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Assessing the ground water quality in Kundadam block of Tiruppur district, Tamil Nadu, India

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Abstract
The quality of groundwater was assessed by determing the physicochemical parameters (pH, EC, TDS) and major ionic concentration (HCo_3, Co_3, Ca, Mg, Na and Fl) around Tiruppur district, Tamil Nadu, India. Ground water quality and ionic composition were assessed through the collection and analysis of the water samples in the Amaravathi river basin area during July-August 2017. GPS based water samples were collected from different locations i.e., 16 villages of Kundadam block of Tiruppur district Tamil Nadu, which are almost uniformly distributed over the river basin area. The analysis was carried out for physico chemical parameters and various water quality parameters were worked out. From the study, it was observed that Kundadam block of Tiruppur district in Tamil Nadu is moderately fluoride endemic. About 25 percent of the villages in this block have fluoride level more than the prescribed permissible limit in drinking water. Based on the ground water quality standards, majority of the samples are suitable for drinking purposes except few in the study area.

Keywords: Fluoride, TDS, CO_3, HCO_3 groundwater quality and Kundadam block

Introduction
Water covers about 70% of the surface of the Earth. Water is an important resource for the people and the environment. Water is the basis of life; it makes up to 60-95% of the total weight of any functioning living cell. However, in recent years due to increased human population, industrialization, urbanization and poor sanitation the water from various sources is getting polluted. The quality of the groundwater is highly related with the local environmental and geological conditions. The groundwater table of a source changes by the regular withdrawal and hence, the quality of groundwater changes [6, 4, 9, 8].
Groundwater quality is mostly affected by either natural geochemical such as mineral weathering dissolution/precipitation reactions, ion exchange, etc.; the quality of groundwater may vary from place to place. In addition to above rapid population growth, increasing living standards, untreated municipal and industrial wastewater fertilizer application of pesticides sewers and landfill areas are the potential sources of groundwater pollution. Therefore, basic concentration is needed to monitor the quality of water as well as to find out various sources, which increased groundwater pollution. The present study was carried to evaluate the groundwater quality in and around Kundadam block of Tiruppur district, Tamil Nadu.

Materials and Methods
Groundwater samples were collected from 64 different locations spreading over 16 revenue villages in Kundadam block of Tiruppur district Tamil Nadu (Table.1) during the months of July-August, 2017. The collected groundwater samples were transferred into a precleaned polyethene container for analysis of chemical parameters. The collected groundwater samples were carried to the laboratory for the analysis of various physico chemical properties such as pH, EC,TDS, calcium, magnesium, sodium, carbonate, bicarbonate, fluoride and water quality parameters such as SAR, RSC, Mg/Ca ratio, Potential Salinity (PS), Permeability Index (PI), Soluble Sodium Percentage (SSP), Residual Sodium Bicarbonate (RSBC). The water quality analysis was done as per the standard procedure of American Public Health Association APHA [1]. Standards have been laid down by various agencies such as the World Health Organizations WHO [10], U.S. Environmental Protection Agency (USEPA), and Bureau of Indian standards BIS [3] for determining water quality for various uses.

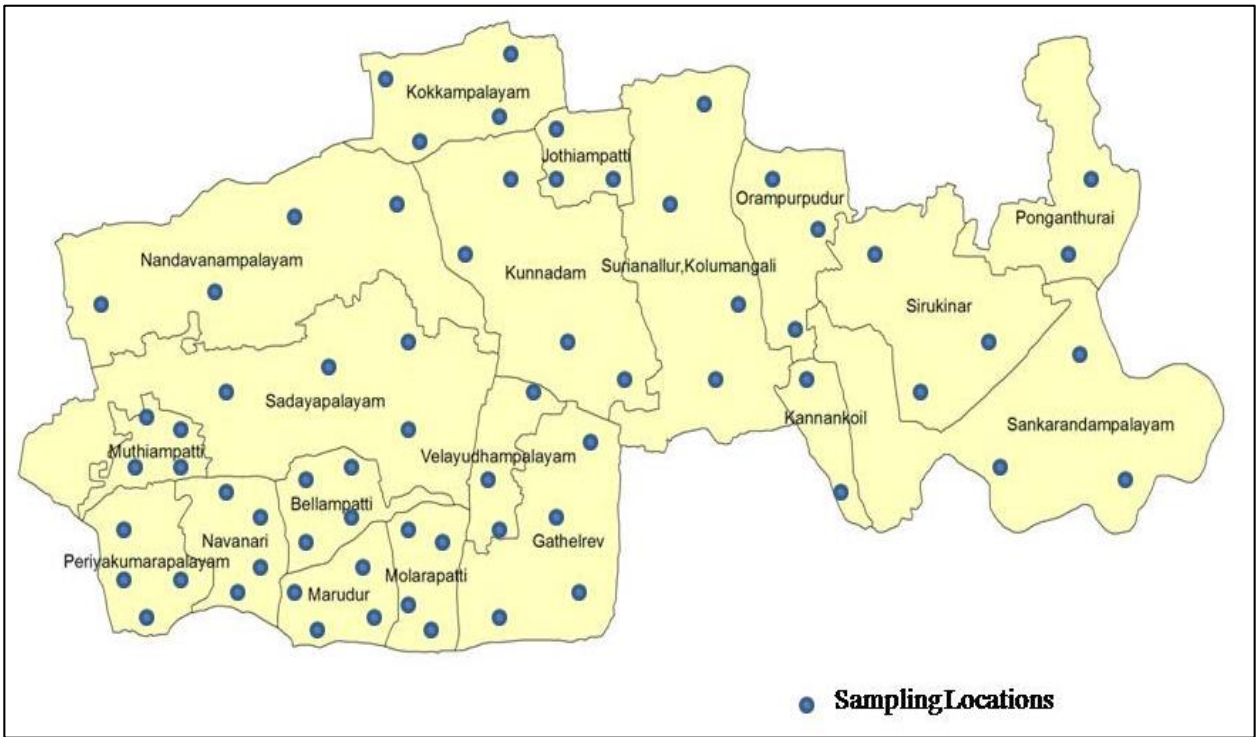

Fig 1: Map of Kundadam Block of Tiruppur district with sampling locations

Table 1; Range of Water quality parameters for the Nature of ground water

pH	EC (dS/m)	TDS	SAR	RSC meq /L	SSP	PI	Nature of water
6.5-8.0	< 0.5	<450	< 15	< 1.5	0	<25	Good
8.0-8.4	0.5-2.0	450-2000	15-25	1.5 -2.5	0-59	25-50	Medium
> 8.4	>2	>2000	> 25	> 2.5	>59	>50	Unsuitable

Results and Discussion

The ground water quality parameters were assessed through the collection and analysis of the samples in the Kundadam block of Tiruppur district. Ground water samples were collected during 2017-18. The analysis was carried out for physico chemical parameters and various water quality parameters were worked out.

The overall mean value of ground water quality parameter on hydrogen ion concentration collected from the different locations in the study area did not vary much and the mean value in general ranged from 8.28 to 9.31. Good irrigation water has the pH in the range of 6.5-8.5. The overall mean value of Electrical conductivity in the groundwater samples vary widely from 0.37 to 3.76 dS m^{-1}.The medium range of EC is 0.5-2.0 dS m^{-1} .The overall mean value of EC IS 1.54.Most of the water samples are comes under good nature of water. The TDS values are considered as important values in determing the usage of water.

The groundwater with high TDS values is not suitable for both irrigation and drinking purposes. The range of TDS for ground water samples of the study area falls in between 236.8 and 2406.4 mg L^{-1} with a mean value of 988.0 mg L^{-1}. The highest value observed that is more than 2000 mg L^{-1} it is not suitable for irrigation. Based on the TDS classification (11) almost majority of the samples will come under desirable for drinking and useful for irrigation category. Most of the water samples in the study area fall within the maximum permissible limit of 2100 mg L^{-1} except in few locations. The high value of TDS may be due to the various pollutants added through fertilizers and pesticides and also parent rock materials of the subsurface horizons. (Table 2)

Table 2: Physio-chemical characteristics of Groundwater quality of Kundadam block

S. No.	Parameters	Minimum	Maximum	Average
1.	pH	8.28	9.31	8.67
2.	EC (dS m^{-1})	0.37	3.76	1.54
3.	TDS (mg L^{-1})	236.8	2406.4	988.0
4.	Calcium (meq L^{-1})	2.8	45	14.9
5.	Magnesium (meq L^{-1})	0.4	26.2	8.84
6.	Carbonate (meq L^{-1})	2.0	10.0	4.8
7.	Bicarbonate (meq L^{-1})	1.0	27.0	3.1
8.	Sodium (meq L^{-1})	0.31	36.8	8.88
9.	Fluoride (mg L^{-1})	0.18	2.12	0.99

Residual sodium carbonate (RSC) also comes under good category of nature of water because all the water samples comes under < 1.5. Similarly Sodium Adsorption Value (SAR) also falls on the good category level of water samples (<15). Maximum SAR value is observed 6.17 and the mean value of SAR is 2.58.The Mg/Ca ratio is the important factor for the assessment of quality of irrigation water. It ranges from 0.14-0.58.

Potential Salinity (PS) ranges from 0.78-37.33. Even though a wider range between minimum and maximum values the mean value of the PS is 6.53.The PS is 3-7, it is suitable for low permeable soil and the PI value upto 15 it is suitable for high permeable soil. The permeability index (PI) of the water samples ranged from 36.73 to 59.07. But the majority of the water samples comes under minimum range of 37.32 (Table 3). The PI is <25, it is good for irrigation for irrigation. The PI 25-50 is medium for irrigation. However, the PI value exceeds 50 it is not suitable for irrigation except few places exceeds PI level of 50.

Table 3: Water Quality Parameters of the Groundwater of Kundadam block

S. No.	Parameters	Minimum	Maximum	Average
1.	Residual Sodium Carbonate (RSC)	-0.20	-34.20	-15.84
2.	Sodium Adsorption Ratio (SAR)	0.25	6.17	2.58
3.	Mg/Ca ratio	0.14	0.58	0.59
4.	Potential Salinity (PS)	0.78	37.33	6.53
5.	Permeability Index (PI)	37.32	59.07	36.73
6.	Soluble Sodium Percentage (SSP)	8.83	34.07	27.22
7.	Residual Sodium Bicarbonate (RSBC)	-5.28	14.96	2.00

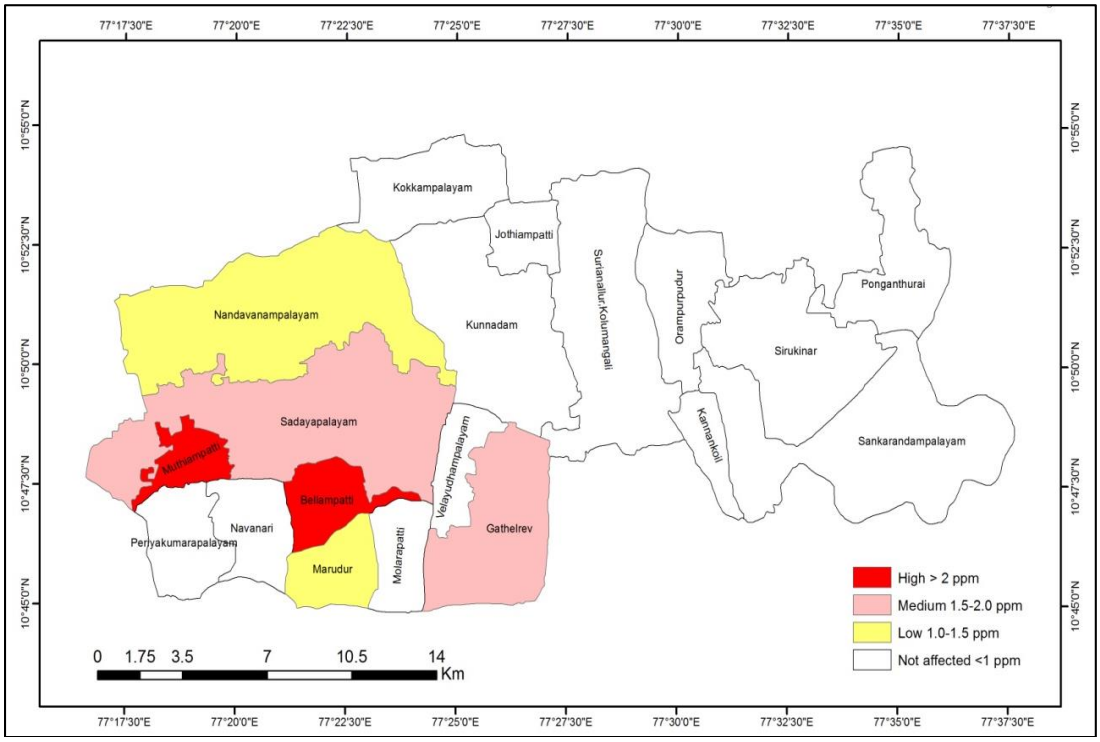

Fig 2: Fluoride contamination mapping of Kundadam block using GIS tools

Results on fluoride content in the ground water samples of the study area suggested that there were variations in the concentration of fluoride ion within the river basin, but the concentration in most cases were within tolerable limits (<1.5 mg L^{-1}) except in few locations of Kundadam block. The range of fluoride content for ground water samples of the study area falls in between 0.18 to 2.12 mg L^{-1} with a mean value of 0.99 mg L^{-1} (Fig.2). The fluoride contamination in the groundwater indicates the presence of fluoride bearing minerals [5, 7]. Consumption of fluoride contaminated ground water (> 1.5 mg /l) causes dental fluorosis [2].

The overall mean values on calcium ion concentration in the ground water samples ranged from 2.8 to 45 meq L^{-1} with a mean value of 14.9 meq L^{-1}. The results on magnesium content of the wells located at Kundadam block varied from 0.4 to 26.2 meq L^{-1} with a mean value of 8.84 meq L^{-1}. The concentration of calcium and magnesium in the groundwater is most probably derived from leaching of carbonate minerals such as calcite and dolomite. The carbonate ion of Kundadam block was found to vary between 2.0 to 10.0 meq L^{-1} with an overall mean value of 4.8 meq L^{-1}. The bicarbonate ion in the study area was found to vary between 1.0 to 27.0 meq L^{-1} with an overall mean value of 3.1 meq L^{-1} (Table 3).

Conclusions

Groundwater is extremely important to the future economy and growth of the country. If the resource is to remain available as high quality water for future generations, it is important to protect from the possible contamination. This freshwater crisis is already evident in many parts of India, particularly Tamil Nadu, varying in scale and intensity, depending mainly on the time of the year. In Tamil Nadu, water crisis plays a major role, varying in scale and intensity depending mainly on the time of the year. However, monitoring is an important device to detect groundwater contamination and to provide an advanced warning of the approaching contaminated groundwater to important sources of water supply. This is of great importance, because the problem concerns securing a safe drinking water supply for the present and future generation. In the absence of strong legislation and the lack of reliable tools to properly quantify potential impacts groundwater is rarely a consideration in the land use planning process.

In the present study, the assessment of groundwater samples for irrigation has been evaluated on the basis of standard guidelines. The analysis evidently says that groundwater in the study is fit for irrigation and other domestic purposes. Most of the groundwater samples are affected by high EC, TDS and Fluoride as concerned with irrigation water. About 25 percent of the villages in this block have fluoride level more than the prescribed permissible limit in drinking water.

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