Spatial Impacts of Factories in Groundwater Quality in Karur Using GIS

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Abstract

Analyzing the water quality is the major need in today's conditions. Current study has been undertaken and maps the spatial variations of water quality parameter using Geographical Information System (GIS). For this present study the 314sq.km was chosen around major factories in Karur district from Southern India, Tamil Nadu State. Water quality analysis for 15 sampling stations was randomly selected within the area of 314 sq.km in this present study. The analysis and representation of spatial information was done by GIS tools which were related to physio-chemical parameters of water quality.

The spatial variation maps were generated for water quality parameters. From this present study it was found that Residual Chlorine, sulphates, chloride, Electrical conductivity were the most affected parameters, it leads to a scope of future study to check the water quality condition as good, moderate and risk spots in the study area.

Keywords: Ground water, GIS, water quality analysis, spatial variation maps, physio-chemical parameter.

Introduction

Water is an essential one for daily life. Now a day the availability of water is very low and they were contaminated by disposal of municipal waste and industrial effluents. Due to infiltration and penetration of effluent's the ground water was also get polluted. While consuming these types of water the health of the living things will be affected and the properties of the materials will be also affected. The quality of ground water varies with location, level of water table, season, etc. The proportion of dissolved constituents will be high in ground water when compared with surface water because there was a higher interaction between ground water and various materials in geological strata. The quality of water depends of various parameters like Electrical Conductivity (EC), Total Dissolved Solids (TDS), pH, Turbidity, Dissolved Oxygen (DO), and Chemical Oxygen Demand (COD) etc.

The present study represents the spatial variation map of ground water quality parameters for 314sq.km Karur District, Tamil Nadu using GIS. GIS was an operative software for water quality mapping and fundamental for monitoring the environmental changes. Water samples were collected for 15 points within the study area. The physio chemical parameters were analyzed for the collected samples and the affected areas were represented by spatial variation maps using QGIS software. The present study shows the status of water quality for the study area.

Study area

The present study has been done in Karur district, Tamil Nadu. It lies between the Latitude of 10.45"N and 11.45"N and Longitude of 77.45"E and 78.07"E. The surface area of Karur District was 2895.57sq.km, from this a circular area of 314sq.km was chosen as the study area for this present study. The location of the study area is shown in Fig. 1.

Methodology

The water samples are collected from 15 locations within in the boundary of 10 km. The locations of the water sample were listed in table. Shape files are created using QGIS, Samples collected are analyzed in laboratory for certain parameters like pH, Electrical Conductivity, Chlorides, Sulphates, Turbidity , Total Hardness, Total Dissolved Solids, Fluorides , Residual Chlorine , Chemical Oxygen Demand, Dissolved Oxygen and Compared with Indian standards which was shown in table 1. The data's are imported in the QGIS software to get the spatial variation maps. Spatial interpolation techniques through inverse distance weighted (IDW) represented by the equation (1) was done for the water quality results in the study area.

$$Zp = \frac{\sum_{i=1}^{n} \frac{Z_i}{d_i^p}}{\sum_{i=1}^{n} \frac{1}{d_i^p}} \quad (1)$$

where Z_p – Interpolated value at the p^{th} required location, Z_i – Coordinate parameter value in the i^{th} location and d_i^p - Distance from i^{th} to p^{th} location.

Results and Discussion

The spatial variation maps of water quality parameters like pH, Electrical, Turbidity, sulphates, chlorides, Residual chlorine, Fluorides, Total hardness, Total dissolved solids, Chemical oxygen demand; Dissolved solids were generated using QGIS. This water quality map helps to correlate the existing water condition in the study area.

pH: As per IS 10500:2012, pH ranges from 6 to 8.5 and it contains both alkaline and acidic nature. The test results for

H shows that all the locations are within the limit indicate that the water is portable which was shown in fig. 2.

Electrical Conductivity: Electrical conductivity depends upon temperature and type of ion concentration present in it. As per IS 10500:2012, the electrical conductivity value should be less than 1000µmho/cm. The test results show that two samples exceed the permissible limit which may cause irritation instomach. The spatial variation map for electrical conductivity was shown in fig. 3.

Total Dissolved Solids: Presence of potassium and sodium chloride increases the TDS in water. Total dissolved solids are categorized into Suspended solids, Volatile solids and Dissolved solids. As per IS 10500:2012, the TDS value for drinking water should be less than 0.5 mg/l. The spatial variation map for TDS was shown in fig.4-a, 4-b, 4c.

Hardness: Hardness is the concentration of calcium, magnesium and dissolved minerals, it has both temporary and permanent hardness. Temporary and Permanent hardness is caused due to calcium and magnesium ion with bicarbonate anion. As per IS 10500:2012, hardness should be less than 600 mg/l for drinking water. From the result obtained three samples have hardness value above the permissible limit and for some samples test results were not obtained during titration. The spatial variation map for hardness was shown in fig. 5.

Sulphates: Sulphates are one of the major dissolved components of rain. It is commonly found in drinking water. As per IS 10500:2012, the sulphate value should be less than 200 mg/l. From the test result, sulphates value for all the sample were not within the permissible limit. The spatial variation map for hardness was shown in fig. 6.

Turbidity: Water get turbid due to the presence of organic matters and suspended solids, when this increases turbidity also increases. As per IS 10500: 2012 the permissible range of turbidity was 1 to 5NTU. All the collected samples have turbidity value within the limit. The spatial variation map for turbidity was shown in fig. 7.

Chlorides: As per IS 10500: 2012 the permissible range of chloride in drinking water is 75ppm to 150ppm. From the result of water quality analysis it was found that only one sample has chloride value within the limit. The spatial variation map for chloride was shown in fig. 8.

Table 1
Test results of sampling points

Collected Place	Latitude	Longitude	pH	Turbidity (NTU)	Electrical Conductivity (µmho/Cm)	Chlorides (Ppm)	Sulphates (Ppm)	Fluoride	Cod (mg/l)	Total Hardness (mg/l)	Do (mg/l)	Dissolved Solids (mg/l)	Volatile Solids (mg/l)	Suspended Solids (mg/l)	Residual Chlorine (mg/l)
Manmanglam	11.02785	78.06378	7.55	4.4	765	302.68	233.52	1	*	470	1	0.0829	0.35	0.043	0.2
Velayuthampalayam	11.07666	78.00525	7.35	4.8	464	287.12	467.04	1	80	276	1.4	0.18	0.102	0.06425	0.3
Punnam Chatram	10.99433	77.99623	7.22	5.1	964	424.32	700.55	1	880	580	2.4	0.1323	0.106	0.057	0.3
Thirukkattuthurai	11.08753	77.98921	7.37	4.9	847	381.89	233.52	1	160	556	0.7	0.0662	0.09	0.11325	0.3
Ayyampalayam	11.06221	78.03414	7.36	4.6	1018	*	233.52	1	*	690	0.7	0.037	0.25	0.08125	0.3
Uppupalayam	11.01749	77.96168	7.17	4.8	1000	*	934	1	800	*	2.5	0.19	0.062	0.0535	0.3
Vangapalayam	10.98366	78.07516	7.55	6	395	207.92	233.52	1	80	340	0.5	0.3	0.085	0.0745	0.3
Kagithapuram	11.06052	77.99383	7.75	7	300	152.76	233.52	1	*	292	12.31	0.1	0.1	0.1	0
Masagoundpudur	11.0373	77.9842	6.99	37.1	437	*	467.03	1	480	*	6.7	0.1	0.09	0.09	0
Orathai	11.03713	78.02919	7.43	5.7	493	*	233.52	1	800	*	1.87	0.1	0.06	0.07	0.2
Kuppam	11.01116	77.92674	7.44	4.2	782	*	233.52	1	480	1992	1.28	0.2	0.1	0.1	0
Andankoil West	10.97515	78.02523	7.41	5	667	669	233.52	1	240	622	1.38	0.2	0.1	0.1	0
Pavithiram	10.96736	77.98636	7.94	4.6	827	196	233.52	1	*	544	0.69	0.1	0.3	0.01	0
Andisangilipalayam	10.99848	77.93282	7.57	7.5	750	418.67	467.03	1	720	444	1.87	0.1	0.4	0.02	0
Mangacholi Palayam	11.00396	78.03759	8.17	4.2	817	128.71	233.52	1	*	242	1.18	0.1	0.1	0.05	0

- No results obtained

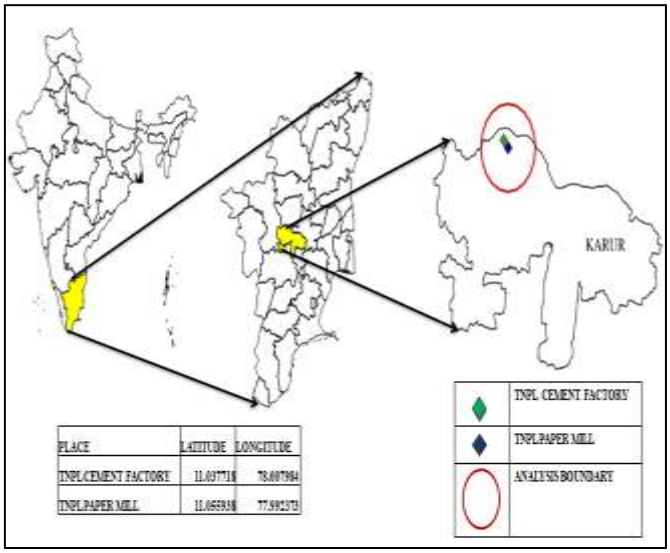


Fig. 1

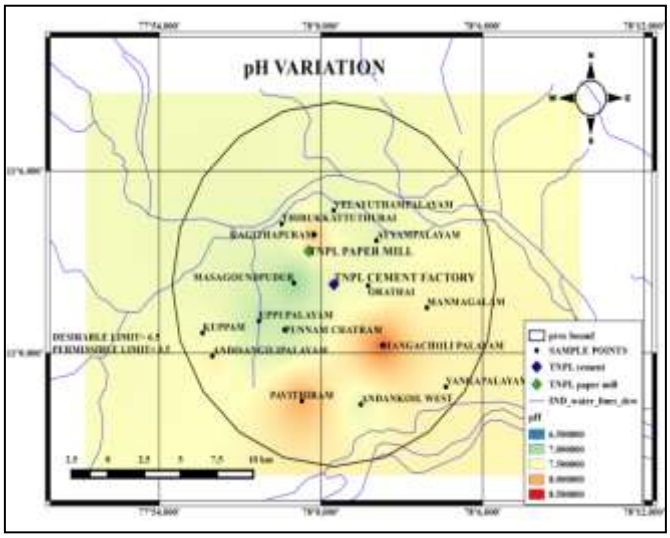


Fig. 2

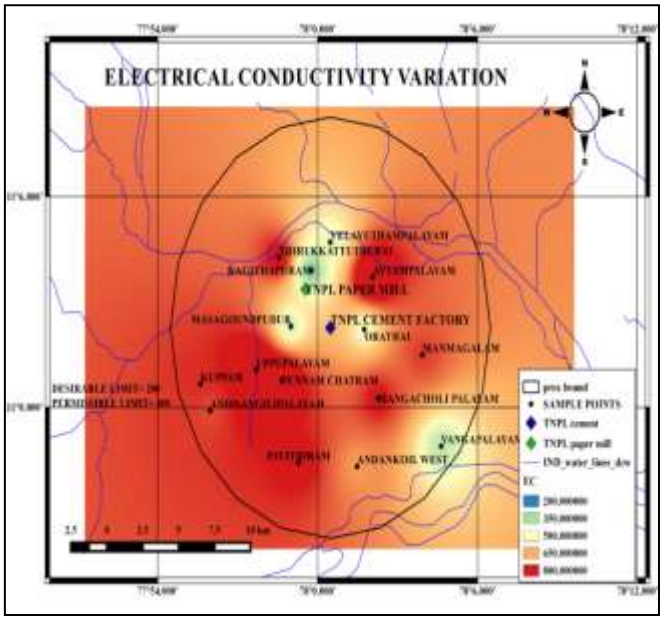


Fig. 3

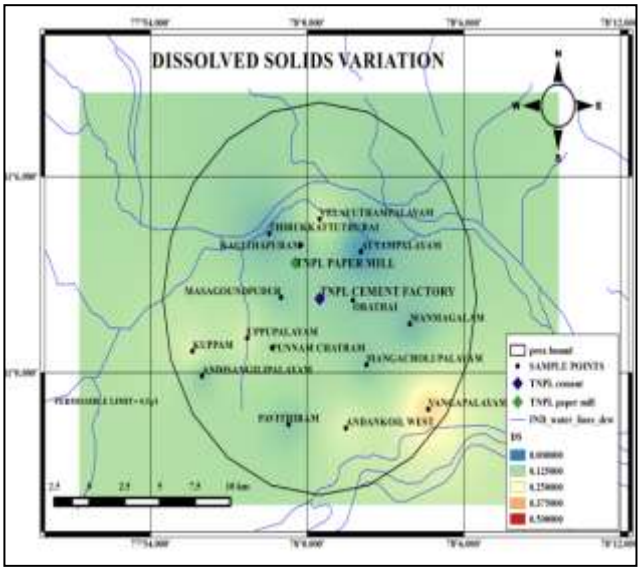


Fig. 4-a

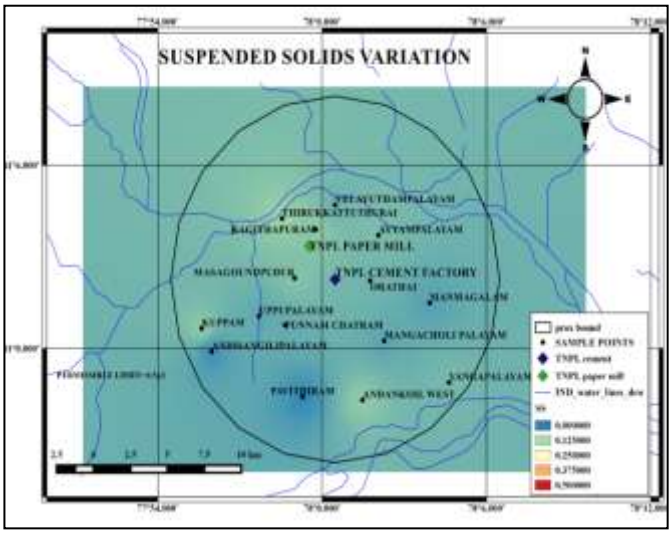


Fig. 4-b

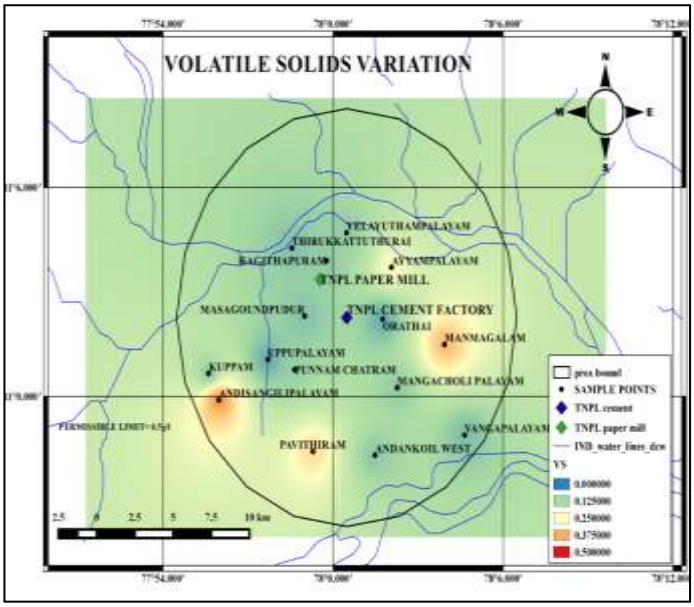
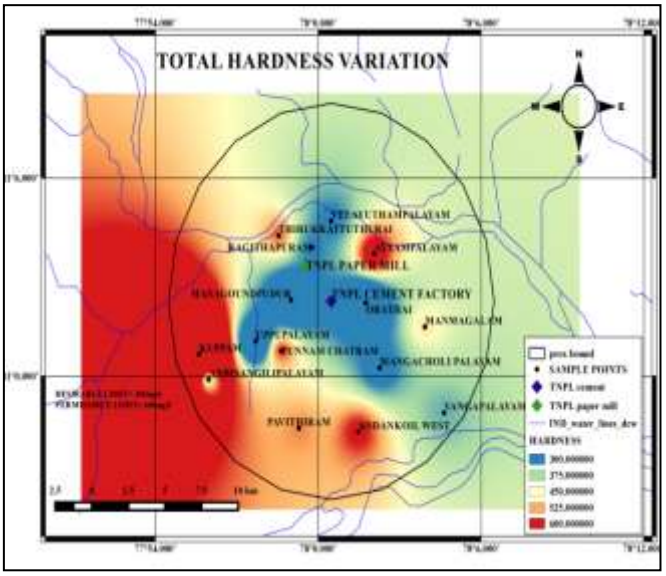


Fig. 4-c



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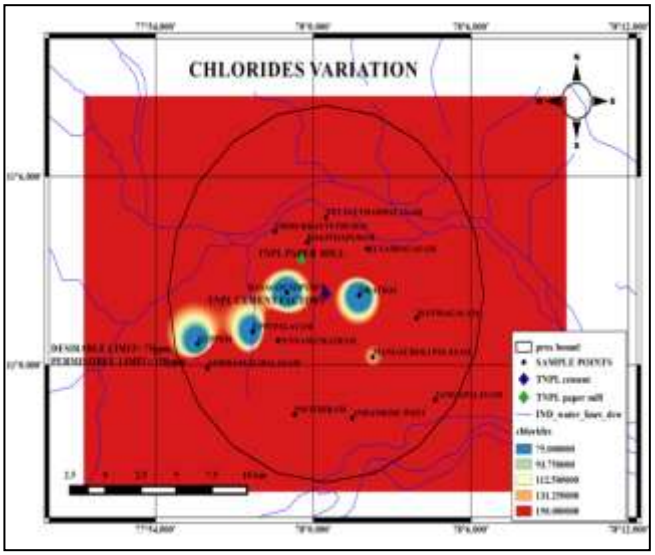

Fig. 8

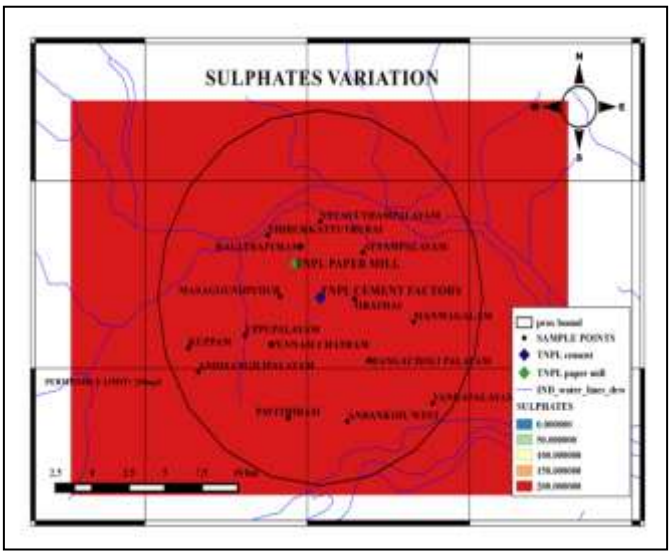

Fig. 6

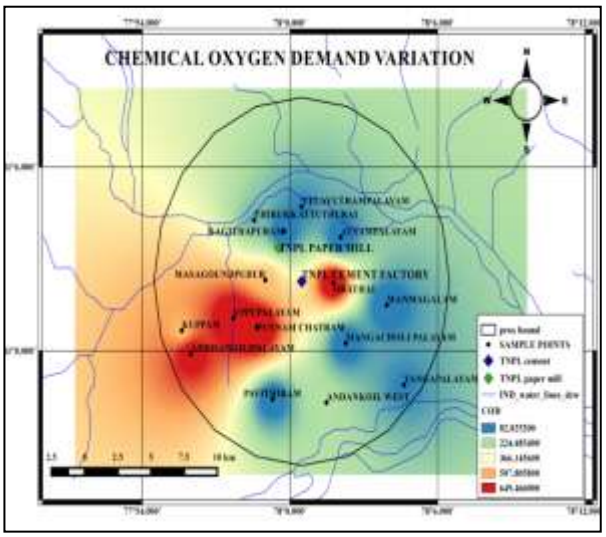

Fig. 9

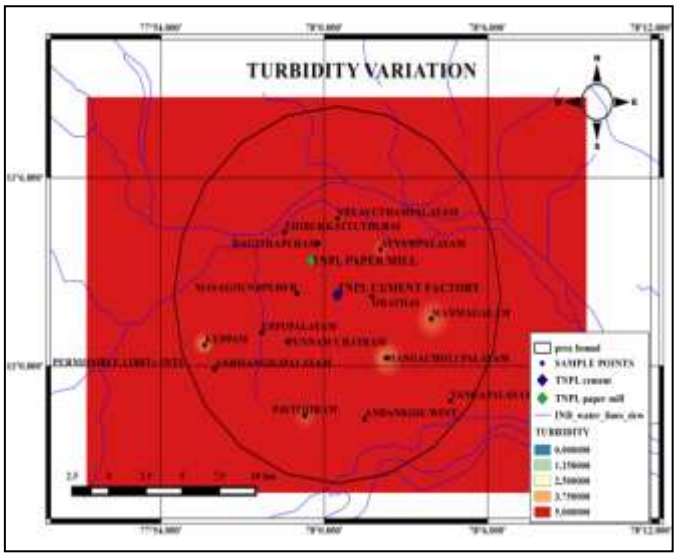

Fig. 7

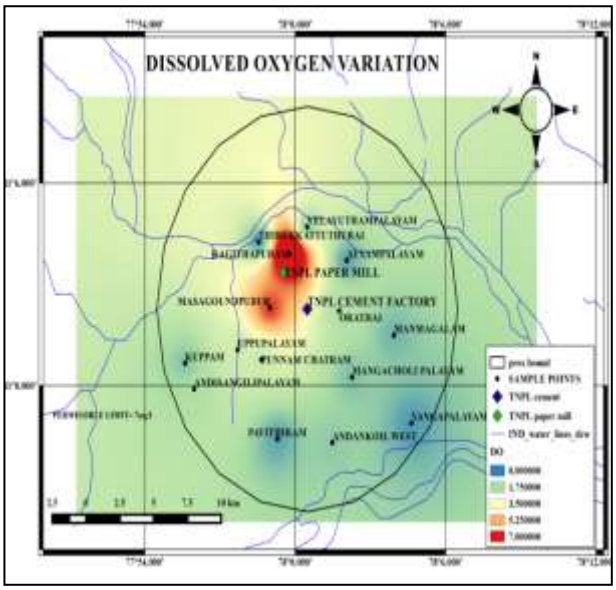

Fig. 10

Chemical Oxygen Demand: As per IS 10500: 2012, there is no standard values for COD but ideally it should be zero or negligible. COD is the total oxygen required for decomposing organic and inorganic components in water. The spatial variation map for COD was shown in fig. 9.

Dissolved Oxygen: Dissolved oxygen enters into to the water by air or photosynthesis process. This help the living organisms present in water. As per IS 10500:2012 the permissible limit for DO in drinking water should not be less than 7mg/l depends on various factors. From the result of water quality analysis it was found that only one sample has DO value higher than the limit. The spatial variation map for DO was shown in fig. 10.

Fluorides: As per IS 10500: 2012, the permissible range of fluoride for drinking water is 0.6 to 1.5mg/l. From the result of water quality analysis it was found that all the samples are within the permissible limit. The spatial variation map for fluoride was shown in fig. 11.

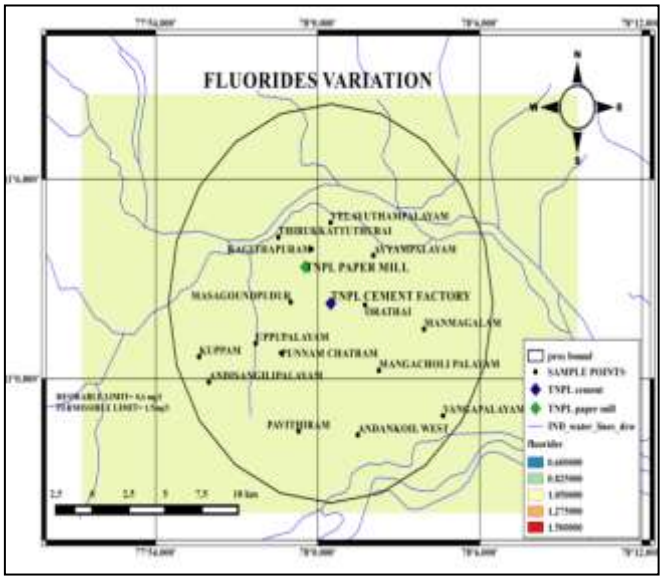

Fig. 11

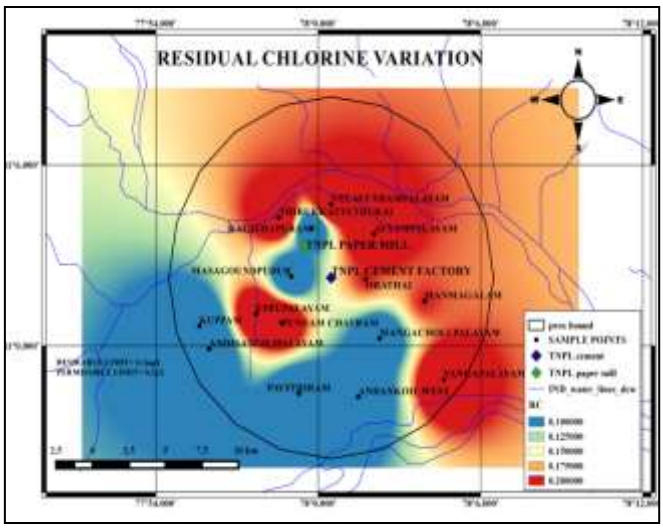

Fig. 12

Conclusion

Ground water is the major source of water now-a-days. It is been affected by land pollutions and also by industrial effluent's. The ground water quality is important because of water scarcity faced in present, its quality is checked using the spatial variation maps by interpolating the data's in QGIS. The present study for water quality parameters like pH, Electrical Conductivity, Total Hardness, Total Solids, Sulphates, Fluorides, Chloride, Residual Chloride, Turbidity, Chemical Oxygen Demand, and Dissolved Oxygen was done. From the test result it was found that Residual Chloride shown in Fig. 12, Electrical Conductivity, Sulphates and Chlorides are mostly affected within the boundary of 10 km surroundings. The spatial maps generated helps in understanding the water quality variations and to make preventive measures for the mostly affected parameters in particular locations

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