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EVALUATION OF GROUND WATER QUALITY IN AND AROUND ARIYALUR DISTRICT, TAMIL NADU - A STATISTICAL APPROACH

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ABSTRACT

The present study has been made to evaluate the quality of underground water in Ariyalur district of Tamil Nadu. A total of 7 representative open well water samples were collected from different localities of Ariyalur district. The water quality parameters selected for physico-chemical analysis are pH, EC, TDS, TA, Hardness, Ca, Mg, Fe, NO_3, NO_2, F,SO_4, PO_4 and DO. The data was statistically analysed and correlation has been observed.

INTRODUCTION

Water pollution is an important aspect of environmental pollution. With fast industrialisation and urbanization, the water consumption is increasing tremendously. Water pollution involves the release into lakes, streams, rivers and oceans, substances that become dissolved or suspended in the water or get deposited upon the bottom and accumulate to the extent of damaging aquatic ecosystems (Malik *et al.* 2000). Rapid growth of industrialisation has affected not only surface water but also ground water (Biswal *et al.* 2001; Reddy and Subba Rao, 2001). Water pollution is a large set of adverse effects upon water bodies caused by human activities. Garg *et al.* (1990); Kaur *et al.* (1992); Rajmohan *et al.* (1997) and Singh *et al.* (2000) reported seasonal as well as yearly changes in the ground water quality. In addition to these natural phenomena such as volcanoes, algal blooms, storms and earthquakes also cause major changes in water quality. It has been suggested that it is the leading world wide cause of death and diseases (Murugesan *et al.* 2004). Ground water pollution causes irreparable damage to soil, plants, humans and animals and spread epidemics and chronic diseases (Srinivas *et al.* 2002).

The water contains dissolved and suspended constituents in varying proportions and often has different chemical and physical properties. (Paka and Narsing Rao, 1997). In rural areas people often use unprotected water drawn from rivers, lakes and wells for drinking and domestic purposes (Indirabai and George, 2002). Discharges of wastes from urban areas and industries and agricultural wastes and farm wastes etc., also precipitate in the ground water pollution, hence waste water should be stopped or treated before discharge into bodies of water (Sangeetha *et al.* 2000).

The strong correlation always exists among the water quality parameters, a systematic calculation and interpretation of correlation coefficient gives

an idea of rapid water quality monitoring methods (Aravinda *et al.* 1998)

MATERIAL AND METHODS

For the above study 7 ground water sampling of open wells were monitored during 2008 period. The parameters were analyzed as per the standard methods described in APHA (1992) and Trivedy & Goel (1986).

These sampling stations were located randomly in different areas of Ariyalur district covering the south directions of the town. The number of sampling stations (Open wells) and their description are as under :

1. Jayankondam (OW1)
2. Pudu anganur (OW2)
3. Melure (OW3)
4. Manakkarai (OW4)
5. Sengunthapuram (OW5)
6. Udayarpalayam (OW6)
7. Suriyamanal (OW7)

RESULTS AND DISCUSSIONS

The physico-chemical parameters of ground water (open well) were tabulated along with the standard value in Table 1.

Temperature, pH and EC

Temperature is one of the important factors in aquatic environment since it regulates the various physico-chemical as well as biological activities (Kumar *et al*. 1996). Temperature affects the various parameters such as alkalinity, salinity, electrical conductivity and DO. It also affects the taste of water. Waters of sampling sites registered a range of 25^0C to 30^0C. The hydrogen ion concentration is an important quality parameter of natural waters. The pH was within the desirable limit of Standards. All ground water samples showed higher values of specific conductivity in summer. During rainy season, dilution of water resulted in lowering the specific conductivity values. Landfill leachate, domestic sewage and urban factors affect the ground water systems (Olaniya and Saxena 1977; Jeevan Rao and Shantaram, 1995; Dubey, 1999; Jain and Sharma, 2000)

The statistical evaluation from physico-chemical data of open well water from the around Ariyalur area are being summarised in Table 2. The mean values of pH is 7.03 out of 7 samples and mean deviation and standard deviation were found to be 0.2286 and 0.3844. Electrical conductivity values were found to be 660 µmho/cm and the temperature value was 27.4^0C which were less than permissible limit for drinking water.

Turbidity

Turbidity is caused due to the presence of suspended matters, clay silt, colloidal organic particles, plankton and other microscopic organisms. It is an expression of certain light scattering and light absorbing properties of water. It has significant effect and microbiological quality of drinking water and irrigation water. WHO recommended 5 NTU and Indian Standards up to 10 NTU for drinking water (ISI, 1983).

Total dissolved solids

Contain different types of nutrients and it determines the suitability of drinking water. Increasing value of TDS indicates pollution by extraneous resources (Aboo and Shastry, 1968). In the present study TDS was found in minimum value 90 mg/L while maximum value 1698 mg/L.

Alkalinity

The alkalinity values of all the ground water samples were slightly because the water reaches the aquifers through soil, dissolving carbonates and bicarbonates in the process. Leachate infiltration from waste disposal systems may also cause of higher values of various parameters. Alkalinity content of all the ground water samples of present study was under the permissible limit.

Hardness, Calcium and Mg

The variation of mean concentration of Calcium (Ca^{+2}), Magnesium (Mg^{+2}) and Hardness of the water samples along with the mean deviations and coefficient of mean deviation. Respective values of concentration of these ions above three parameters were found as 42.31mg/L, 18.06 mg/L Ca Hardness and Mg hardness together represent the total hardness of the water samples. Water with hardness greater than 200 mg/L may cause scale formation in the distribution system and results in excessive soap consumption and prior scum formation (Singanan *et al*. 1996). Large amount Ca and Mg affect the acidity of water and can alter the ionic balance of water.

High Ca content in drinking water might increase the change of having gall bladder stone. Both Ca and Mg content were found positively correlated.

Table 1. Physico-chemical parameters of ground water (open well) water collected from Ariyalur district

Parameters	OW1	OW2	OW3	OW4	OW5	OW6	OW7	CPHEEO(A)	CPHEEO (B)
Appearance	Turbid	Clear	Clear	Clear	Clear	Clear	Clear	-	-
Colour	---	---	---	---	---	---	---	5	25
Temperature	290C	29.60C	250C	260C	270C	300C	250C	-	-
Odour	None	None	None	None	None	None	None	Unobjectionable	
Turbidity	9	1	1	1	1	1	1	2.5	10
TDS	210	1685	300	630	90	240	300	500	2000
EC	310	2490	150	730	330	360	250	-	-
pH	7.40	7.5	6.7	6.8	6.6	7.5	6.7	7.0-8.5	6.5-9.2
Alkalinity	100	640	471.6	141.5	283	120	147.2	200	600
Total Hardness	108	300	146	156	92	140	140	200	600
Calcium	27	72	44.1	53.70	22.44	32	44.9	75	200
Magnesium	10	29	23.73	14.50	23.73	14	18.5	30	150
Iron	2.7	0	0	0	0	0	0	0.1	1
Nitrate	2	44	36	5	3	5	5	45	100
Nitrite	0	0.11	0	0	0	0	0	-	*
Chloride	40	250	12.8	100.8	66.7	35	39.8	250	1000
Fluoride	0.2	0.6	0.3	0.008	0.4	0.2	0	1	1.5
Sulphate	2	1.62	1.72	2.63	7.82	5	3.41	200	400
Phosphate	0.042	0.28	0.061	0.034	0.044	0.058	0.083	-	**
Sodium	16	340	63	12	24	10	1	-	-
Potassium	6	82	5	1	7	4	1	-	-
DO	4.69	5.84	5.97	7.08	6.12	6.37	5.97	-	***

Note : = No standards; * = Standard for nitrite is 3.0 mg/L (WHO 1994); ** = Standard for Phosphate is 0.05 mg/L(USEPA);*** = Std for DO is 6 mg/L (BIS) Units: Except Colour (Hazen Unit), pH (Units); Turbidity (NTU, EC (mhos/cm). A – Desirable limit(Standard value); B- Permissible limit in the absence of alternative source (standard value); NT – Not tested. The values of figures in the tables are mg/L.

Table 2. Statistical evaluation for the groundwater (open well)

Parameters	Mean	Mean Deviation	Coefficient of MD	Standard Deviation	Co efficient of SD
pH	7.03	0.2286	0.0336	0.3844	5.4680
EC	660	572.86	0.7847	786.14	119.11
Temp	27.4^0C	1.9429	0.0747	1.9926	7.2723
TDS	493.57	437.86	0.6950	509.99	103.33
TA	271.9	148.386	1.0487	192.98	70.97
TH	154.57	42.571	0.2729	62.95	40.73
Ca	42.31	16.623	0.3096	15.84	37.44
Mg	19.06	5.99	0.4131	6.225	32.66
Cl	77.87	65.56	0.6504	74.866	176.95
SO4	3.457	1.556	0.5916	2.0702	59.884
PO4	0.086	0.052	1.529	0.0806	93.721
Na	22.86	14.57	1.2142	113.15	497.97
DO	6.01	1.0743	0.1517	0.6613	11.003

Iron (Fe)

The presence of iron in water may cause decolouri-sation of clothes washed in such waters. As per IS standards the iron concentration values ranges between 0.1 to 1 mg/L (WQS). The collected open well sample values have with in the limits except Jayangondam (OW1) is essential for human health since it is the most essential component of many heme and nonheme enzymes of human body. The high amount of Fe has adverse effect on humans or animals. It is proved that the metal iron precipitates on the mucous secretion of the gills; subsequently respiration is arrested in fish. The high content may

Table 3. Correlation coefficient (r) for different physico – chemical parameters (open well)

Parameters	Correlation Coefficient (r)
pH and TDS	0.7117
pH and Alkalinity	0.8166
pH and Hardness	0.9343
pH and Calcium	0.9387
pH and Magnesium	0.9458
pH and DO	0.9902
Alkalinity and TDS	0.8684
Alkalinity and Hardness	0.9168
Alkalinity and Calcium	0.7070
Alkalinity and Mg	0.9382

be due to corrosion of geological factors.

Chlorides

Chloride level of water indicates the pollution degradation of water. It is found in the form of Na, K and Ca salts. Higher concentration of chloride is hazardous to human consumption and creates health problems. Desirable recommended limit for chloride is 250 mg/L by ISI (1983). In the present study it varies from 12.8 mg/L at OW3. The findings are similar with those of Kataria (1995) and Mitra (1982).

Nitrates

Concentration in open well water depends upon geochemical conditions such as the extent to which nitrogenous fertilizers are used in agriculture. In the present study nitrate ranged from 2 - 44 mg/L.

Sulphates and Phosphates

Sulphate is a naturally occurring anion in all kinds of natural waters. Rain water has quite high concentration of sulphates particularly in the areas with high atmospheric pollution. Discharge of industrial wastes and domestic sewage in waters tend to increase its concentration. The mean and standard deviation value of sulphate was 3.457 and 2.0702. Sulphate is an important constituent of hardness with calcium and magnesium. Sulphate produces objectionable taste at 300 -400 mg/L and a bitter taste at 500 mg/L. All values recorded in this study were below permissible limit prescribed by WHO, BIS and ICMR.

Normally phosphorus exists in inorganic and organic forms. In the present study the phosphorus present in inorganic form was estimated and within the standard values given for drinking water.

Dissolved Oxygen

Dissolved Oxygen reflects the water quality. Depletion of DO in water is due to high temperature and increased microbial activities. The observed DO values of all water samples ranged from 4.69 - 7.08 mg/L. These values are within maximum permissible limit as per WHO and ICMR.

Analysis of Statistical Method

The numerical values of correlation coefficient (r) for 8 parameters(open well) are tabulated inTable 3. The high positively correlated values were found between pH and Hardness (0.9343), pH and Calcium (0.9358), pH and Magnesium (0.9458), pH and DO (0.9902), Alkalinity and Hardness (0.9168) and Alkalinity and Magnesium (0.9382) respectively. Some correlations were observed between Alkalinity and calcium (0.7070) and pH and Alkalinity (0.8166) respectively.

CONCLUSION

In present study, the mean, mean deviation, standard deviation and correlation of the physico-chemical parameters of ground water (open well) reveals that all the parameters are more or less correlated with others. In Jayankondam area, the ground water sources are not suitable for drinking purpose without a proper treatment. The Iron content is very high with out the standard value.

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