International Journal of Science and Research Archive
eISSN: 2582-8185
Cross Ref DOI: 10.30574/ijsra
Journal homepage: https://ijsra.net/

(RESEARCH ARTICLE)

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A study of physico-chemical parameters of well and bore hole water in Pozhikkarai to Manavalakkurichi South Coast of Tamil Nādu

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International Journal of Science and Research Archive, 2022, 07(02), 221–233

Publication history: Received on 16 October 2022; revised on 24 November 2022; accepted on 26 November 2022

Article DOI: https://doi.org/10.30574/ijsra.2022.7.2.0277

Abstract

A systematic analysis has been carried out to explore physico-chemical parameters of ground water from well and bore hole in four different stations (sites) Pozhikarai, Periyakadu, Muttom, and Manavalakurichi in Kanyakumari District of South India. Well and bore hole water samples were collected from four stations in different seasons & in two years and analyzed for temperature, pH, turbidity, alkalinity, hardness, salinity, fluoride, chloride, total dissolved solids, dissolved oxygen, BOD, electrical conductivity, total nitrogen, nitrate, sulphate, ammonia, phosphate, total phosphorus, sodium, potassium and oxidation & reduction potential. Comparative studies of parameters in different stations and in different seasons in different years were also carried out. The physico-chemical parameters were analyzed and the results were compared with water quality standards described by WHO. The above study is useful to know the water quality and their fitness for drinking purposes at various stations undertaken.

Keywords: Well water; Bore hole water; Pozhikarai; Periyakadu; Muttom; Manavalakurichi Physico-chemical parameters; Comparative studies

1. Introduction

The life of living organism depends on water [1-4]. The main source of life for many people in the world is the ground water [5]. The pollution of surface and ground water is a major problem due to rapid urbanization and industrialization [6]. The water demand is continuously increasing mainly due to population growth and raising needs in agriculture, industrial uses and domestic services [7]. Several studies on the ground water quality have been carried out in different parts of India [8-11]. Kanyakumari district is divided into four Taluks. The district is part of the composite east flowing river basin "between Pazhayar and Tamirabarani" as per the irrigation Atlas of India [12]. People in Kanya Kumari district depends on well and bore holes for domestic purpose. The quality of ground water from well and bore holes are to be analyzed. The objective of this study is to investigate physico-chemical analysis of parameters of water from well and bore holes in our study area. Study area consists of Pozhikarai, Periyakadu, Muttom, and Manavalakurichi.

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2. Material and methods

2.1. Study Area (Figure 1).

Kanyakumari district is the southernmost district of the state of Tamil Nadu, and the southernmost tip of peninsular India. It is located between 77°15' and 77° 36'of east of longitudes and 8° 03'and 8° 35' north of latitudes. Agateeswaram and Kalkulam Taluks are situated near to Thovalai and Vilavancode respectively.

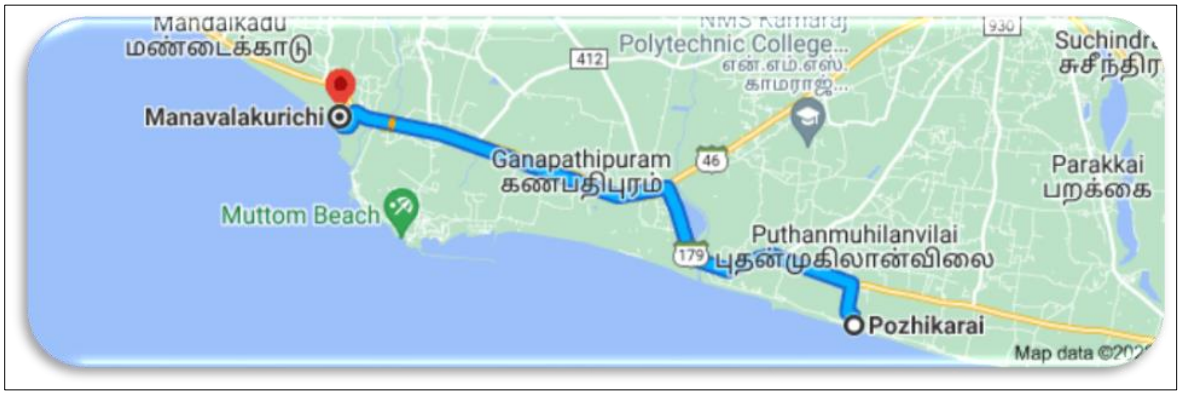

Figure 1 Study Area

2.2. Collection of samples

Ground water samples such as well water and bore whole water collected from four stations namely Pozhikarai, Periyakadu, Muttom, and Manavalakurichi in different season's pre moon and post moon in two years. The stations are referred as PO Pozhikarai, PE for Periyakadu, and MU for Muttom, and MA for Manavalakurichi. Well water collected in pre moon season during 2019 are labelled as WPRA19PO, WPRA19PE, WPRA19MU, WPRA19MA. Well water collected in post moon season during 2019 are labelled as WPON19PO, WPON19PE, WPON19MU, WPON19MA. Well water collected in pre moon season during 2020 are labelled as WPRA20PO, WPRA20PE, WPRA20MU, WPRA20MA. Well water collected in post moon season during 2020 are labelled as WPON20PO, WPON20PE, WPON20MU, WPON20MA.

Bore hole water collected in pre moon season during 2019 are labelled as BPRA19PO, BPRA19PE, BPRA19MU, BPRA19MA. Bore hole water collected in post moon season during 2019 are labelled as BPON19PO, BPON19PE, BPON19MU, BPON19MA. Bore hole water collected in pre moon season during 2020 are labelled as BPRA20PO, BPRA20PE, BPRA20MU, BPRA20MA. Bore hole collected in post moon season during 2020 are labelled as BPON20PO, BPON20PE, BPON20MU, BPON20MA.

2.3. Physico-Chemical Analysis

Samples collected from all the stations were analysed for physico-chemical analyzis using standard methods [13]. The following physico-chemical parameters such as temperature, pH, turbidity, alkalinity, hardness, salinity, fluoride, chloride, total dissolved solids, dissolved oxygen, BOD, electrical conductivity, total nitrogen, nitrate, sulphate, ammonia, phosphate, total phosphorus, sodium, potassium and oxidation & reduction potential have been analyzed. The temperature of the water samples was measured by mercury thermometer. The pH measurement of the water samples was carried out using digital pH meter (Elico pH-13 model). Flame photometer was used to identify sodium and potassium. Mohr's method was used to measure chloride by titration with silver nitrate. UV-Vis Spectrophotometer was used to analyse nitrate. The dissolved oxygen was estimated by Winkers method. The findings of the present investigation were summarized and compared with standards [14,15]. A conductivity meter was used to measure EC. Volumetric method using sulfuric acid as titrant and phenolphthalein and methyl orange as indicators was used to determine alkalinity. EDTA (complexometric) method was used to determine calcium, magnesium and total hardness titremetrically. Salinity was estimated by Argentometric titration method.

2.4. Reagents and Classware

All reagents used in our work were of analytical grade. Double distilled water was used to prepare all the reagents and calibration standards.

3. Result and Discussion

The physical and chemical parameters such as temperature, pH, turbidity, alkalinity, hardness, salinity, fluoride, chloride, total dissolved solids, dissolved oxygen, BOD, electrical conductivity, total nitrogen, nitrate, sulphate, ammonia, phosphate, total phosphorus, sodium, potassium and oxidation & reduction potential of the ground water samples collected from four different stations Pozhikarai, Periyakadu, Muttom, and Manavalakurichi in different seasons in two years. The parameters are tabulated in Tables 1 to 16. In this study the tools used for data analysis are mainly experimental aimed at defining possible trends, relationships or interactions among the measured parameters.

Table 1 Physical and Chemical Parameters of well water and bore hole water from Pozhikkarai (Pre -April 2019) WPRA19PO, BPRA19PO

Water	Parameters							
	Temp(°C)	**pH**	**Turbidity**	**EC (MicS/cm)**	**TDS (mg/L)**	**Sodium (mg/L)**	**Potassium (mg/L)**	**Alkalinity (mg/L)**
Well	28	7.4	8	621	540	25.1	16.1	164
Bore hole	29	7.8	8.1	531	630	11.6	19	191
Water	**Hardness Ca (mg/L)**	**Hardness Mg (mg/L)**	**Fluoride (ppm)**	**Chloride (mg/L)**	**Total N (mg/L)**	**Nitrate (mg/L)**	**Sulphate (mg/L)**	**Ammonia (mg/L)**
Well	50	4.9	0.8	241	4.9	0.2	7	0.9
Bore hole	61	8	0.8	182	5	0.9	7.1	0.9
Water	**Phosphate (mg/L)**	**Total P (mg/L)**	**Salinity (ppm)**	**DO (mg/L)**	**BOD (mg/L)**	**OXREDPot (mV)**		
Well	0.3	0.4	96	7	8	711		
Bore hole	0.2	0.1	111	6	6.4	739		

ZONE : FROM POZHIKARAI TO MANAVALAKKURICHI Season : Pre monsoon April 2019; Area: POZHIKARAI

Table 2 Physical and Chemical Parameters of well water and bore hole water from Periyakadu (Pre -April 2019) WPRA19PE, BPRA19PE

Water	Parameters							
	Temp(°C)	**pH**	**Turbidity**	**EC (MicS/cm)**	**TDS (mg/L)**	**Sodium (mg/L)**	**Potassium (mg/L)**	**Alkalinity (mg/L)**
Well	29	7.4	8	620	590	24.6	17.3	175
Bore hole	30	7.8	8.1	531	631	11.4	19	195
Water	**Hardness Ca (mg/L)**	**Hardness Mg (mg/L)**	**Fluoride (ppm)**	**Chloride (mg/L)**	**Total N (mg/L)**	**Nitrate (mg/L)**	**Sulphate (mg/L)**	**Ammonia (mg/L)**
Well	60	4.9	0.8	250	4.9	0.3	0.8	0.9
Bore hole	50	8	0.9	181	5	0.9	0.3	0.3
Water	**Phosphate (mg/L)**	**Total P (mg/L)**	**Salinity (ppm)**	**DO (mg/L)**	**BOD (mg/L)**	**OXRED Pot (mV)**		
Well	0.4	0.5	96	7	9	711		
Bore hole	0.3	0.6	117	6	6.4	741		

ZONE : FROM POZHIKARAI TO MANAVALAKKURICHI Season : Pre monsoon April 2019; Area: Periyakadu

The physico-chemical parameters of well water in pre moon and post moon season during 2019, during 2020 are compared each other. Similarly, the physico-chemical parameters of bore hole water in pre moon and post moon season during 2019, during 2020 are compared each other.

Table 3 Physical and Chemical Parameters of well water and bore hole water from Muttom (Pre -April 2019) WPRA19MU, BPRA19MU

Water	Parameters							
	Temp(°C)	**pH**	**Turbidity**	**EC (MicS/cm)**	**TDS (mg/L)**	**Sodium (mg/L)**	**Potassium (mg/L)**	**Alkalinity (mg/L)**
Well	29	7.9	8	620	590	26.6	16.3	164
Bore hole	27	7.8	8.2	531	620	12.1	19	192
Water	**Hardness Ca (mg/L)**	**Hardness Mg (mg/L)**	**Fluoride (ppm)**	**Chloride (mg/L)**	**Total N (mg/L)**	**Nitrate (mg/L)**	**Sulphate (mg/L)**	**Ammonia (mg/L)**
Well	60	4.9	0.8	290	4/9	0.2	6	0.9
Bore hole	61	8	0.9	190	5	0.5	7.5	0.9
Water	**Phosphate (mg/L)**	**Total P (mg/L)**	**Salinity (ppm)**	**DO (mg/L)**	**BOD (mg/L)**	**OXRED Pot (mV)**		
Well	0.8	0.3	96	8	6	710		
Bore hole	0.1	0.4	111	9	6.3	741		

ZONE : FROM POZHIKARAI TO MANAVALAKKURICHI Season : Pre monsoon April 2019; Area: Muttom

Table 4 Physical and Chemical Parameters of well water and bore hole water from Manavalakkurichi (Pre -April 2019) WPRA19MA, BPRA19MA

Water	Parameters							
	Temp(°C)	**pH**	**Turbidity**	**EC (MicS/cm)**	**TDS (mg/L)**	**Sodium (mg/L)**	**Potassium (mg/L)**	**Alkalinity (mg/L)**
Well	28	7.9	8	630	570	25.3	16.1	166
Bore hole	31	7.9	8.9	540	630	11.4	18	192
Water	**Hardness Ca (mg/L)**	**Hardness (mg/L)**	**Fluoride (ppm)**	**Chloride (mg/L)**	**Total N (mg/L)**	**Nitrate (mg/L)**	**Sulphate (mg/L)**	**Ammonia (mg/L)**
Well	51	4.9	0.8	290	4.9	0.2	0.8	6
Bore hole	61	8	0.9	181	5	0.4	0.4	7.4
Water	**Phosphate (mg/L)**	**Total P (mg/L)**	**Salinity (ppm)**	**DO (mg/L)**	**BOD (mg/L)**	**OXRED Pot (mV)**		
Well	0.8	0.2	96	8	8	719		
Bore hole	0.3	0.1	110	6	6.4	742		

ZONE : FROM POZHIKARAI TO MANAVALAKKURICHI Season : Pre monsoon April 2019; Area: Manavalakkurichi

Table 5 Physical and Chemical Parameters of well water and bore hole water from Pozhikkarai (Post -November 2019) WPON19PO, WPON19PO

Water	Parameters							
	Temp(°C)	**pH**	**Turbidity**	**EC (MicS/cm)**	**TDS (mg/L)**	**Sodium (mg/L)**	**Potassium (mg/L)**	**Alkalinity (mg/L)**
Well	30	7.4	7	620	581	25.6	16.4	165
Bore hole	31	7.8	8.9	531	621	11.6	18	190
Water	**Hardness Ca (mg/L)**	**Hardness Mg (mg/L)**	**Fluoride (ppm)**	**Chloride (mg/L)**	**Total N (mg/L)**	**Nitrate (mg/L)**	**Sulphate (mg/L)**	**Ammonia (mg/L)**
Well	50	4.8	0.8	240	4.8	0.2	6	0.8
Bore hole	90	7	0.9	181	5	0.4	7.4	0.3
Water	**Phosphate (mg/L)**	**Total P (mg/L)**	**Salinity (ppm)**	**DO (mg/L)**	**BOD (mg/L)**	**OXREDPot (mV)**		
Well	0.2	0.3	95	7	8	711		
Bore hole	0.1	0.4	116	6	6.3	742		

ZONE : FROM POZHIKARAI TO MANAVALAKKURICHI Season : Post monsoon November 2019; Area: Pozhikkarai

Table 6 Physical and Chemical Parameters of well water and bore hole water from Periyakadu (Post -November 2019) WPON19PE, BPON19PE

Water	Parameters							
	Temp(°C)	**pH**	**Turbidity**	**EC (MicS/cm)**	**TDS (mg/L)**	**Sodium (mg/L)**	**Potassium (mg/L)**	**Alkalinity (mg/L)**
Well	28	7.4	8	670	580	25.1	16.3	169
Bore hole	29	7.3	8.2	540	621	21	19	199
Water	**Hardness Ca (mg/L)**	**Hardness Mg (mg/L)**	**Fluoride (ppm)**	**Chloride (mg/L)**	**Total N (mg/L)**	**Nitrate (mg/L)**	**Sulphate (mg/L)**	**Ammonia (mg/L)**
Well	50	4.9	0.8	214	4.9	0.9	0.9	0.2
Bore hole	70	8	0.8	190	6	0.4	4.4	0.1
Water	**Phosphate (mg/L)**	**Total P (mg/L)**	**Salinity (ppm)**	**DO (mg/L)**	**BOD (mg/L)**	**OXREDPot (mV)**		
Well	0.3	25.6	96	8	9	710		
Bore hole	0.4	11.4	112	7	6.4	742		

ZONE: FROM POZHIKARAI TO MANAVALAKKURICHI Season : Post monsoon November 2019; Area: Periakadu

Table 7 Physical and Chemical Parameters of well water and bore hole water from Muttom (Post -November 2019) WPON19MU, BPON19MU

Water	Parameters							
	Temp(°C)	**pH**	**Turbidity**	**EC (MicS/cm)**	**TDS (mg/L)**	**Sodium (mg/L)**	**Potassium (mg/L)**	**Alkalinity (mg/L)**
Well	27	7.3	7	620	580	25.6	16.3	165
Bore hole	28	7.9	8.1	530	620	11.4	19	190
Water	**Hardness Ca (mg/L)**	**Hardness Mg (mg/L)**	**Fluoride (ppm)**	**Chloride (mg/L)**	**Total N (mg/L)**	**Nitrate (mg/L)**	**Sulphate (mg/L)**	**Ammonia (mg/L)**
Well	50	4.8	0.7	240	4.8	0.2	6	0.8
Bore hole	60	7	0.9	180	5	0.4	7.4	0.3
Water	**Phosphate (mg/L)**	**Total P (mg/L)**	**Salinity (ppm)**	**DO (mg/L)**	**BOD (mg/L)**	**OXREDPot (mV)**		
Well	0.2	0.3	95	7	8	710		
Bore hole	0.1	0.4	110	6	6.3	740		

ZONE: FROM POZHIKARAI TO MANAVALAKKURICHI Season : Post monsoon November 2019; Area: Muttom

Table 8 Physical and Chemical Parameters of well water and bore hole water from Manavalakkuruchi (Post -November 2019) WPON19MA, BPON19MA

Water	Parameters							
	Temp(°C)	**pH**	**Turbidity**	**EC (MicS/cm)**	**TDS (mg/L)**	**Sodium (mg/L)**	**Potassium (mg/L)**	**Alkalinity (mg/L)**
Well	28	7.9	8.1	620	620	25.6	12.2	190
Bore hole	27	7.3	7	530	580	11.4	11.4	165
Water	**Hardness Ca (mg/L)**	**Hardness Mg (mg/L)**	**Fluoride (ppm)**	**Chloride (mg/L)**	**Total N (mg/L)**	**Nitrate (mg/L)**	**Sulphate (mg/L)**	**Ammonia (mg/L)**
Well	60	4.8	0.7	180	4.8	0.4	7.4	0.3
Bore hole	50	7	0.9	240	5	0.2	6	0.8
Water	**Phosphate (mg/L)**	**Total P (mg/L)**	**Salinity (ppm)**	**DO (mg/L)**	**BOD (mg/L)**	**OXREDPot (mV)**		
Well	0.2	0.3	110	7	8	562		
Bore hole	0.1	0.4	95	6	8.3	672		

ZONE : FROM POZHIKARAI TO MANAVALAKKURICHI Season : Post monsoon November 2019; Area: Manavalakkurichi

Table 9 Physical and Chemical Parameters of well water and bore hole water from Pozhikkarai (Pre -April 2020) WPRA20PO, BPRA20PO

	Temp(°C)	**pH**	**Turbidity**	**EC (MicS/cm)**	**TDS (mg/L)**	**Sodium (mg/L)**	**Potassium (mg/L)**	**Alkalinity (mg/L)**
Well	28	7.5	10	422	421	19.9	13.4	241
Bore hole	27	7.6	11	385	321	17.9	12.9	231
Water	**Hardness Ca (mg/L)**	**Hardness Mg (mg/L)**	**Fluoride (ppm)**	**Chloride (mg/L)**	**Total N (mg/L)**	**Nitrate (mg/L)**	**Sulphate (mg/L)**	**Ammonia (mg/L)**
Well	42	21	0.4	180	4.7	0.4	2.6	0.6
Bore hole	31	31	0.2	182	2.9	0.2	4.7	0.4
Water	**Phosphate (mg/L)**	**Total P (mg/L)**	**Salinity (ppm)**	**DO (mg/L)**	**BOD (mg/L)**	**OXREDPot (mV)**		
Well	0.9	0.5	86	8.5	9	571		
Bore hole	0.8	0.8	56	7.5	6.5	461		

ZONE : FROM POZHIKARAI TO MANAVALAKKURICHI Season : Pre monsoon April 2020; Area: POZHIKARAI

Table 10 Physical and Chemical Parameters of well water and bore hole water from Periyakadu (Pre -April 2020) WPRA20PE, BPRA20PE

Water	**Parameters**							
	Temp(°C)	**pH**	**Turbidity**	**EC (MicS/cm)**	**TDS (mg/L)**	**Sodium (mg/L)**	**Potassium (mg/L)**	**Alkalinity (mg/L)**
Well	26	7.6	11	385	282	12.8	18	231
Bore hole	27	7.5	10	422	321	19.2	13.3	241
Water	**Hardness Ca (mg/L)**	**Hardness Mg (mg/L)**	**Fluoride (ppm)**	**Chloride (mg/L)**	**Total N (mg/L)**	**Nitrate (mg/L)**	**Sulphate (mg/L)**	**Ammonia (mg/L)**
Well	31	4.2	0.2	181	2.9	0.2	4.7	0.4
Bore hole	42	2.1	0.4	180	4.7	0.4	2.6	0.6
Water	**Phosphate (mg/L)**	**Total P (mg/L)**	**Salinity (ppm)**	**DO (mg/L)**	**BOD (mg/L)**	**OXRED Pot (mV)**		
Well	0.8	17.6	56	7.5	6.4	470		
Bore hole	0.7	0.5	86	8.5	9.0	560		

ZONE : FROM POZHIKARAI TO MANAVALAKKURICHI Season : Pre monsoon April 2020; Area: Periyakadu

Table 11 Physical and Chemical Parameters of well water and bore hole water from Muttom (Pre- April 2020) WPRA20MU, BPRA20MU

Water	Parameters							
	Temp(°C)	**pH**	**Turbidity**	**EC (MicS/cm)**	**TDS (mg/L)**	**Sodium (mg/L)**	**Potassium (mg/L)**	**Alkalinity (mg/L)**
Well	28	6.5	9	420	320	18.3	11.3	240
Bore hole	29	7.4	11	375	380	17.5	12.8	230
Water	**Hardness Ca (mg/L)**	**Hardness Mg (mg/L)**	**Fluoride (ppm)**	**Chloride (mg/L)**	**Total N (mg/L)**	**Nitrate (mg/L)**	**Sulphate (mg/L)**	**Ammonia (mg/L)**
Well	40	40	0.3	190	4.8	0.3	2.5	0.4
Bore hole	30	20	0.2	170	2.8	0.1	4.8	0.3
Water	**Phosphate (mg/L)**	**Total P (mg/L)**	**Salinity (ppm)**	**DO (mg/L)**	**BOD (mg/L)**	**OXRED Pot (mV)**		
Well	0.8	0.5	85	6.5	8.0	530		
Bore hole	0.7	0.9	55	7.5	2.3	461		

ZONE : FROM POZHIKARAI TO MANAVALAKKURICHI Season : Pre monsoon April 2020; Area: Muttom

Table 12 Physical and Chemical Parameters of well water and bore hole water from Manavalakkurichi (Pre- April 2020) WPRA20MA, BPRA20MA

Water	Parameters							
	Temp(°C)	**pH**	**Turbidity**	**EC (MicS/cm)**	**TDS (mg/L)**	**Sodium (mg/L)**	**Potassium (mg/L)**	**Alkalinity (mg/L)**
Well	28	6.4	9.1	420	330	18.3	11.3	241
Bore hole	29	7.7	11.1	395	240	17.5	18.3	291
Water	**Hardness Ca (mg/L)**	**Hardness Mg (mg/L)**	**Fluoride (ppm)**	**Chloride (mg/L)**	**Total N (mg/L)**	**Nitrate (mg/L)**	**Sulphate (mg/L)**	**Ammonia (mg/L)**
Well	40	70	0.4	192	4.8	0.3	0.6	0.9
Bore hole	50	40	0.3	171	2.8	0.1	0.5	0.8
Water	**Phosphate (mg/L)**	**Total P (mg/L)**	**Salinity (ppm)**	**DO (mg/L)**	**BOD (mg/L)**	**OXRED Pot (mV)**		
Well	0.8	0.9	85	7.5	8	560		
Bore hole	0.6	0.9	66	6.5	8.3	461		

ZONE : FROM POZHIKARAI TO MANAVALAKKURICHI Season : Pre monsoon April 2020; Area: Manavalakkurichi

Table 13 Physical and Chemical Parameters of well water and bore hole water from Pozhikkarai (Post -November 2020) WPON20PO, BPON20PO

Water	Parameters							
	Temp(°C)	**pH**	**Turbidity**	**EC (MicS/cm)**	**TDS (mg/L)**	**Sodium (mg/L)**	**Potassium (mg/L)**	**Alkalinity (mg/L)**
Well	27	7.8	6.7	462	415	33.2	12.9	161
Bore hole	28	7.1	6	592	370	35.1	11.8	221
Water	**Hardness Ca (mg/L)**	**Hardness Mg (mg/L)**	**Fluoride (ppm)**	**Chloride (mg/L)**	**Total N (mg/L)**	**Nitrate (mg/L)**	**Sulphate (mg/L)**	**Ammonia (mg/L)**
Well	61	42	0.1	0.8	4.9	0.3	0.4	0.8
Bore hole	54	61	0.8	0.1	4.8	0.1	0.6	0.9
Water	**Phosphate (mg/L)**	**Total P (mg/L)**	**Salinity (ppm)**	**DO (mg/L)**	**BOD (mg/L)**	**OXREDPot (mV)**		
Well	6	0.1	94	8	7	562		
Bore hole	7.1	0.9	74	9	6.3	692		

ZONE : FROM POZHIKARAI TO MANAVALAKKURICHI Season : Post monsoon November 2020; Area: Pozhikkarai

Table 14 Physical and Chemical Parameters of well water and bore hole water from Periyakadu (Post- November 2020) WPON20PE, BPON20PE

Water	Parameters							
	Temp(°C)	**pH**	**Turbidity**	**EC (MicS/cm)**	**TDS (mg/L)**	**Sodium (mg/L)**	**Potassium (mg/L)**	**Alkalinity (mg/L)**
Well	25	7.8	6	491	410	33.1	14.1	219
Bore hole	27	7.1	6.7	581	360	31.1	15	161
Water	**Hardness Ca (mg/L)**	**Hardness Mg (mg/L)**	**Fluoride (ppm)**	**Chloride (mg/L)**	**Total N (mg/L)**	**Nitrate (mg/L)**	**Sulphate (mg/L)**	**Ammonia (mg/L)**
Well	60	61	0.1	310	4.9	0.2	0.8	0.81
Bore hole	54	42	0.2	370	4.6	0.1	0.51	0.1
Water	**Phosphate (mg/L)**	**Total P (mg/L)**	**Salinity (ppm)**	**DO (mg/L)**	**BOD (mg/L)**	**OXREDPot (mV)**		
Well	0.6	1.5	92	9.0	6.0	561		
Bore hole	0.5	0.8	75	8.0	6.2	621		

ZONE : FROM POZHIKARAI TO MANAVALAKKURICHI Season : Post monsoon November 2020; Area: Periakadu

Table 15 Physical and Chemical Parameters of well water and bore hole water from Muttom (P3- Post November 2020) WPON20MU, BPON20MU

Water	Parameters							
	Temp(°C)	**pH**	**Turbidity**	**EC (MicS/cm)**	**TDS (mg/L)**	**Sodium (mg/L)**	**Potassium (mg/L)**	**Alkalinity (mg/L)**
Well	28	7.8	6.7	471	480	35.1	12.8	161
Bore hole	30	7.1	6.0	559	360	32.1	19.0	219
Water	**Hardness Ca (mg/L)**	**Hardness Mg (mg/L)**	**Fluoride (ppm)**	**Chloride (mg/L)**	**Total N (mg/L)**	**Nitrate (mg/L)**	**Sulphate (mg/L)**	**Ammonia (mg/L)**
Well	54	61	0.1	360	4.2	0.2	6	0.81
Bore hole	40	42	0.8	390	4.9	0.3	6.1	1.3
Water	**Phosphate (mg/L)**	**Total P (mg/L)**	**Salinity (ppm)**	**DO (mg/L)**	**BOD (mg/L)**	**OXREDPot (mV)**		
Well	0.3	32.1	92	9.0	5.0	570		
Bore hole	0.8	31.1	52	6.0	5.4	681		

ZONE FROM POZHIKARAI TO MANAVALAKKURICHI Season : Post monsoon November 2020; Area: Muttom

Table 16 Physical and Chemical Parameters of well water and bore hole water from Manavalakkuruchi (Post - November 2020) WPON20MA, BPON20MA

Water	Parameters							
	Temp(°C)	**pH**	**Turbidity**	**EC (MicS/cm)**	**TDS (mg/L)**	**Sodium (mg/L)**	**Potassium (mg/L)**	**Alkalinity (mg/L)**
Well	29	7.6	8.9	492	468	32.1	12.4	216
Bore hole	30	7.8	8.1	651	492	21.8	11.3	181
Water	**Hardness Ca (mg/L)**	**Hardness Mg (mg/L)**	**Fluoride (ppm)**	**Chloride (mg/L)**	**Total N (mg/L)**	**Nitrate (mg/L)**	**Sulphate (mg/L)**	**Ammonia (mg/L)**
Well	59	61	0.9	341	4.9	0.8	6.1	0.7
Bore hole	60	45	0.3	390	4.2	0.1	8	1.3
Water	**Phosphate (mg/L)**	**Total P (mg/L)**	**Salinity (ppm)**	**DO (mg/L)**	**BOD (mg/L)**	**OXREDPot (mV)**		
Well	0.5	0.4	91	9	8	560		
Bore hole	0.3	0.9	74	7	6.8	640		

ZONE: FROM POZHIKARAI TO MANAVALAKKURICHI Season : Post monsoon November 2020; Area: Manavalakkurichi

3.1. pH

pH is an indicative of acidity or basicity of water. The pH values of well water varied between 7.3 to 7.9 for WPRA19PO to WPON19MA, 6.4 to 7.8 for WPRA20PO to WPON20MA. The pH values of bore hole water varied between 7.3 to 7.9 for BPRA19PO to BPON19MA, 7.1 to 7.8 for BPRA20PO to BPON20MA. This shows that water samples from well is almost neutral but water samples from bore hole is slightly alkaline trend. The pH of water is influenced by geology of catchments area and buffering capacity of water.

3.2. Turbidity

Turbidity is a measure of the light scattering potential of water caused by the presence of colloidal and suspended material The turbidity values of well water varied between 7.0 to 8.1 for WPRA19PO to WPON19MA, 6.0 to 11 for WPRA20PO to WPON20MA. The turbidity values of bore hole water varied between 7.0 to 8.9 for BPRA19PO to BPON19MA, 6.0 to 11.1 for BPRA20PO to BPON20MA. The limit of turbidity value for drinking water is specified as 5 to 10 NTU. The observed turbidity values are within the permissible limits.

3.3. Dissolved Oxygen and Biochemical oxygen demand

It is one of the most fundamental parameters in water, as it is to the metabolism of of all aerobic aquatic organisms. The permissible limit of DO for drinking water is 6 mg/L. DO values of well water varied between 7.0 to 8.0 for WPRA19PO to WPON19MA, 6.5 to 9.0 for WPRA20PO to WPON20MA. DO values of bore hole water varied between 6.0 to 9.0 for BPRA19PO to BPON19MA, 6.0 to 8.5 for BPRA20PO to BPON20MA. In all the cases, dissolved oxygen is present more. The permissible limit for BOD as per WHO is 5 mg/L. BOD values of well water varied between 6.0 to 9.0 for WPRA19PO to WPON19MA, 5.0 to 9.0 for WPRA20PO to WPON20MA. BOD values of bore hole water varied between 6.3 to 8.3 for BPRA19PO to BPON19MA, 2.3 to 6.8 for BPRA20 PO to BPON20MA.

3.4. Magnesium

The upper limit of magnesium concentration in drinking water is specified as 30 mg/L (ISI, 1983). Magnesium content in well water varied between 4.8 to 4.9 for WPRA19PO to WPON19MA, 40 to 70.0 for WPRA20PO to WPON20MA. Magnesium content in bore hole water varied between 7.0 to 8.0 for BPRA19PO to BPON19MA, 20.0 to 61.0 for BPRA20PO to BPON20MA. The observed values are not within the permissible limits except for WPRA19PO to WPON19MA.

3.5. Nitrate

The nitrate values of well water varied between 0.2 to 0.4 for WPRA19PO to WPON19MA, 0.2 to 0.8 WPRA20PO to WPON20MA. The nitrate values of bore hole water varied between 0.2 to 0.9 for BPRA19PO to BPON19MA, 0.1 to 0.4 for BPRA20PO to BPON20MA. The observed values are within the permissible limits.

3.6. Fluoride

Fluoride content is an important factor in the development of normal bones and teeth The desirable limit is 1 to 1.5 mg/L for drinking purpose. Fluoride values observed in well water varied between 0.7 to 0.8 for WPRA19PO to WPON19MA, 0.1 to 0.9 for WPRA20PO to WPON20MA. Fluoride values observed in bore hole water varied between 0.8 to 0.9 for BPRA19PO to BPON19MA, 0.2 to 0.8 for BPRA20PO to BPON20MA .

3.7. Chloride

Chloride is a most common inorganic anion present in water to it through biogenic sources and indicates the state of contamination. The chloride values of in well water varied between 180 to 290 for WPRA19PO to WPON19MA, 180 to 360 for WPRA20PO to WPON20MA. Chloride values observed in bore hole water varied between 181 to 210 for BPRA19PO to BPON19MA, 170 to 390 for BPRA20PO to BPON20MA. The observed values are within the permissible limits.

3.8. Total dissolved solids (TDS)

ISI prescribed desirable limit of TDS is 500 mg/L. The TDS values of in well water varied between 540 to 620 for WPRA19PO to WPON19MA, 282 to 480 for WPRA20PO to WPON20MA. TDS values observed in bore hole water varied between 620 to 630 for BPRA19PO to BPON19MA, 240-492 for BPRA20PO to BPON20MA. The observed values are within the permissible limits except bore hole water for BPRA19PO to BPON19MA

3.9. Alkalinity

Alkalinity of water is a measure of its capacity to neutralize acids and provides an index for the nature of slats present in the water samples. The standard desirable limit of alkalinity in drinking water is 120 mg/L. The maximum permissible level is 600 mg/L. The alkalinity values of well water varied between 185 to 195 for WPRA19PO to WPON19MA, 161to 241 for WPRA20PO to WPON20MA. The alkalinity values bore hole water varied between 165 to 195 for BPA, 161 to 291for BPRA20PO to BPON20MA. The observed values are within the permissible limits.

3.10. Calcium

The upper limit of calcium concentration in drinking water is specified as 75 mg/L (ISI, 1983). The Ca content of well water varied between 50 to 60 for WPRA19PO to WPON19MA, 31 to 61 for WPRA20PO to WPON20MA. The Ca content of bore hole water varied between 50 to 90 for BPRA19PO to BPON19MA, 31 to 60 for BPRA20PO to BPON20MA . The observed values are within the permissible limits.

3.11. Salinity

The salinity values of well water varied between 95 to 110 for WPRA19PO to WPON19MA, 56 to 94 for WPRA20PO to WPON20MA. The salinity values of bore hole water varied between 95 to 117 for BPRA19PO to BPON19MA, 52 to 86 for BPRA20PO to BPON20MA. The observed values are within the permissible limits.

4. Conclusion

Conclusively, in this study the water quality properties in terms of its physico-chemical parameters of Pozhikarai, Periyakadu, Muttom and Manavalakurichi coast, Kanyakumari District, Southeast coast of India were assessed. The values obtained for the for temperature, pH, turbidity, alkalinity, hardness, salinity, fluoride, chloride, total dissolved solids, dissolved oxygen, BOD, electrical conductivity, total nitrogen, nitrate, sulphate, ammonia, phosphate, total phosphorus, sodium, potassium and oxidation & reduction potential were within the recommended values of the World Health Organization (WHO).

Compliance with ethical standards

Acknowledgments

The authors thank the people from the abovesaid area for helping in drawing the water samples from the two sources during 2019, and 2020.

Disclosure of conflict of interest

No conflict of interest.

Author's contribution

The first author is a research scholar. The second author is supervisor. The third author is joint supervisor. The fourth author is also encouraging and promoting the research carrier to the students.

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