The sample should be delivered to the lab within 24 hours from die times of collection.

3.3.2 Determination of Total Dissolved Solids

3.3.2.1 Principle

Total dissolved solids are determined as the residue left after evaporation and drying of the filtered sample.

3.3.2.2 Procedure

i. A clean crucible dish is ignited in a muffle furnace and after cooling in the air; it is cooled in a desiccators and weighed.
ii. A 100 ml of filtered sample was placed in the dish and evaporated at 100^0c on water bath, followed by drying in oven at 103^0C for one hour.
iii. Dry to a constant weight at 103^0c, cool in desiccators and weighed.

3.4 ArcMap 10.3 Analysis

i. When ArcMAP opens you will see the ArcMap dialog box appear, Click on OK to start using ArcMap with a new empty map.
ii. Click the "Add Data" button and the Add Data dialog box displays.
iii. Double-click on "FILE_NAME.CSV" to add the layer to the Table of Contents, or you can highlight the " FILE_NAME.CSV " then click on the "Add" button. The layer and its symbol appear in the Table of Contents. In ArcGIS you can add layers several ways
iv. Right-click on the file “FILE_NAME.CSV” in left side pan and Click “XY Display”.
v. Then choose the longitudes and latitudes of sample stations. Then you can see the sample stations on map.
vi. Export table data and Click “GEOSTATICAL ANAYST”.
vii. In Geostatical anayst wizard, choose suitable spacial interpolation methods and export the map.

Experimental Investigation

4.1 Comparision of Various Guidelines for Drinking Water Quality Standard

Drinking water quality standards describes the quality parameters set for drinking water. The World Health Organisation (WHO) and BIS standards include the following recommended limits on naturally occurring constituents that may have direct adverse health impact. Comparison both standards are shown in table 4.1.

Results

5.1 Results and Discussion

Ground water quality assessment carried out to determine suitability of water samples in terms of drinking and domestic purposes. The portability of drinking water from domestic well samples is mainly based on recommended permissible limits for certain parameters described in WHO, 1996 and BIS for drinking water. Result obtained from the laboratory analysis is interpreted with drinking water standards (TNPCB) and the health effects of various chemical parameters are discussed below:

5.2 Total Dissolved Solids (TDS)

This shows indicator of polluted water. The TDS concentrations ranges were between 232-811 mg/l as shown in Table 4.3. The qualities of water samples were mostly fair.

The maximum acceptable limits of TDS in drinking water by WHO, 1996 was 1000mg/l. The TDS concentrations of samples from sample areas fell within the acceptable standard for drinking water except sample station-1and 7 with 650 mg/l and sample station-10 with 811mg/l in the areas respectively which is shown in Fig. 5.3 and Fig. 5.4 and recorded the concentrations higher than desirable limits and within acceptable limit.

Only three sample stations having TDS values above the recommended value of 500 mg/l (WHO, 1996).

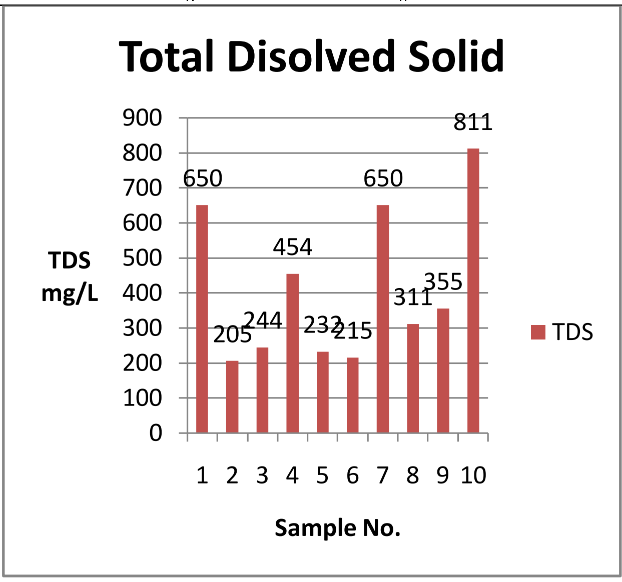

Fig.No.5.3 TDS of various sample

Fig.No.5.4 Spatial distribution of TDS

5.3 Chloride (Cl)

The concentration of chloride in the drinking water samples ranged from 56-212 mg/L as shown in Table 4.7 and comparison is shown in Fig. 5.8. In drinking water, the concentration of chloride should not exceed 250mg/L as recommended by WHO. However, about 100% of drinking water samples recorded lower chloride values (< 250mg/l) as given Fig. 5.9. The amount of chloride ions recommended being acceptable by WHO (1996) is within 10 – 250 mg/L.

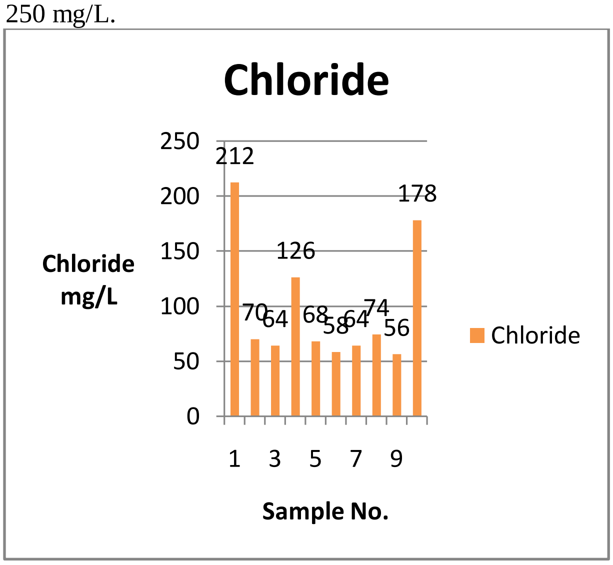

Fig.No.5.8 Chloride of various samples

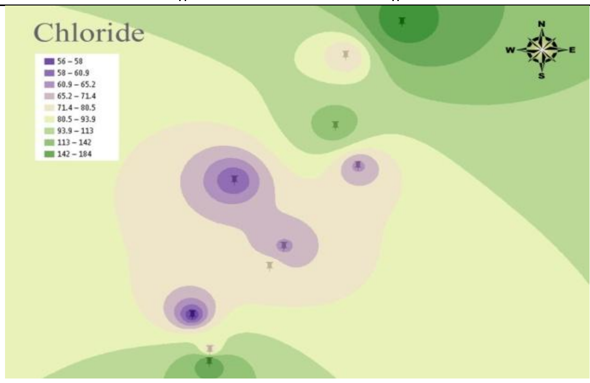

Fig.5.9 Spatial distribution of Chloride

5.4 Total Iron

The concentration of Irons in the samples ranged from 0.01-1 mg/L as shown in Table 4.8 and comparison of different sample stations are plotted in Fig. 5.10.

In drinking water, concentration of irons should not exceed 0.3 mg/L as recommended by WHO and 1.0 as by BIS.

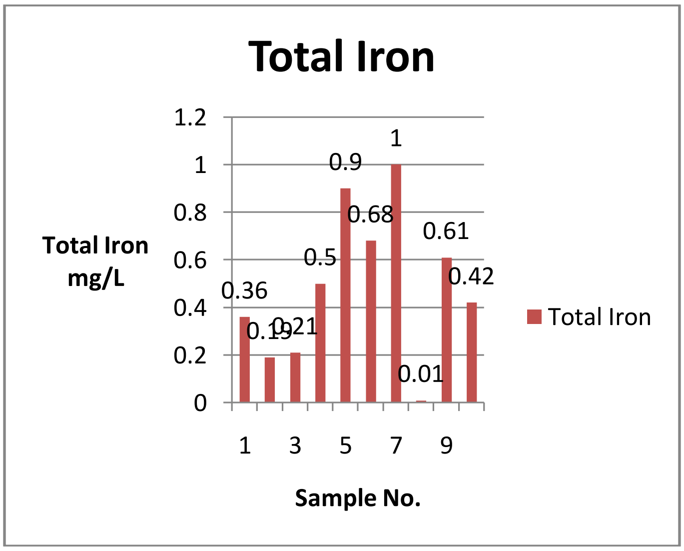

Fig.No.5.10 Total Iron of various samples

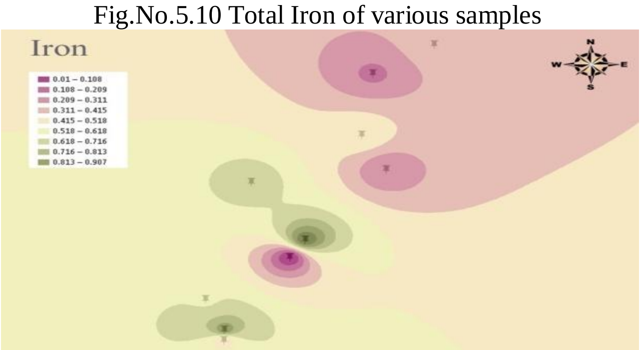

Fig.No.5.11 Spatial distribution of Total Iron

5.5 Dissolved Oxygen

The concentration of dissolved oxygen (DO) in the samples ranged from 3.6-6.2 mg/L as shown in Table 4.10 and values of various samples are shown in Fig. 5.16 and Fig. 5.17. In drinking water, concentration of dissolved oxygen should not exceed 7 mg/L as recommended by WHO and BIS.

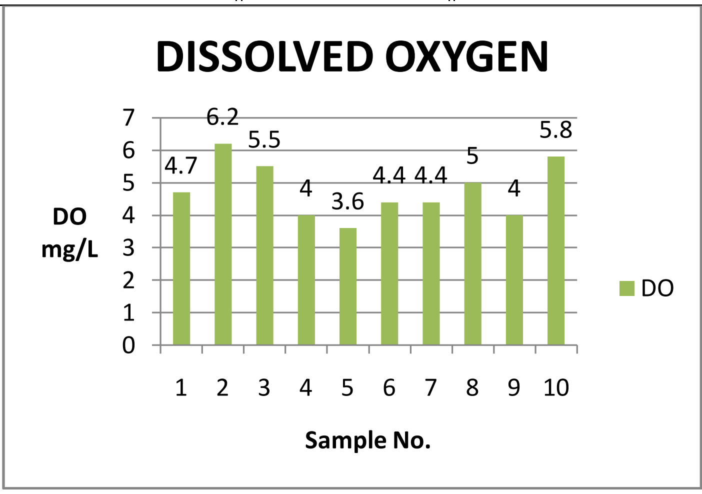

Fig.No.5.16 Dissolved Oxygen of various samples

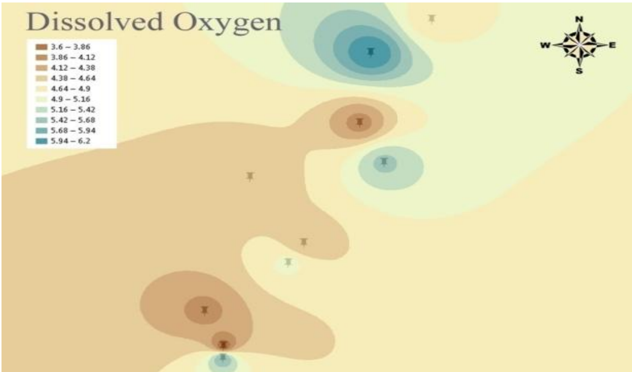

Figure 5.17 Spatial distribution of dissolved oxygen

Conclusion

- The study reveals issues related with water quality in the study area.
- The groundwater samples from Sipcot community were assessed for their quality in terms of their potential for drinking. The results revealed that drinking water in the study area were mostly acidic. Most of the water samples recorded TDS values less than WHO maximum allowable levels. The amounts of iron in some of the water samples were higher than recommended levels and within the maximum allowable level.
- In general ground water quality of cuddalore region is not harmful to human beings. Except few instances where some parameters such as TDS at karaikadu Village, Pachaiyankuppam village, Kudikadu village, semmankuppam village bore well water and total hardness at semmankuppam village were crossed prescribed limits of drinking water (ISI: 10500-91). The reason behind this may be due to industrial activities, industrial discharge, urbanization, other anthropogenic activities and increased human interventions in the ground water quality. Municipal water was found to be fit for drinking purpose than groundwater.
- Correlation studies have also indicated the contribution of changes in land use and industrial discharge. The values of correlation coefficients will help in selecting proper treatment to minimize groundwater pollution.
- From our project, we conclude that the physical and chemical properties of ground water and municipal water are not constant and vary with time.
- The results are within the permissible limits, it shows that the water is chemically portable for drinking and other purposes.

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