Impact of dyeing industrial effluents on the groundwater quality in Kancheepuram (India)

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Abstract: Dyeing and printing of textile being a traditional industry of Kancheepuram town, a good number of textile industries along with dyeing and printing clusters have come up in the area. The dyeing units in Kancheepuram municipality and the surrounding villages are under constant threat of ground water contamination with chemicals of dyes. The present study evaluates the groundwater quality in and around the Kancheepuram town of Tamil Nadu with reference to drinking and irrigation purposes. Twenty groundwater samples were collected from various parts of the dyeing industrial region and the samples were analysed with standard analytic methods. The concentrations of total dissolved solids (1138 to 2574 mg/L), chloride (216 to 847 mg/L), total hardness (225 to 760 mg/L), sulphate (64 to 536 mg/L), nitrate (up to 58 mg/L), iron (up to 2.3 mg/L) and lead (up to 0.281 mg/L) were found to be higher and exceeded the permissible limits of BIS and WHO standards. The user specific water quality indices (USWQI) of each groundwater sample were evaluated for both purposes. The USWQI of the groundwater samples varied from 85 to 30 for drinking purpose and 89 to 50 for irrigation purpose. The results show that, the groundwater quality in the present study area can be categorized under 'good' for irrigation purpose and 'fair' for drinking purpose. Access to safe drinking water supply is one of the basic needs of society and hence a comprehensive plan of action is sought to curb groundwater contamination in the studied region.
Keywords: Dye, groundwater, water quality, drinking, irrigation, USWQI, Kancheepuram.

Introduction

Perhaps one of the industries under the strong radar of the environmental agencies is the dyeing units and the dyestuff industries as a whole. Next to food, the second basic need of man 'cloth' is supplied by processing of natural and synthetic fibers in the industries called textiles. India is the second largest producer of cotton yarn and silk and third largest producer of cotton and cellulose fiber in the world. Increased population and modernized civilization trend gave rise to blooming of textile sectors in India. An estimate shows that textiles account for 14% of India's industrial production and around 27% of its export earnings (Ministry of Textiles, 2004). There are about 10,000 garment manufacturers and 2100 bleaching and dyeing industries in India. Majority are concentrated in the states of Tamil Nadu, Punjab and Gujarat. Many textile processing units in Tamil Nadu use a number of unclassified chemicals that are likely to be from the Red List Group which is said to be harmful and unhealthy (Ravikumar & Dutta, 1996).

The processes followed in textile industries are spinning of fiber to yarn, sizing to improve stiffness, scouring and desizing to remove excess sizing materials, bleaching to remove pectin and wax from the yarn and fabric and colouring and printing to provide desired colour and design to the cloth. Dyeing is a combined process of bleaching and colouring, which generates voluminous quantities of wastewaters and in turn causes environmental degradation. The effluents consist of high concentrations of dye stuff, biochemical oxygen demand, total dissolved solids, sodium, chloride, sulphate, hardness, heavy metals and carcinogenic dye ingredients (Tchobanoglous & Burton, 1995).

Over the last several years, water quality in urban locale and villages adjoining dyeing industrial areas has deteriorated owing to effluent inflow into land and water bodies. This is evident in some pockets in and surrounding Kancheepuram (PIP, 2005). Increasing human and livestock population as well as per capita consumption owing to urbanization compounded by industrial development has raised the pressure on water resources to unprecedented levels. As added complications, pollution and contamination of both surface and ground water resources by the dyeing units in and around Kancheepuram municipality are worrisome. Dhanya *et al.,* (2005) have studied the impact of dyeing industrial effluent on the groundwater quality and soil micro organisms in Tirupur and found that the bore well water samples had higher values of all the parameters except nitrate. Earlier studies by Kesavan and Parameswari (2005) revealed that the groundwater sources in Kancheepuram are not suitable for drinking purpose without proper treatment. The present study was carried out to investigate the effect of dyeing industrial effluents on the quality of groundwater in and around the Kancheepuram town with reference to drinking and irrigation purposes.

Pollution due to dyes

A dye is a synthetic chemical used to impart colour to materials of which it becomes an integral part. The large variety of chemicals used in bleaching and dyeing process render them very complex. These chemicals are used in an attempt to make more attractive popular shades of fabrics for a competitive market (Rajagopalan, 1990). Dyes are carbon-based organic compounds while pigments are normally inorganic compounds, often involving heavy toxic metals. An aromatic ring structure coupled with a side chain is usually required for resonance and thus to impart colour (resonance structures that cause displacement or appearance of absorption bands in the visible spectrum of light are responsible for colour).

Table 1. Types of Pollutants associated with various dyes

Class	Fiber	Nature of Pollution
Direct dye	Cotton	Salt, unfixed dyes, copper salts, cationic fixing agents
Reactive dye	Cotton	Salt, unfixed dyes, Alkali
Vat dye	Cotton	Alkali, oxidizing agent, reducing agent
Sulphur dye	Cotton	Alkali, oxidizing agent, reducing agent, unfixed dyes
Acid dye	Wool	Unfixed dyes, organic dyes
Disperse dye	Polyester	Carriers, reducing agent, organic acids
Metal complex dyes	Wool	Metals, organic acids

Correlation of chemical structure with colour has been accomplished in the synthesis of dye using a chromogen-chromophore with auxochrome. Chromogen is the aromatic structure containing benzene, naphthalene, or anthracene rings. A chromophore group is a colour giver and is represented by the following radicals, which form a basis for the chemical classification of dyes when coupled with the chromogen: azo (-N=N-); carbonyl (=C=O); carbon (=C=C=); carbon-nitrogen (>C=NH or -CH=N-); nitroso (-NO or N-OH); nitro (-NO_2 or =NO-OH); and sulfur (>C=S). The chromogen-chromophore structure is often not sufficient to impart solubility and cause adherence of dye to fiber. The auxochrome or bonding affinity groups are amine, hydroxyl, carboxyl and sulfonic radicals or their derivatives (Sankar, 2000).

The nature of pollution that accompanies the dyeing industry is primarily due to the non-biodegradable nature of the dyes along with the strong presence of appreciable amounts of toxic trace metals, acids, alkalis and carcinogenic aromatic amines in the effluents (Manivasakam, 2003). Table 1 illustrates the pollutants associated with some of the very popular dyes.

Materials and Methods

Study area

Kancheepuram town is located at a distance of 76 km from Chennai on the northern bank of the river Vegavathy, a tributary of the river Palar in Tamil Nadu, India. It is situated at 12° 50' north latitude and 79° 42' east longitude. Kancheepuram District is principally made up of hard rocks and sedimentary formations overlaid by laterite and alluvium. The average annual rainfall of the district is 1212 mm and occurs mostly during the north-east monsoon. Kancheepuram District does not have any perennial rivers. Even heavy rainfall areas are short of potable drinking water in Kancheepuram due to pollution and gradual destruction of water bodies (PIP, 2005).

Waste water discharge from the textile dyeing units in and surrounding villages of Kancheepuram town has caused pollution and degradation of water quality. Untreated textile dyeing effluents released from the industries on open land seeps into the aquifer and increases the concentration of pollutants in the groundwater. The ground water quality in this vicinity has resulted in damage to agricultural crops and has caused skin disorder. Local people are facing problem in obtaining water for drinking and irrigation since ground water has been significantly polluted. A survey carried out by Tamil Nadu Water supply and Drainage Board in the year 2001 in Kancheepuram block has found that there was high incidence of water-borne diseases like jaundice, amoebiasis and acute diarrhea due to contamination of potable groundwater. The study also revealed the lack of systems in ensuring safe quality of drinking water at the village level and a deplorable lack of community awareness in protecting their own drinking water systems (TWAD Board, 2001). The Fig.1 shows the location of the present study area.

Fig. 1 Location of the study area

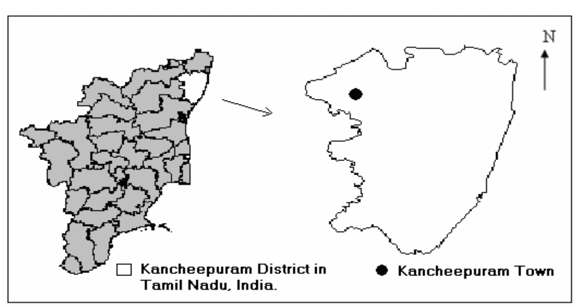

Table 2. List of groundwater sample sites

GW Sample	Site	Source
S1, S2, S3	Periya Kancheepuram, Kancheepuram	Open well
S4, S5, S6	Pillayar Palayam, Kancheepuram	Bore well
S7, S8	Uppukulam, Kancheepuram	Bore well
S9, S10	Toll Gate, Kancheepuram	Bore well
S11, S12, S13	Weaver's colony, Kancheepuram.	Bore well
S14, S15	Nazarethpet, Kancheepuram	Bore well
S16, S17, S18	Punchai Arasanthangal village, Kancheepuram	Open well
S19, S20	Vegavathi Nadhi Road, Kancheepuram	Bore well

Sample collection and analysis

Twenty representative groundwater samples were collected in the dyeing industrial areas of Kancheepuram town and its surrounding villages during July 2007. The locations of the groundwater sample sites were listed in Table 2. The samples were analysed for the parameters turbidity, electrical conductivity (EC @ 25 ^oC), total dissolved solids (TDS), pH and dissolved oxygen (DO), alkalinity, sulphate (SO_4), chloride (Cl), nitrate (NO_3), total hardness (TH), calcium (Ca), iron (Fe), magnesium (Mg), sodium (Na), faecal coliform bacteria count (F.Coli.), biochemical oxygen demand (BOD_5) and the trace elements cadmium (Cd), mercury (Hg), lead (Pb), arsenic (As), chromium (Cr), copper (Cu), fluoride (F), boron (B), manganese (Mn) and zinc (Zn) by standard analytic methods (APHA, 1995). All the groundwater samples were found to be colourless and odourless. The temperature of the groundwater samples was found about 30 ^oC. The various analytical results of the groundwater samples were listed in Tables 3a-3b.

Estimation of USWQI

The parameter quality index (PQI) of a water quality parameter is defined by the following relations.

$$PQI_i = \begin{cases} 100 & x_i \le x_{0i} \\ y_i & x_{0i} < x_i < x_{ei} \\ 2 & x_i \ge x_{ei} \end{cases} \quad \ldots (1)$$

$$y_i = y_0 e^{-k_i z_i} \quad \ldots (2)$$

$$z_i = (x_i - x_{0i})\,;\, k_i = \frac{(\ln 100 - \ln 2)}{(x_{ei} - x_{0i})} \quad \ldots (3)$$

The USWQI of a water sample can be obtained by aggregating the PQIs using equation (4).

$$USWQI = \frac{\sum_{i=1}^{n} PQI_i}{n} \quad \ldots (4)$$

Where, *n* - is the number of water quality parameters considered for a designated use.

The tolerance limit (x_0) and excessive limit (x_e) of individual water quality parameters for the two designated uses were used from the standard values as given in Tables 4-5 (BIS, 1991; FAO, 1985; Minhas & Gupta, 1992; WHO, 2003). The user specific water quality indices for the two designated uses were calculated and listed in Table 6. The USWQI ranks water quality into one of five categories: excellent (100-91), good (90-71), fair (70-51), poor (50-26) and very poor (25-2).

Results and discussion

Drinking purpose

Tables 3a and 3b show that the heavy metal pollutants such as cadmium, mercury, arsenic, iron and chromium were present in higher concentrations than the permissible standard values (WHO, 2003; BIS, 1991). The presence of iron in water may cause decolourisation of clothes washed in such waters (Kesavan & Parameswari, 2005). Arsenic is a cancerous heavy metal. Higher value of mercury intake is toxic and causes neurological damage, paralysis and blindness (Masood Alam & Anwar Ahmad, 2002). The pH values of all the groundwater samples varied between 7.46 and 8.55 which are in the alkaline range. Dissolved oxygen was found low in most of the samples. Total hardness of all the samples exceeded the permissible limit. Higher values of hardness may be attributed to leaching of calcium, magnesium and other polyvalent cations from soil or rocks naturally. Although hardness has no adverse effect on health, there is evidence that hard water plays a role in heart disease (Masood Alam & Anwar Ahmad, 2002). Similar results have been recorded in Kancheepuram by Kesavan *et al.,* (2005). BOD varied from 2 to 6.6 mg/L, which indicates organic pollution in water due to percolation of effluents containing soluble organic compounds (Sastry *et al.,* 2003).

The sample S10 showed high value of chloride (847 mg/L) and crossed WHO desirable limit. Since a lesser amount of chlorides could be added by natural resources, higher concentration is indicative of industrial pollution (Sastry *et al.,* 2003). Concentration of fluoride is significantly low in most of the samples. Fluoride ions have dual significance in

Table 3a. Analytical results of groundwater samples

Parameters	Units	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10
Colour		*CL	CL	CL	CL	CL	CL	CL	CL	CL	CL
Turbidity	NTU	0.52	0.34	0.58	1.4	0.51	2.6	2.4	3.5	0.85	4.5
EC	µS/cm	3284	3885	3542	2438	3433	3664	3335	4210	3026	3165
TDS	mg/L	2015	2340	2135	1462	2106	2248	2045	2574	1857	1942
pH		7.52	7.95	7.83	8.02	7.54	7.88	8.12	8.41	8.55	7.98
Sulphate	mg/L	150	225	248	165	212	340	280	236	345	310
Chloride	mg/L	323	265	310	255	280	346	470	360	385	847
Nitrate	mg/L	40	32	20	34	28	16	25	52	38	52
TH	mg/L	340	424	466	475	336	378	383	545	430	459
DO	mg/L	5.2	4.8	6.3	4.2	3.5	5.1	4.6	5.5	4.1	3.9
BOD	mg/L	3.3	3.8	4.5	3.2	5	4.4	6.4	2.1	3.8	3
F.Coli.	MPN/ 100ml	5	3	6	10	4	13	5	7	2	10
Ca	mg/L	85	96	68	102	80	65	86	90	95	110
Mg	mg/L	32	45	74	60	34	53	42	80	50	46
Na	mg/L	215	229	185	290	254	240	128	280	185	190
SAR	meq/L	5.04	4.83	3.69	5.63	5.99	5.35	2.83	5.17	3.82	3.84
F	mg/L	0.95	1.03	0.86	0.5	0.1	0.24	1.57	0.61	0.85	1.64
Fe	mg/L	0.65	0.25	0.13	0.22	0.56	0.3	0.32	0.7	0.4	0.65
Cd	mg/L	0.005	0.01	0.01	#0	0.008	0.005	0.02	0	0	0.06
Pb	mg/L	0.025	0.013	0.022	0	0	0.01	0	0	0	0.281
Hg	mg/L	0.02	0	0.01	0.015	0.035	0	0	0.03	0	0.02
Zn	mg/L	0.08	0.02	0.3	0.1	0.08	0.4	0.12	0.2	0.65	0.023
As	mg/L	0	0	0	0.025	0.042	0	0	0.035	0.027	0.12
Cu	mg/L	0.07	0.03	0.16	0.22	0.45	0.27	0.08	0.01	0	0.54
Cr	mg/L	0.28	0.31	0.56	0.47	0.34	0.9	0.25	0.28	0.65	0.34
B	mg/L	0	0.02	0.3	0.05	0	0	0.32	0.04	0.02	0.97
Mn	mg/L	0.05	0	0	0.03	0.06	0	0.05	0.12	0.04	0.14

** CL - Colourless; #0 - concentration of the element is below the detectable limit*

water supplies. Excess concentration of fluoride causes dental fluorosis while a concentration less than 1 mg/L results in dental caries (Neetu Saxena & Harinder Kaur, 2003). The values of total dissolved solids varied from 1138 to 2574 mg/L. TDS indicates the salinity of water. Nitrate content in all the samples except S8, S10, & S13 were found to be less than the threshold value of 45 mg/L and hence poses no health problem to the consumers. It is observed that all the groundwater samples have consistently higher Feacal coliform counts. Drinking water should be free from bacterial contamination. The presence of coliform bacteria may be due to improper sewage and waste disposal systems. As these samples have bacterial contamination, the groundwater in the present study area has to be disinfected and purified before

Table 3b. Analytical results of groundwater samples

Parameters	Units	S11	S12	S13	S14	S15	S16	S17	S18	S19	S20
Colour		CL	CL	CL	CL	CL	CL	CL	CL	CL	CL
Turbidity	NTU	2.3	4.8	3.7	0.96	1.8	2.4	5.2	1.3	2.2	1.6
EC	µS/cm	3718	4025	3237	3165	3474	1757	3880	3054	2693	3749
TDS	mg/L	2281	2467	1986	1942	2115	1138	2338	1840	1622	2255
pH		7.48	8.25	7.68	7.81	8.15	7.51	7.75	7.46	7.65	7.82
Sulphate	mg/L	64	536	198	175	210	185	320	182	165	228
Chloride	mg/L	415	358	243	365	420	223	255	216	260	314
Nitrate	mg/L	25	38	58	22	41	22	34	30	31	37
TH	mg/L	225	382	760	555	423	411	374	365	485	396
DO	mg/L	3.8	5.2	5.8	4.9	5.1	7	4.7	3.8	5.3	4.7
BOD	mg/L	2.7	4.3	6.6	5.2	4.6	2	3.4	4.5	2.5	3.7
F.Coli.	MPN/ 100ml	4	6	11	3	5	2	2	5	3	6
Ca	mg/L	73	89	104	78	70	107	105	84	95	72
Mg	mg/L	35	44	88	90	62	36	28	47	61	54
Na	mg/L	155	140	170	210	230	186	125	162	212	190
SAR	meq/L	3.73	3.03	2.97	3.84	4.82	3.97	2.80	3.51	4.17	4.12
F	mg/L	0.95	1.09	0.55	0.53	0.61	0.45	0.13	0.31	0.26	0.38
Fe	mg/L	0.42	0.28	2.3	0.51	0.44	0.26	0.3	0.38	0.4	0.29
Cd	mg/L	0.004	0.007	0.01	0.008	0.004	0	0	0.006	0.005	0
Pb	mg/L	0.018	0.025	0.05	0.033	0.028	0	0.03	0	0	0
Hg	mg/L	0.01	0.021	0	0.047	0.025	0	0	0.022	0.03	0.014
Zn	mg/L	0.3	0.18	0.32	0.4	0.025	0.03	0.041	0.2	0.14	0.32
As	mg/L	0.043	0	0	0.05	0.03	0.032	0.015	0.021	0.011	0.052
Cu	mg/L	0.6	0.07	0	0	0.05	0.012	0.024	0	0.02	0.04
Cr	mg/L	0	0.62	0.02	0	0	0.03	0.06	0.04	0	0.15
B	mg/L	0.11	0.25	0	0	0.15	0.23	0	0.038	0.15	0.05
Mn	mg/L	0	0.03	0	0	0	0.05	0.1	0.2	0	0.04

consumption to avoid possible water borne diseases (Gowrisankar *et al.,* 1998).

The user specific water quality indices of the groundwater samples ranged between 85 and 30 for drinking purpose (Table 6). Among the twenty samples, seven were of good quality; twelve were of fair quality and only the sample S10 was of poor quality for drinking purpose. Since sixty percent of the samples were found to have fair quality, the overall quality is fair for the same purpose.

Table 4. Tolerance and excess limits of drinking water quality parameters

Parameter	Tolerance limit (x_0)	Excessive limit (x_e)
Colour (Pt-Scale)	5	25
Turbidity (NTU)	5	25
pH	7.5	6.5 if pH < 7.5 8.5 if pH > 7.5
DO @ 30 °C	10	3
Chloride (mg/L)	250	1000
Nitrate (mg/L)	45	100
Sulphate (mg/L)	200	400
TH (mg/L)	200	600
TDS (mg/L)	500	1500
F.Coli. (MPN/100ml)	1	100
BOD_5 (mg/L)	0	30
Iron (mg/L)	0.3	1.0
Zinc (mg/L)	5.0	15.0
Fluoride (mg/L)	1.0	2.0
Copper (mg/L)	0.05	1.5
Arsenic (mg/L)	0.05	0.05
Cadmium (mg/L)	0.05	0.05
Chromium (mg/L)	0.05	0.05
Mercury (mg/L)	0.001	0.001
Lead (mg/L)	0.10	0.10

Disinfection of community wells, proper sewage drainage systems, periodical quality monitoring of drinking water sources, simple and economical water treatments like filtration, boiling, reverse osmosis etc. would prove beneficial to avoid water borne diseases in the study area. The use of membrane filtration technology to treat coloured wastewater from the textile dyeing operations is a viable technique that significantly reduces the volume of wastewater and provides possibilities for the reuse of dyestuffs, chemicals and water. However the capital cost of the membrane filtration equipment may be high. Ultra filtration is an economical method used to recover the expensive indigo dyes for reuse and at the same time reduce the pollution burden (Imada & Hashizume, 1993).

Irrigation purpose

The various analytical results given in Tables 3a-3b show that, the values of electrical conductivity of the groundwater samples ranged between 1757 µS/cm and 4210 µS/cm. All the samples except S4, S16 & S19, have EC values beyond the excessive limit of 3000 µS/cm. When EC values exceed 3000 µS/cm, the germination of almost all the crops would be affected and result in much reduced yield (Lokhande *et al.,* 1996). Nitrate content was found to exceed the desirable limit of 25 mg/L in 80% of the samples. The concentration of TDS was also found to be higher in all the samples. Presence of high TDS in groundwater makes it less suitable for irrigation (Kannan & Thavamani, 1993). Excess TDS (salinity) within the plant root zone has a deleterious effect on plant growth primarily because; it increases the energy that must be expended to acquire water from the soil of the root zone and to make biochemical adjustments necessary to survive under stress. This energy is diverted from the processes leading to growth and yield (Solaimalai & Saravanakumar, 2004). Irrigation with poor quality groundwaters may cause salinity, specific ion toxicity or infiltration problems in soils which may adversely affect crop production. Use of poor quality water with high pH and EC has a negative influence on germination, root growth, absorption of water and nutrients (Solaimalai & Saravanakumar, 2004).

Table 5. Tolerance and excess limits of irrigation water quality parameters

Parameter	Tolerance limit (x_0)	Excessive limit (x_e)
EC @ 25 °C (µ mhos/cm)	700	3000
SAR (meq /L)	10	26
pH	7.5	4.5 if < 7.5 9.6 if > 7.5
Nitrate (mg/L)	25	140
Boron (mg/L)	0.5	2.0
Chloride (mg/L)	250	1000
Sulphate (mg/L)	200	500
TDS (mg/L)	700	2000
Chromium (mg/L)	1.0	5.0
Lead (mg/L)	5.0	15.0
Copper (mg/L)	0.2	1.0
Arsenic (mg/L)	0.05	1.0
Manganese (mg/L)	0.05	2.0
Zinc (mg/L)	5.0	15.0

Table 6. User specific water quality index classification of groundwater samples

Groundwater Sample	Drinking purpose		Irrigation purpose	
	USWQI	Quality	USWQI	Quality
S1	67.93	Fair	80.62	Good
S2	71.70	Good	77.91	Good
S3	63.89	Fair	77.47	Good
S4	66.34		79.63	Good
S5	69.10		77.54	Good
S6	64.58	Fair	71.50	Good
S7	60.41	Fair	71.61	Good
S8	57.63	Fair	69.15	Fair
S9	64.49	Fair	67.70	Fair
S10	30.10	Poor	50.36	Poor
S11	72.56	Good	75.55	Good
S12	59.92	Fair	67.99	Fair
S13	70.72	Good	79.15	Good
S14	68.57	Fair	79.67	Good
S15	66.95	Fair	72.91	Good
S16	85.45	Good	88.68	Good
S17	71.42	Good	74.77	Good
S18	75.87	Good	82.76	Good
S19	74.48	Good	82.98	Good
S20	61.48	Fair	76.11	Good

The pH values varied between 7.46 and 8.55 which are well within the limits prescribed by the Food and Agriculture Organisation (FAO) and Indian Council of Agriculture and Research (ICAR) (FAO, 1985; Minhas *et al.,* 1992). Sulphate concentration in 60 % of samples marginally exceed the permissible limit of 200 mg/L. Water having sulphate level less than 200 mg/L is excellent for irrigation (Rajkumar *et al.,* 2003). Therefore as far as sulphate is concerned, the irrigation water quality in the present study area is unaffected. The Sodium Absorption Ratio (SAR) values of all the samples were found to be less than 10, which shows low sodium hazard making it suitable for irrigation in almost all types of soils (Rajkumar *et al.,* 2003). The heavy metals like Cr, B, Pb, Zn, As, Cu and Mn were found to be well within their respective tolerance limits in almost all the samples and hence pose no threat for irrigation.

An examination of Table 6 shows that the user specific water quality indices of the groundwater samples ranged between 89 and 50 for irrigation purpose. It showed that all the groundwater samples in the study area are good for irrigation except the samples S8, S9 & S12 which were of fair quality and S10 which was of poor quality. It is also found that none of the sample was found to be excellent for irrigation.

Conclusion

From the above discussions, it can be said that the quality of groundwater in the study area is fair or satisfactory for drinking purposes and good for irrigation purposes. Presence of Hg, arsenic, lead and chromium in groundwater pose significant threat to the consumers. This may be the possible impact of dyeing industries. The textile industries are to satisfy the ever growing demands in terms of quality, variety, fastness and other technical requirements, but the use of dye stuffs has become increasingly a subject of environmental concern. The crops cultivated in the dyeing industry and textile waste water locations are very much interfered due to the slow change in soil salinity and sodicity. Establishment and yield productivity is greatly interfered and none of the food crops grow in these affected locations. Besides the crop yield, the hygienic condition was also considerably affected. The quality of groundwater is hampered by way of increased sodium, TDS, EC etc. Therefore, it is essential to evolve regulations designated to improve the health and safety of the human and natural environment in the study area.

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