ISSN: 0974-2115
www.jchps.com Journal of Chemical and Pharmaceutical Sciences

Climatic influences on the quality of well water in Muthalakurichy panchayat, Kalkulum taluk, Kanyakumari district, Tamilnadu

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ABSTRACT

Quality of water is an important criterion for evaluating the suitability of water for drinking and irrigation. Water quality of open wells of Muthalakurichy Panchayat in Kanyakumari District of Tamilnadu state was studied for a period of three seasons from March 2011 to December 2011with an objective to assess the water quality status in the study area and its potability. The water quality parameters considered in the present study were:colour, odour, turbidity, temperature, pH, electrical conductivity, total dissolved solids, alkalinity, total hardness, chloride, fluoride, calcium, magnesium, iron, sodium, potassium, nitrate, nitrite and ammonia. Over all analysis explains that all the parameters showed higher values at monsoon season compared to other seasons. Some of the parameters were found to be higher than the prescribed limits while other parameters were lower than the limits. The water quality of these sites will be degrading much in future. The major factors of the water quality deterioration appeared to be the lack of proper sanitation and protection of drinking water bodies**.**

KEY WORDS: Groundwater, Physico-chemical parameters, Seasonal variation, Drinking Water Standards.

1. INTRODUCTION

Water, after air, is the most essential commodity to the survival of life. Human life depends to a large extent, on water. It is used for an array of activities; chief among these being for drinking, food preparation, as well as for sanitation purposes. Drinking water is essential to health, a community lacking a good quality of this commodity will be saddled with a lot of health problems which could otherwise be avoided (Miller, 1997).

Fresh water is found as underground water in large reservoirs surrounded by rock called aquifers. This ground water has long been considered as one of the purest forms of water available in nature to meet the overall demand of rural and semi urban people. Majority of people in India depends upon fresh water supplies from dug wells, ponds, borewells, springs and the like. Apart from domestic use, these sources provide the water essential for irrigation and small scale industries. The availability of ground water depends upon the rate at which it is recycled by hydrological cycle than on the amount that is available for use at any moment in time. In most parts of the country, finite water resources are being exploited and degraded at an accelerating rate by anthropogenic activities.

The growing demands for adequate quality water resources create an urgent need to link research with improved water management, better monitoring, assessment, and forecasting of water resources and sanitation issues with much emphasis on the roles of stakeholders (Yamaguchi &Wesselink, 2000). Sources of water available to mankind are: atmospheric water (precipitate), surface water (including rivers, streams, ponds, etc), and ground water. The potability of water from any of these sources is determined by the water quality (Miller, 1997).With 97% of all freshwater found on the earth being stored underground, accessing ground water in the quest for potable water is a laudable venture. Groundwater is accessed by way of sinking wells and boreholes to reach the water table (Overseas Development Institute, 2009).

Potable water should be free from compounds that can cause change in the 'normal' colour, taste (e.g. high salinity) and odour. Shallow wells are normally located in valleys where the ground water table is relatively high (1 – 4 m below ground level) and infiltration of rain and river water plays a main part in the groundwater recharge. Boreholes however, draw water from deep (20 – 80 m or more) aquifers (Pritchard, 2008; Sleema and Ramesh Babu, 2009) investigated the water quality of dug well, tube well and municipal supply of 19 wards of Vadekkekara Panchayath in Ernakulam District of Kerala ,with an objective to assess the water quality status in the study area and its potability. Remia and Logaswamy (2010) analysed the physical and chemical characteristics of the drinking water in the selected areas of Kavundampalayam Panchayat in Coimbatore District, Tamilnadu.

2. MATERIALS AND METHODS

2.1. Study Area: In Kalkulam Taluk Thuckalay block is 1.6 Km^2 area starts with Muthalakurichy Panchayat. The Muthalakurichy village panchayat started in 1969, December 19th RD×LJ NRAC 192653/69 (19.12.1969). The Muthalakurichy Panchayat contains ten remote villages. The landscape of Muthalakurichy is fertile with six ponds, twelve panchayat wells, private wells, one school, three library and a river. People of this area mainly depend on municipal supply, dug well, tube well and fresh water ponds for their water needs.

2.2. Samplings: Water samples were collected in three different seasons (pre monsoon PRM, monsoon MON, Postmonsoon POM) from March 2011 –Dec 2011. A total of 14 well water samples were analysed during the study period. Sampling was done in the early morning and samples collected in pre cleaned polyethylene bottles were brought to the laboratory for analyzing various physicochemical water quality parameters. Water quality parameters vizcolour, odour, turbidity, temperature, pH, electrical conductivity, total dissolved solids (TDS), acidity, alkalinity, total hardness, chloride, fluoride, calcium, magnesium, iron, sodium, potassium, nitrate, nitrite and ammonia were analysed as per the standard methods of APHA (2005).

3. RESULTS AND DISCUSSION

3.1. Physical characteristics: The Physico-chemical parameters are considered as the most important principles in the identification of the nature, quality and type of the water. The results of the physical characteristics of water collected from the open wells in all the seasons are given in table 1.

3.1.1. Colour and Odour: All the water samples collected from the open wells in the study area showed unobjectionable colour during all the three seasons. In monsoon season W7 showed brownish colour. The odour of water is mainly due to dissolved impurities, often organic in nature. The W3 well water sample was algal odour and all others are none.

3.1.2. Temperature: The temperature is basically important for its effects on the chemistry, and biological reactions in the organisms in water. The mean temperature of ground water samples collected from the sampling stations in the present study recorded 26.55^0c (MON), 27.47^0c (POM) 28.36c (PRM) seasons respectively.

3.1.3. P^H: The mean value for pH of well water in the study area recorded 6.92,6.60,and 5.54 during MON, POM, and PRM seasons respectively. This result indicates that the samples are slightly acidic to neutral values in nature. Water sample from W14 showed alkaline P^H value of 9.16 in monsoon season. According to WHO (1984) and CPHEEO standards, the permissible limits of P^H for drinking water is 6.5 to 8.5. pH has no direct effect on health, however, a lower value below 4 will produce sour taste and higher value above 8.5, an alkaline taste.

3.1.4. Electrical Conductivity: The electrical conductivity of water is due to the presence of various dissolved salts. The conductivity of ground water samples collected from the study area ranged between 72 mics/cm to 1417 mics/cm during postmonsoon season with an average value of 411.79mics/cm. During monsoon season the value ranged between 66micsμS/cm to 1556μS/cm, and the average value obtained is 442μS/cm,in monsoon season the average mean value 454.93mics/cm in PRM. Most of the water samples showed decrease in conductivity values during monsoon, and it may due to the dilution of samples by precipitation.

According to Wilcox (1995), based on electrical conductivity values, the water quality for irrigation can be classified as excellent (<250 μS/cm); permissible (750-2,250 μS/cm.); doubtful (2,250-5000 μS/cm); unsuitable (>5000 μS/cm). Based on this, it was found that the majority of the well water samples collected from different stations around Muthalakurichy Panchayat comes under good category and is suitable for irrigation.

3.1.5. Turbidity: The turbidity is caused by a wide variety of suspended materials which range in size from colloidal to coarse dispersion, depending upon the degree of turbulence (Sawyer, 1994). According to CPHEEO and WHO (1993) the permissible limit of turbidity value of drinking water is 10 NTU. In the present study all water samples showed turbidity values within the permissible limit. Expect only one well water w7 exceeds the permissible limit in monsoon season.

3.2. Chemical characteristics: The result of the analysis of chemical characteristics of ground water samples during the three seasons are given in Table 2.

3.2.1. Total Alkalinity: Alkalinity of water is due to the presence of carbonates, bicarbonates and hydroxide lions.The mean value for different seasons are 49.71mg/L , 42.14 mg/L and 39.71 mg/L. The alkalinity value of all the water samples lies within the desirable limit of water standards (CPHEEO).W4 exceeds the permissible limit in MON.

3.2.2. Hardness: The principal hardness causing cations are the divalent calcium, magnesium, strontium, ferrous and manganous ions. In the present study the average value is 104.14mg/L, 91.43mg/L and 86.85mg/L during all the three seasons. As per CPHEEO the total hardness of all water samples studied lies within the permissible limit. Water is commonly classified in terms of the degree of hardness by Sawyer (1994) as soft (0-75 mg/L), moderately hard (75-150 mg/L); hard (150-300 mg/L) and very hard (>300 mg/L). Based on this, the results obtained shows that water samples collected during monsoon season from the sampling stations W2 and W4 are hard; W9 was very hard,W5,W8,W13&W14 are moderately hard and the remaining samples lies as soft category. In post monsoon season, 42.85% water samples are in moderately hard category and 14.28% are in hard category, and the remaining water samples are as soft category.

3.2.3. Calcium and Magnesium: According to CPHEEO the desirable limit of calcium content in drinking water is 75mg/L. The values of calcium content in well water samples are within the desirable limit except in two well water sample i.e., W2&W9 and it recorded 90 mg/L, 80 mg/L during MON season. The content of Mg is

comparatively less than that of Ca. Magnesium content of all water samples during the three seasons are lie within the desirable limit for drinking standard prescribed by CPHEEO.

3.2.4. Total Dissolved Solids: All water samples in the present study recorded TDS values within the desirable limit prescribed by CPHEEO except the well water in W13, W9 during POM season, W2, W4, W9 in MON&PRM season. The ground water samples can be classified based on the concentration of TDS as fresh water (0-1000 mg/L); brackish water (1000-10,000 mg/L) an brine water (>1,00,000 mg/L). Based on this classification 95% of the water samples in the study area come under fresh water category in all seasons.

3.2.5. Chloride and Fluoride: In natural waters, chloride content results from the leaching of chloride containing rocks and soils with which the water comes in contact. The chloride values of all water samples are within the permissible limit. In the well water analysed the fluoride concentration was in the range 0.2 mg/L to 0.6 mg/L (POM), 0.0 mg/L to 1.0 mg/L(MON),0.0 mg/L to 0.6 mg/L (PRM). All the water quality in the wells of Muthalakurichy .panchayat also reported the fluoride concentration below 1 mg/L.

3.2.6. Nitrate, Nitrite and Ammonia: The nitrate content in the well water samples analysed ranged from 1 mg/L to 11 mg/L (MON), 1mg/L to 11 mg/L (POM) 1 mg/L to 7 mg/L (PRM). All the water samples showed the nitrate value exceeds the desirable limit of drinking water standards CPHEEO.

The nitrite content in the well water samples analysed in the present study mean value from 0.01 mg/L (POM), 0.13 mg/L (MON),0.1 mg/L (PRM). Well water showed nitrate value within the permissible limit during all the three seasons. Ammonia content in ground water samples showed ammonia content below detectable limit during all seasons. In most of well waters studied the ammonia content are within the prescribed limits for drinking water standards (WHO, 1993).

3.2.7. Phosphate and Sulphate: Phosphate level higher than 0.1 mg/L indicates pollution. Of the total samples 50% in monsoon season exceeds the permissible limit. The highest concentration of phosphate was obtained in the water samples W5during monsoon season respectively. Relatively high concentration of phosphate value is observed in well nearest to the area highly polluted and it may due to the leaching of solid wastes from the dumping area. The mean values of sulphate obtained from the analysis were 13.71 mg/L (MON), 11.71 mg/L (PRM) and 10.78 mg/L (POM). In all the well water studies the sulphate values were within the desirable limit as prescribed by the water quality standards CPHEEO.

3.2.8. Sodium and Potassium: Ground water in well drained areas with good amounts of rainfall usually has less than 10-15 ppm of sodium. The concentration of sodium in ground water samples analysed in the present study ranged from 7 mg/L to 184 mg/L (POM), 7mg/L to 196 mg/L (MON) and 5mg/L to 170 mg/L (PRM). The present study revealed that the sodium content in the water samples collected from all stations are within the permissible limit for drinking water standards by CPHEEO.

The common sources of potassium are the silicate minerals such as orthoclase, microcline and biotite (Karanth, 1993). Potassium compounds are predominantly soluble and rarely precipated. In the present study the potassium content in the wells ranges from 4.1mg/L to 36.9 mg/L. The highest value of potassium recorded is 48 mg/L (POM), 32 mg/L (MON) 30mg/L (PRM) in W9 site. In all seasons, most of the water samples recorded potassium content above the permissible limit for drinking water standards. The major source of potassium natural fresh water is weathering of rocks of the quantities increase in the polluted waters due to the disposal of waste waters. It has a similar chemistry like sodium and remains mostly in solution without undergoing any precipitation. As such, it is not very much significant from the health point of view but in large quantities may be laxative (Trivedi, 1986).

3.2.9. Heavy metals: Heavy metals are usually present in trace amounts in natural waters but many of them are toxic even at very low concentrations. According to CPHEEO the desirable limit of iron in drinking water is 0.1 mg/L. In MO Nseason the water samples from W7 1.53 mg/L recorded values which are above the permissible limits. Studies conducted by Umesh Rao (1968) on the geology of Kazhakuttomarea, Thiruvananthapuram showed the occurrence of hematite in the top most sand stone bed and this point out that the condition of leaching of iron bearing minerals.

Table.1.Physical characteristics of well water in monsoon, postmonsoon and premonsoon season

Parameters	**Sampling Stations**													
	W_1	W_2	W_3	W_4	W_5	W_6	W_7	W_8	W_9	W_{10}	W_{11}	W_{12}	W_{13}	W_{14}
Appearance														
MON	C&C	C&C	C&C	C&C	C&C	C&C	C&C	C&C	C&C	C&C	C&C	C&C	C&C	C&C
POM	C&C	C&C	C&C	C&C	C&C	C&C	C&C	C&C	C&C	C&C	C&C	C&C	C&C	C&C
PRM	C&C	C&C	C&C	C&C	C&C	C&C	C&C	C&C	C&C	C&C	C&C	C&C	C&C	C&C
Odour														
MON	None	None	None	None	None	None	Algae	Algae	Algae	Algae	Algae	None	None	None
POM	Algae	Algae	Algae	Algae	None	None	None	None	None	None	None	None	None	None

PRM	None	None	None	None	Algae	Algae	Algae	Algae	Algae	None	None	None	None	None
Turbidity NT Units														
MON	1	1	9	3	1	5	15	1	1	1	2	0	0	0
POM	1	2	0	2	2	0	1	1	0	1	2	1	1	1
PRM	2	3	1	4	2	1	24	0	1	1	2	1	1	1
EC mics/cm														
MON	67	931	93	845	262	66	260	484	1556	120	283	139	688	394
POM	72	527	87	745	454	84	154	564	1417	126	373	127	868	467
PRM	93	543	105	767	417	90	169	578	1525	145	392	145	885	515
Temp ^{0}c														
MON	27.5	27.6	27.5	26	27	26.7	27.5	26.5	22.8	27	25.5	26.6	26.5	27
POM	28	29	28.5	27	27.45	26.55	26	28	29	28.5	27	27.45	26.55	25.55
PRM	29	30	29.5	28	27.5	26	29	28	29	28.5	29	28	27.5	28
p^H														
MON	6.84	6.35	6.13	7.14	7.67	7.53	7.22	7.67	4.85	6.01	6.69	6.73	6.95	9.16
POM	6.44	6.24	5.89	7.28	7.27	7.35	6.91	6.99	5.41	5.98	6.59	6.86	6.90	6.32
PRM	5.33	6.27	6.06	5.34	6.07	5.33	5.14	5.04	5.15	5.98	5.59	5.86	5.01	5.32

Table.2.Chemical characteristics of well water in monsoon, postmonsoon and premonsoon season

Parameters	**Sampling Stations**													
	W_1	W_2	W_3	W_4	W_5	W_6	W_7	W_8	W_9	W_{10}	W_{11}	W_{12}	W_{13}	W_{14}
TDS														
MON	45	624	62	566	176	44	174	32	1042	81	189	93	461	264
POM	47	348	57	491	300	55	102	372	935	83	246	84	573	308
PRM	55	654	68	570	182	40	186	44	1050	91	200	96	480	276
Alkalinity														
MON	10	40	16	220	60	10	52	92	12	32	52	40	48	12
POM	8	28	16	136	80	18	20	108	36	16	40	32	40	12
PRM	18	22	104	32	58	8	24	12	138	16	40	32	40	12
Total Hardness														
MON	16	268	26	220	84	14	60	136	310	32	68	40	92	92
POM	16	124	20	124	100	26	44	148	270	32	84	36	152	104
PRM	14	120	16	122	90	22	40	140	260	30	80	34	150	98
Calcium Ca	4	90	6	51	27	6	16	35	80	6	16	10	24	19
MON														
POM	4	29	6	29	21	6	10	37	72	8	24	8	35	29
PRM	2	24	4	20	21	4	8	31	68	6	20	8	30	24
Magnesium Mg														
MON	1	11	2	22	4	0	5	12	26	4	7	4	8	11
POM	1	12	1	12	12	2	5	13	22	3	6	4	15	8
PRM	1	8	1	6	8	1	4	11	18	2	4	3	12	4
Sodium Na	7	67	10	74	17	8	23	36	196	12	34	11	106	11
MON														
POM	8	53	10	97	53	7	16	48	184	13	37	12	106	48
PRM	5	60	4	64	15	4	20	26	170	6	30	9	96	8
Potassium K	1	11	1	7	3	1	6	6	32	1	2	1	6	2
MON														
POM	1	5	1	8	6	1	2	11	48	1	5	1	21	9
PRM	1	7	1	3	2	1	5	5	30	1	1	1	4	2
Iron Fe														
MON	0.12	0.12	0.95	0.35	0.12	0.59	1.53	0	0	0	0.24	0	0	0

POM	0	0.24	0	0.12	0.12	0	0	0	0	0.06	0.24	0.06	0.06	0.06
PRM	0	0	0	0	0.12	0	0.12	0	0.24	0.06	0	0.12	0	0.06
Ammonia NH_3														
MON	0	0	0	0.12	0.04	0.04	0.12	0.08	0.15	0.12	0.04	0.12	0.08	0.12
POM	0.12	0.12	0.08	0.04	0.85	0.12	0.08	0.04	0.08	0.04	0.04	0.04	0.02	0.04
PRM	0.14	0.16	0.12	0.06	1.26	0.24	0.08	0.06	0.15	0.08	0.04	0.06	0.04	0.06
Nitrate NO_2	0.24	0.31	0.03	0.38	0.03	0.01	0.01	0.01	0.12	0.04	0.08	0	0.03	0.04
MON														
POM	0.01	0	0	0.03	0	0.03	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
PRM	0.02	0.02	0.01	0.02	0.08	0.01	0	0	0.03	0.01	0.01	0.01	0.01	0.01
Nitrite NO_3	1	9	1	11	6	1	5	9	11	4	3	3	8	4
MON														
POM	1	10	1	9	9	1	2	7	11	2	3	2	8	2
PRM	1	7	1	5	5	1	2	4	6	1	2	1	6	1
Chloride Cl	16	286	16	94	28	12	52	88	490	16	48	16	20	120
MON														
POM	16	140	16	124	82	16	32	116	480	30	92	20	264	148
PRM	12	28	118	472	88	16	140	16	124	30	92	20	264	148
Fluoride F														
MON	0	0.2	0	0.8	0.4	0	0	0	1	0	0.4	0.4	0.4	0.4
POM	0.2	0.2	0.2	0.6	0.2	0.2	0.2	0.2	0.6	0.2	0.4	0.2	0.4	0.2
PRM	0	0.2	0.2	0.4	0.4	0.2	0.2	0.2	0.6	0.2	0.4	0.2	0.4	0.2
Sulphate SO_4														
MON	1	17	4	23	14	3	11	20	46	3	6	4	26	14
POM	3	11	3	31	9	1	10	14	17	4	11	3	20	14
PRM	1	7	14	19	23	3	11	3	31	4	11	3	20	14
Phosphate PO_4														
MON	0.4	0.8	0.3	0.65	0.9	0.05	0.45	0.15	0.7	0.1	0	0.15	0	0.16
POM	0.05	0.03	0.1	0.05	0	0	0.05	0	0.1	0	0	0.03	0	0
PRM	0	0.03	0	0.2	1.5	0.05	0.03	0.1	0.05	0	0	0.03	0	0

4. CONCLUSION

The present investigation reveals that most of the physico-chemical characteristics of the well waters in the study area are within the permissible standard limits as prescribed by CPHEEO. Seasonal fluctuations show rise in concentrations of all the parameters during MON, followed by POM and PRM. The sodium percentage is calculated for assessing the irrigational suitability of well water and the results indicated that most of the well water in the study area is excellent for irrigation. Iron concentration is higher in one site(W7) and this indicates the leaching of iron bearing minerals.

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