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EVALUATION OF GROUND WATER QUALITY IN PATHANAMTHITTA DISTRICT AND A COMPARISON OF OPEN WELL AND BORE WELL

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ABSTRACT

Ground water is the major source of drinking water in both urban and rural parts of India. Clean water is absolutely essential for healthy living and is a precious gift of nature. Water is being polluted with increased population, agricultural needs and industrial purpose. The polluted water on drinking may cause serious effect in human beings, domestic animals and even in the case of aquatic organisms. The physicochemical parameters of water samples from Pathanamthitta district were assessed. Water samples were collected from open well and bore well. The ground water is analyzed for various physicochemical parameters like colour, odour, taste, turbidity, pH, temperature, total alkalinity, total hardness, calcium, sulphate, nitrate, sodium, potassium, iron, aluminium, conductance, total dissolved solid and chloride after following the methods of American Public Health Association 1995. The results were compared with Bureau of Indian Standard and World Health Organization.

KEYWORDS

Ground water analyses, physicochemical analysis, Open well and Bore well.

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INTRODUCTION

Water is absolutely essential for healthy living and is a precious gift of nature. Ground water is the major source of drinking water in both urban and rural parts of India. Besides, it is an important source of water for the agricultural and the industrial sector[1, 2]. The quality of ground water depends on large number of hydrological, physical, chemical and biological factors. Ground water quality is getting adversely affected because of wide spread pollution of surface water. The polluted

groundwater is the major source of many diseases in human beings and domestic animals[3]. An uncontrolled use of the bore well technology has led to the extraction of ground water at such a high rate that often recharge is not sufficient. The causes of low water availability in many regions are also directly linked to the reducing forest cover and soil degradation[4].

The disorder of teeth and bones is due to the consumption of fluoride-rich water[5]. Insufficiency of calcium causes severe rickets and excess causes concretions in the body such as kidney or bladder stones and irritation in urinary passage[6]. Here, water for drinking purpose is taken from ground water resources without any physical or biochemical treatment. The objective of the current study is to assess the ground water quality of Pathanamthitta district.

MATERIAL AND METHODS

Study Area and Sample unit

Pathanamthitta district is formed on 1 Nov 1982. It is spreaded over an area of about 2,462 square kilometers. The district lies on the latitudes of 9.27º and longitudes 76.78, divided into 5 taluks named as Adoor, Kozhencherry, Mallappally, Ranni and Thiruvalla. Pathanamthitta town is the place where district headquarters is located. Kottayam, Iddukki, Kollam are the districts which are bordering Pathanamthitta.

Pathanamthitta is famous for the pilgrim centers such as Sabarimala Sree Dharmasastha temple: this temple is famous pilgrim centre in South India which is located on the mountain ranges of the Western Ghats, Aramula: which is located on the banks of the Holy River Pamba, Mannadi. It is the folk Art Centre where Veluthampi Dalawa spent his last days. Pathanamthitta is also known as headquarters of pilgrimage tourism[7].

The ground water samples (open well and bore well) were collected randomly from Thiruvalla town, Pathanamthitta town and Pandalam village of Pathanamthitta district, Kerala (Figure No.1).

Sampling and Analysis

Samples were collected in good quality polythene bottles of 1L capacity during the month of June - July 2012. The bottles were well rinsed before sampling[8]. Three samples were collected randomly from three different open wells and three samples were collected from the bore wells at an interval of ten days.

The samples were carried to the laboratory for physicochemical analysis like colour, odour, taste, turbidity, pH, temperature, total alkalinity, total hardness, total dissolved solids, calcium, chloride, iron, aluminium, sodium, potassium, nitrate, electrical conductivity and sulphate according to standard methods of American Public Health Association (1995)[9]. All glass wares were carefully cleaned by distilled water before use. All reagents used were of analytical grade and double distilled water was used throughout the study.

RESULTS AND DISCUSSION

The colour of water samples in TVLA BW was found to be not clear. The odour and colour of other water samples was found to be odourless and colourless. The taste of Pandalam open well sample was found to be sour. The taste of samples differed from place to place with the change in temperature of water[10]. The ground water samples of open well and bore well in selected areas of Pathanamthitta district showed pH values in the range 6.80-7.32. The temperature of the sample fell in the range of 25.9 - 26.2^{0}C.

The turbidity in water is the reduction of transparency due to the presence of particulate matter such as clay or slit, finely divided organic matter, plankton or other microscopic organisms[11, 12]. The Thiruvalla bore well was found to be turbid.

The desirable limit for alkalinity in water is 200 - 600mg/l (BIS). From our analysis few of the samples were deviating from the limit. Ground water samples of Pathanamthitta town (open well) - 991mg/l, Othera village (open well) - 775mg/l, Thiruvalla town (bore well) - 5400mg/l were found to be above the limit and Pandalam village (open well) - 184mg/l was found to be below the limit.

Main cause of alkalinity is the mineral which dissolves in water from soil. Hydroxides carbonates, bicarbonates and organic acids contribute to alkalinity of water[13, 14].

Chloride is considered to be an indicator of organic pollution of animal origin[15, 16]. The desirable limit of chloride in BIS and WHO is 250-1000mg/l and250mg/l. Chloride concentration was found in the range of 126.7mg/l - 535.6mg/l. From these two samples such as open well& bore well from Thiruvalla town (535.6mg/l and 409.3mg/l) was found to be above the limit, when compared with WHO standard.

The BIS standard values for sodium and potassium is 100mg/l and 12mg/l respectively. All the samples analyzed were well within the limit. The BIS and WHO standard for Nitrate is 45mg/l. All the samples were within the limit. The total dissolved solids test measures the total amount of dissolved minerals in water. The solids can be iron, chloride, sulphate, calcium or other minerals found on the earth's surface. The desirable limit for TDS in BIS and WHO is 500-2000 mg/l and1000mg/l respectively. Ground water samples show the range of 250-2135mg/l. Only TVLA bore well shows above limit (2135mg/l).

Calcium is the major constituent of various types of rock. Calcium is a cause for hardness in water and incrustation in boilers. The calcium value for BIS and WHO is 75mg/l. The samples found in the range of 4-118mg/l. From our analysis, the samples from Pathanamthitta bore well and Thiruvalla bore well shows high calcium concentration 118mg/l and 96mg/l. Due to this high calcium concentration, total hardness is also high in these samples Pathanamthitta bore well (180mg/l) and Thiruvalla bore well (765mg/l).

Sulphate occurs naturally in water as a result of leaching from gypsum and other common minerals[1]. The standard values for sulphate in BIS and WHO are 200 and 250 mg/l respectively. Water with about 400mg/l sulphate has a bitter taste and those with 1000mg/l or more of sulphate cause intestinal disorders. The ground water samples were found within the desirable limit of BIS and WHO.

Iron in drinking water can be objectional because it can give a rusty colour and may affect taste. The BIS and WHO limit of iron is 0.3 and 0.1 mg/l respectively. The iron concentration ranges from 0.017 - 0.034mg/l. Only Thiruvalla bore well shows a high concentration of iron (0.35mg/l) as compared with the WHO standard value (0.1mg/l).

The standard value for Aluminium in BIS is 0.03mg/l. Concentration of all ground water samples was found within the desirable limit.

Conductivity is a measure of how conductive the water is to electrical current. Greater the ion concentration, greater is the electrical conductivity. Generally higher the electrical conductivity, higher is the total dissolved solids. The BIS standard for electrical conductivity is 750 - 2250µs/cm. All the samples analyzed were within the limit.

The results indicate that there is marked difference in the values of certain parameters analyzed such as alkalinity, chloride, calcium, total hardness, TDS and iron between open well and bore well samples (Table No.1 and 2). This is shown graphically in Figure No.2.

Table No.1: Standards for Drinking Water

S.No	Parameters (units)	Bureau of Indian Standard	World Health Organization
1	pH	6.5-8.5	6.5-8.5
2	Total alkalinity (mg/l)	200-600	250
3	Total hardness (mg/l)	300-600	500
4	TDS (mg/l)	500-2000	500-1500
5	Calcium hardness (mg/l)	75	75
6	Chloride (mg/l)	250-1000	250
7	Sulphate (mg/l)	200-400	400
8	Iron (mg/l)	0.3	0.1
9	Sodium (mg/l)	100	100
10	Potassium (mg/l)	12	10
11	Aluminium (mg/l)	0.03	0.1
12	Nitrate (mg/l)	45	45
13	Conductance (µs/cm)	45	45

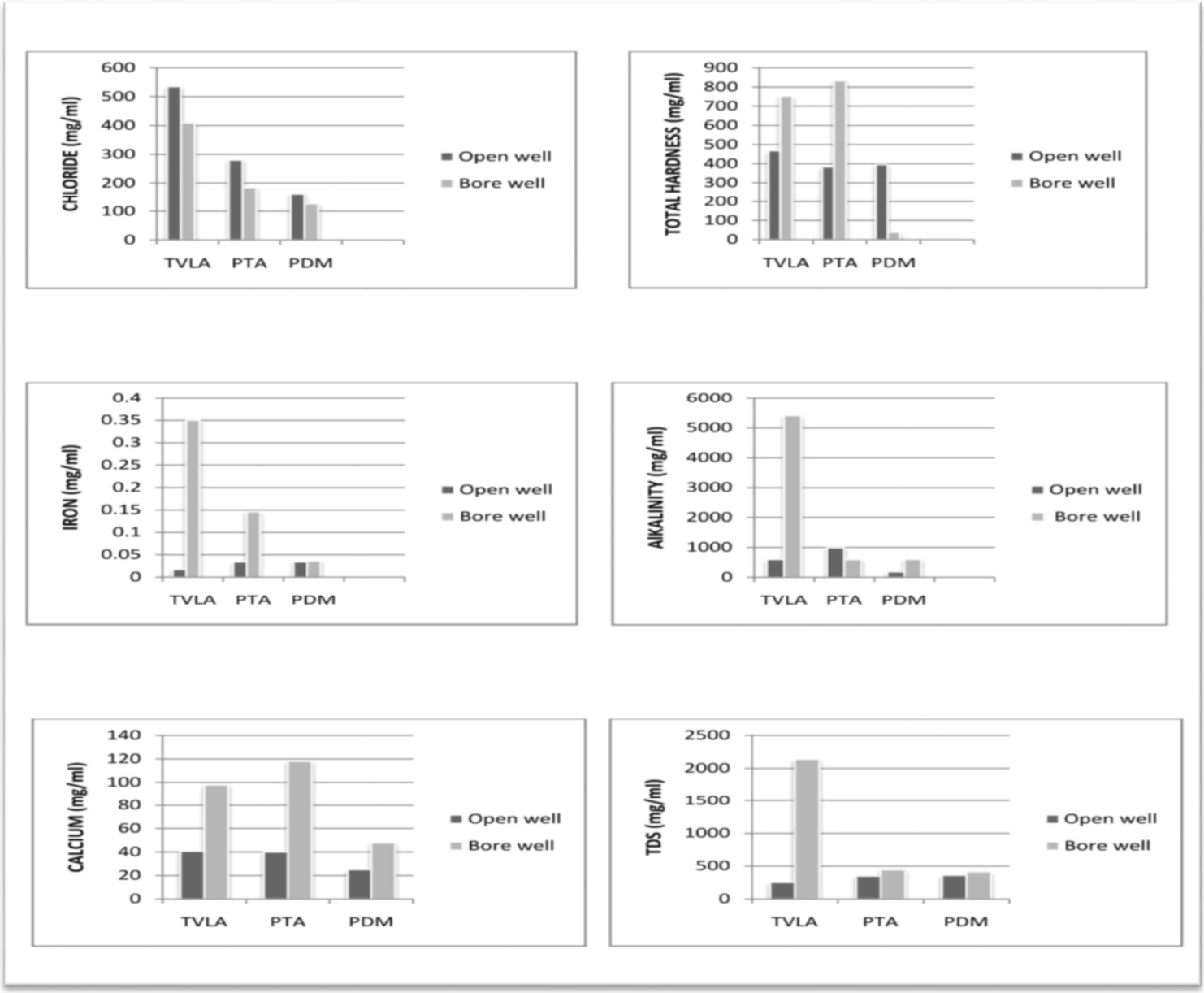
Table No.2: Analysis of physicochemical parameters of ground water samples of Pathanamthitta district

S.No	Parameters Units	Ground Water					
		TVLA		PTA		PDM	
		OW	BW	OW	BW	OW	BW
1	Colour	CL	Not clear	CL	CL	CL	CL
2	Odour	OL	OL	OL	OL	OL	OL
3	Taste	N	N	N	N	S	N
4	Turbidity	CLR	TURBID	CLR	CLR	CLR	CLR
5	pH	6.92	7.16	6.80	7.32	6.73	7.18

6	Temperature (^{0}C)	25.86	25.9	26.2	26.2	26.06	25.9
7	Alkalinity (mg/l)	600.0	5400.0	991.0	598.0	184.0	600.0
8	Hardness (mg/l)	498.6	754.0	384.0	832.0	396.0	392.0
9	TDS (mg/l)	250.0	2135.0	350.0	444.0	360.0	414.4
10	Calcium (mg/l)	4.0	97.8	4.0	118.6	2.5	4.7
11	Chloride (mg/l)	535.6	409.3	280.6	184.5	162.3	126.7
12	Sulphate (mg/l)	6.0	12.6	1.6	2.0	1.06	4.0
13	Iron (mg/l)	0.017	0.035	0.35	0.014	0.034	0.037
14	Sodium (mg/l)	6.45	BDL	BDL	BDL	BDL	BDL
15	Potassium (mg/l)	2.4	1.1	BDL	BDL	BDL	1.1
16	Nitrate (mg/l)	0.39	0.19	0.29	0.293	0.36	BDL
17	Aluminium (mg/l)	0.023	0.034	0.011	0.0145	0.0146	0.0246
18	Electrical Conductivity (µs/cm)	1322.6	1592.0	1454.0	1703.0	1127.6	1725.0

TVLA: Thiruvalla town, PTA: Pathanamthitta town, PDM: Pandalam, CL: clear, OL: odourless, N: normal, S: sour, CLR: clear, BDL: below detectable limit

Figure No.1: Map of Pathanamthitta district



CONCLUSION

This study provides an informative data and helps to understand the physicochemical characteristics of ground water samples in selected areas of Pathanamthitta district. The results indicate that open well source of water is good when compared to bore well source. The Thiruvalla bore well samples were deteriorated with alkalinity, chloride, iron, calcium, total solids and total hardness. Values of these parameters were higher than the permissible limit. The Pathanamthitta bore well samples shows high calcium and total hardness. The taste of Pandalam open well samples is found to be sour and they are below the desirable alkalinity limit. Therefore all samples of Pathanamthitta district are not potable. The quality of ground water and surface water should be continuously monitored and water can be used for cooking and drinking purpose only after proper treatment.

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CONFLICT OF INTEREST

We declare that we have no conflict of interest.

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