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ANALYSIS OF PHYSICO-CHEMICAL PARAMETERS OF WELL AND BORE HOLE WATER IN COLACHEL TO MELMIDALAM OF SOUTH KANYAKUMARI DISTRICT

M.V. Reena[1], A. Amalraj[2*], R. Ajitha[3]

[1]Research Scholar, Reg. No. 19133282032008, Research Centre of Chemistry,
Women's Christian College, Nagercoil, Kanyakumari District,
Affiliated to Manonmaniam Sundaranar University, Abishekapatti, Tirunelveli 627 012, Tamil Nadu,
India email: mvreena25@gmail.com

[2]Associate Professor of Chemistry, St. Jerome's College Anandhanadarkudy-629 201, Kanyakumari District,
Affiliated to Manonmaniam Sundaranar University, Abishekapatti, Tirunelveli 627 012, Tamil Nadu,
India email: amalrajngl1972@gmail.com

[3]Assistant Professor, Department of Chemistry, Women's Christian College, Nagercoil-629 001, Kanyakumari District,
Affiliated to Manonmaniam Sundaranar University, Abishekapatti, Tirunelveli 627 012, Tamil Nadu,
India email: ajigreesh@gmail.com

[*]Corresponding author

Email : amalrajngl1972@gmail.com Mobile : 91- 9486761574

ABSTRACT

A systematic study has been carried out to explore physico-chemical parameters of ground water from well and bore hole in four different stations (sites) Colachel, `Kurumbanai, Midalam and Melmidalam in South Kanyakumari District of South India. Water samples from well and bore hole in four stations were collected in different seasons & in two years and analyzed for temperature, pH, turbidity, alkalinity, hardness, salinity, fluoride, chloride, total dissolved solids, dissolved oxygen, sodium, potassium and oxidation & reduction potential BOD, electrical conductivity, total nitrogen, nitrate, sulphate, ammonia, phosphate, total phosphorus, 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. Overall water quality was found satisfactory for drinking purpose without prior treatment.

Key Words: Well water, bore hole water, Colachel, Kurumbanai, Midalam, Melmidalam, Physico-chemical parameters, Comparative studies.

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

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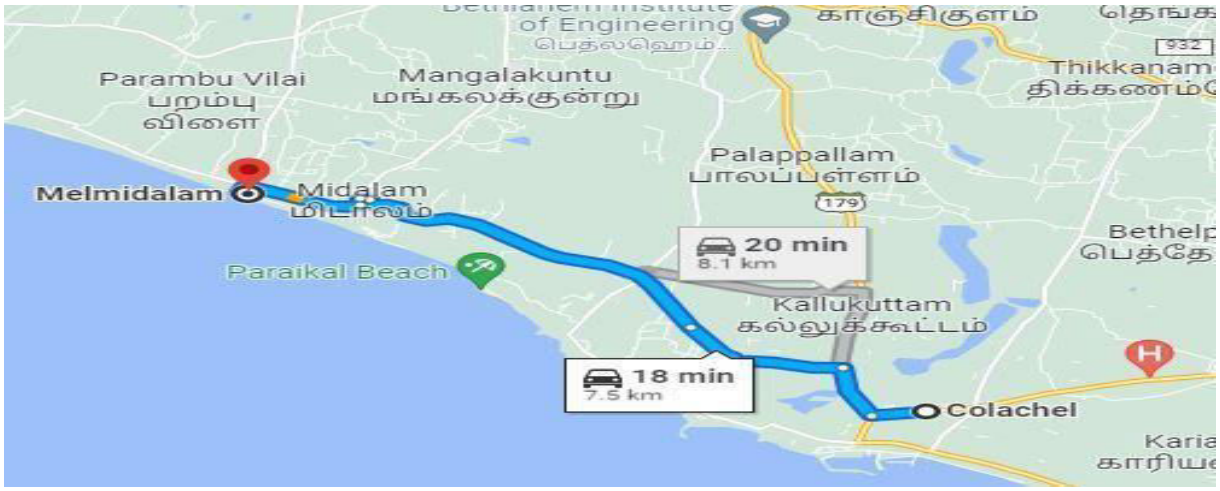
district depends on well and bore holes for domestic purpose. The quality of ground water from well and bore holes are to be analyzed. The objective of this study is to investigate physico-chemical analysis of parameters of water from well and bore holes in our study area. Study area consists of Colachel, Kurumbanai, Midalam, and Melmidalam,

MATERIAL AND METHODS

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



Collection of samples

Ground water samples such as well water and bore hole water collected from four stations namely Colachel, Kurumbanai, Midalam, and Melmidalam in different seasons pre

moon and post moon in two years. The stations are referred as CO for Colachel, KU for Kurumbanai, MI for Midalm, ME for melmidalam. Well water collected in pre moon season during 2019 are labelled as WPRA19CO, WPRA19KU, WPRA19MI, WPRA19ME. Well water collected in post moon season during 2019 are labelled as WPON19CO, WPON19KU, WPON19MI, WPON19ME. Well water collected in pre moon season during 2020 are labelled as WPRA20CO, WPRA20KU, WPRA20MI, WPRA20ME. Well water collected in post moon season during 2020 are labelled as WPON20CO, WPON20KU, WPON20MI, WPON20ME.

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Bore hole water collected in pre moon season during 2019 are labelled as BPRA19CO, BPRA19KU, BPRA19MI, BPRA19ME. Bore hole water collected in post moon season during 2019 are labelled as BPON19CO, BPON19KU, BPON19MI, BPON19ME. Bore hole water collected in pre moon season during 2020 are labelled as BPRA20CO, BPRA20KU, BPRA20MI, BPRA20ME. Bore hole collected in post moon season during 2020 are labelled as BPON20CO, BPON20KU, BPON20MI, BPON20ME.

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, ammonia, phosphate, total phosphorus, sodium, fluoride, chloride, total dissolved solids, dissolved oxygen, BOD, electrical conductivity, total nitrogen, nitrate, sulphate, 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). 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. 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. Salinity was estimated by Argentometric titration method. The dissolved oxygen was estimated by Winkers method. The findings of the present investigation were summarized and compared with standards[14,15].

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.

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 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.

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. The relation between the parameters is also analysed through graphical representation using Microsoft office Excel 2019. (Figures 2 to 21).

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ZONE : FROM COLACHEL TO MEL MIDALALM Season : Pre monsoon April 2019 Area: COLACHEL

Table 1 : Physical and Chemical Parameters of well water and bore hole water from Colachel (Pre April 2019) WPRA19CO, BPRA19CO

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	6.8	472	415	32.1	12.4	168
Bore hole	30	7.1	6.0	500	370	33.1	11.4	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	260	4.6	0.3	7	0.8
Bore hole	54	61	0.8	230	4.7	0.5	7.8	1.4
Water	**Phosphate (mg/L)**	**Total P (mg/L)**	**Salinity (ppm)**	**DO (mg/L)**	**BOD (mg/L)**	**OXREDPot (mV)**		
Well	0.5	0.9	94	8	7	560		
Bore hole	0.6	0.8	76	9	6.4	632		

ZONE : FROM COLACHEL TO MEL MIDALALM Season : Pre monsoon April 2019 Area: KURUMBANAI

Table 2 : Physical and Chemical Parameters of well water and bore hole water from Kurumbanai (Pre April 2019) WPRA19KU, BPRA19KU

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	8.2	560	460	33.5	13.4	180
Bore hole	27	8.0	7	490	390	26.3	12.4	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	70	76	0.4	830	4.8	0.6	8	0.7
Bore hole	56	41	0.3	390	4.2	0.9	6.8	1.5
Water	**Phosphate (mg/L)**	**Total P (mg/L)**	**Salinity (ppm)**	**DO (mg/L)**	**BOD (mg/L)**	**OXRED Pot (mV)**		
Well	0.9	0.8	91	8	6.6	581		
Bore hole	0.3	0.3	76	9	7	630		

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ZONE : FROM COLACHEL TO MEL MIDALALM Season : Pre monsoon April 2019 Area: MIDALAM

Table 3 : Physical and Chemical Parameters of well water and bore hole water from Midalam (Pre April 2019) WPRA19MI, BPRA19MI

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	7	460	460	33.4	13.3	231
Bore hole	28	7.2	8.2	570	390	26.8	12.3	180
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	56	40	7.6	250	4.8	0.9	8	0.7
Bore hole	70	70	9.1	240	4.2	0.9	6.9	1.5
Water	**Phosphate (mg/L)**	**Total P (mg/L)**	**Salinity (ppm)**	**DO (mg/L)**	**BOD (mg/L)**	**OXRED Pot (mV)**		
Well	0.8	0.3	41	8	7	582		
Bore hole	1.1	0.8	70	9	6.6	631		

ZONE : FROM COLACHEL TO MEL MIDALALM Season : Pre monsoon April 2019 Area:

Table 4 : Physical and Chemical Parameters of well water and bore hole water from Melmidalm (Pre April 2019) WPRA19ME, BPRA19ME

Water	Parameters							
	Temp(°C)	**pH**	**Turbidity**	**EC (MicS/cm)**	**TDS (mg/L)**	**Sodium (mg/L)**	**Potassium (mg/L)**	**Alkalinity (mg/L)**
Well	27	7.9	8.9	460	392	33.8	13.1	231
Bore hole	28	7.8	6	570	270	32.8	12.2	180
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	54	42	0.4	360	4.5	0.5	8	0.1
Bore hole	71	71	0.4	340	4.9	4.9	9	0.5
Water	**Phosphate (mg/L)**	**Total P (mg/L)**	**Salinity (ppm)**	**DO (mg/L)**	**BOD (mg/L)**	**OXRED Pot (mV)**		
Well	0.4	0.8	74	9	6	571		
Bore hole	1.5	0.9	92	8	7.7	681		

MELMIDALAM

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ZONE : FROM COLACHEL TO MEL MIDALALM Season : Post monsoon April 2019 Area: COLACHEL

Table 5 : Physical and Chemical Parameters of well water and bore hole water from Colachel (Post April 2019) WPON19CO, BPON19CO

	Parameters							
Water	**Temp(°C)**	**pH**	**Turbidity**	**EC (MicS/cm)**	**TDS (mg/L)**	**Sodium (mg/L)**	**Potassium (mg/L)**	**Alkalinity (mg/L)**
Well	30	7.8	6	570	419	33.2	13.1	231
Bore hole	29	7.9	8.9	460	378	32.8	12.4	180
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	56	42	3.4	470	0.4	8	0.1	0.9
Bore hole	71	71	3.6	392	0.9	9	0.5	1.5
Water	**Phosphate (mg/L)**	**Total P (mg/L)**	**Salinity (ppm)**	**DO (mg/L)**	**BOD (mg/L)**	**OXREDPot (mV)**		
Well	0.8	0.8	74	7.7	4.9	562		
Bore hole	0.9	0.5	92	6.0	0.5	640		

ZONE : FROM COLACHEL TO MEL MIDALALM Season : Post monsoon April 2019 Area: KURUMBANAI

Table 6 : Physical and Chemical Parameters of well water and bore hole water from Kurumbanai (Post April 2019) WPON19KU, BPON19KU

	Parameters							
Water	**Temp(°C)**	**pH**	**Turbidity**	**EC (MicS/cm)**	**TDS (mg/L)**	**Sodium (mg/L)**	**Potassium (mg/L)**	**Alkalinity (mg/L)**
Well	30	7.6	8	472	421	16.8	16.1	181
Bore hole	30	8	7.4	521	381	17.8	15	176
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	34	12	0.5	211	3.9	0.4	6.6	0.9
Bore hole	26	10	0.4	180	2.1	0.3	7.7	0.4
Water	**Phosphate (mg/L)**	**Total P (mg/L)**	**Salinity (ppm)**	**DO (mg/L)**	**BOD (mg/L)**	**OXRED Pot (mV)**		
Well	0.8	0.3	41	8	7.6	581		
Bore hole	0.6	0.4	86	7	8.5	672		

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ZONE : FROM COLACHEL TO MEL MIDALALM Season : Post monsoon April 2019 Area: MIDALAM

Table 7 : Physical and Chemical Parameters of well water and bore hole water from Midalam (Post April 2019) WPON19MI, BPON19MI

Water	Parameters							
	Temp(°C)	**pH**	**Turbidity**	**EC (MicS/cm)**	**TDS (mg/L)**	**Sodium (mg/L)**	**Potassium (mg/L)**	**Alkalinity (mg/L)**
Well	29	7	7.3	510	530	21.5	13.9	180
Bore hole	28	6.8	6	640	480	18.3	20.1	178
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	65	3	0.2	230	3.8	0.4	7	0.5
Bore hole	60	4.5	0.4	280	4.3	0.3	5.6	0.4
Water	**Phosphate (mg/L)**	**Total P (mg/L)**	**Salinity (ppm)**	**DO (mg/L)**	**BOD (mg/L)**	**OXRED Pot (mV)**		
Well	0.5	0.8	90	7	9	691		
Bore hole	0.8	0.4	85	8	6.4	721		

Table 8 : Physical and Chemical Parameters of well water and bore hole water from Melmidalm (Post April 2019) WPON19ME, BPON19ME

Water	Parameters							
	Temp(°C)	**pH**	**Turbidity**	**EC (MicS/cm)**	**TDS (mg/L)**	**Sodium (mg/L)**	**Potassium (mg/L)**	**Alkalinity (mg/L)**
Well	29	6.8	7.3	510	480	21.6	13.9	180
Bore hole	30	7	6	640	230	18.9	19	171
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	66	4.9	0.5	290	4.9	0.9	5.7	0.6
Bore hole	65	3	0.2	240	3.9	0.4	8	0.9
Water	**Phosphate (mg/L)**	**Total P (mg/L)**	**Salinity (ppm)**	**DO (mg/L)**	**BOD (mg/L)**	**OXRED Pot (mV)**		
Well	0.8	0.9	86	4.9	9	671		
Bore hole	0.5	0.8	91	7	5.4	721		

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ZONE : FROM COLACHEL TO MELMIDALAM Season : Pre monsoon April 2020 Area: COLACHEL

Table 9 : Physical and Chemical Parameters of well water and bore hole water from Colachel (Pre April 2020) WPRA20CO, BPRA20CO

	Parameters							
Water	**Temp(°C)**	**pH**	**Turbidity**	**EC (MicS/cm)**	**TDS (mg/L)**	**Sodium (mg/L)**	**Potassium (mg/L)**	**Alkalinity (mg/L)**
Well	30	7.5	8.1	631	582	26.1	19.6	170
Bore hole	29	7.2	6	537	691	21.4	18	215
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	4.5	0.8	237	4.5	0.2	5	0.9
Bore hole	61	6	0.2	185	4	0.2	7.2	0.3
Water	**Phosphate (mg/L)**	**Total P (mg/L)**	**Salinity (ppm)**	**DO (mg/L)**	**BOD (mg/L)**	**OXREDPot (mV)**		
Well	0.2	0.5	92	8	9	765		
Bore hole	0.1	0.6	112	7	6.2	791		

ZONE : FROM COLACHEL TO MELMIDALAM Season : Pre monsoon April 2020 Area: KURUMBANAI

Table 10 : Physical and Chemical Parameters of well water and bore hole water from Kurumbanai (Pre April 2020) WPRA20KU, BPRA20KU

	Parameters							
Water	**Temp(°C)**	**pH**	**Turbidity**	**EC (MicS/cm)**	**TDS (mg/L)**	**Sodium (mg/L)**	**Potassium (mg/L)**	**Alkalinity (mg/L)**
Well	30	8.1	7	692	592	29.1	16.1	192
Bore hole	29	7.3	8.1	592	691	12.1	19	154
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	4.5	0.8	237	4.9	0.6	5	0.8
Bore hole	60	6	0.2	185	9	0.9	7.8	0.3
Water	**Phosphate (mg/L)**	**Total P (mg/L)**	**Salinity (ppm)**	**DO (mg/L)**	**BOD (mg/L)**	**OXRED Pot (mV)**		
Well	0.5	1.5	92	8	9	760		
Bore hole	0.8	6.1	161	6	9.1	792		

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Table 11 : Physical and Chemical Parameters of well water and bore hole water from Midalam (Pre April 2020) WPRA20MI, BPRA20MI

Water	Parameters							
	Temp(°C)	**pH**	**Turbidity**	**EC (MicS/cm)**	**TDS (mg/L)**	**Sodium (mg/L)**	**Potassium (mg/L)**	**Alkalinity (mg/L)**
Well	30	6.5	9	420	320	19.3	11.3	240
Bore hole	29	7.4	11	375	380	19.8	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	20	0.3	190	4.8	0.3	2.5	0.4
Bore hole	30	40	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	7.5	8	561		
Bore hole	0.7	0.9	55	6.5	6.3	491		

Table 12 : Physical and Chemical Parameters of well water and bore hole water from Melmidalam (Pre April 2020) WPRA20ME, BPRA20ME

Water	Parameters							
	Temp(°C)	**pH**	**Turbidity**	**EC (MicS/cm)**	**TDS (mg/L)**	**Sodium (mg/L)**	**Potassium (mg/L)**	**Alkalinity (mg/L)**
Well	28	7.3	8	620	620	25.6	16.3	190
Bore hole	29	7.9	7.0	530	580	11.4	19	185
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	0.9	180	4.9	0.8	9	0.9
Bore hole	50	7	0.7	240	5	0.4	7.4	0.3
Water	**Phosphate (mg/L)**	**Total P (mg/L)**	**Salinity (ppm)**	**DO (mg/L)**	**BOD (mg/L)**	**OXRED Pot (mV)**		
Well	0.1	0.5	110	7	8.1	770		
Bore hole	0.2	0.9	95	8.1	6.3	714		

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ZONE : FROM COLACHEL TO MELMIDALAM Season : Post monsoon November 2020 Area: Colachel

Table 13 : Physical and Chemical Parameters of well water and bore hole water from Colachel (Post November 2020) WPON20CO, BPON20CO

	Parameters							
Water	**Temp(°C)**	**pH**	**Turbidity**	**EC (MicS/cm)**	**TDS (mg/L)**	**Sodium (mg/L)**	**Potassium (mg/L)**	**Alkalinity (mg/L)**
Well	27	7.8	7	480	480	33.5	12.4	230
Bore hole	29	7.2	8.2	570	390	29.8	11.6	180
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	70	104	0.2	325	4.1	0.1	7	0.8
Bore hole	55	60	0.3	380	4.8	0.8	6.5	1.9
Water	**Phosphate (mg/L)**	**Total P (mg/L)**	**Salinity (ppm)**	**DO (mg/L)**	**BOD (mg/L)**	**OXREDPot (mV)**		
Well	0.4	0.9	90	8.1	7	570		
Bore hole	0.7	0.5	75	8	6.6	680		

Table 14 : Physical and Chemical Parameters of well water and bore hole water from Kurumbanai (Post November 2020) WPON20KU, BPON20KU

	Parameters							
Water	**Temp(°C)**	**pH**	**Turbidity**	**EC (MicS/cm)**	**TDS (mg/L)**	**Sodium (mg/L)**	**Potassium (mg/L)**	**Alkalinity (mg/L)**
Well	28	7.9	8	490	480	32.6	12.5	330
Bore hole	29	7.5	9.2	580	390	21.9	11.8	189
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	77	90	0.9	390	4.9	0.9	7	0.7
Bore hole	58	40	0.4	360	4.8	0.5	6.5	0.1
Water	**Phosphate (mg/L)**	**Total P (mg/L)**	**Salinity (ppm)**	**DO (mg/L)**	**BOD (mg/L)**	**OXREDPot (mV)**		
Well	0.4	0.3	80	9	7	570		
Bore hole	0.2	0.7	65	8	6.9	680		

ZONE : FROM COLACHEL TO MELMIDALAM Season : Post monsoon November 2020 Area: Kurumbanai

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ZONE : FROM COLACHEL TO MELMIDALAM Season : Post monsoon November 2020 Area: Midalam

Table 15 : Physical and Chemical Parameters of well water and bore hole water from Midalam (Post November 2020) WPON20MI, BPON20MI

	Parameters							
Water	**Temp(°C)**	**pH**	**Turbidity**	**EC (MicS/cm)**	**TDS (mg/L)**	**Sodium (mg/L)**	**Potassium (mg/L)**	**Alkalinity (mg/L)**
Well	25	7.8	7	490	472	39.5	12.4	270
Bore hole	27	7.9	8.9	540	380	31.8	11.9	210
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	80	77	0.3	398	4.9	0.2	7	0.8
Bore hole	56	48	0.2	380	4.6	0.1	6.9	1.2
Water	**Phosphate (mg/L)**	**Total P (mg/L)**	**Salinity (ppm)**	**DO (mg/L)**	**BOD (mg/L)**	**OXREDPot (mV)**		
Well	0.4	0.3	92	8	7	560		
Bore hole	0.2	0.7	85	9	6.9	670		

Table 16 : Physical and Chemical Parameters of well water and bore hole water from Melmidalam (Post November 2020) WPON20ME, BPON20ME

	Parameters							
Water	**Temp(°C)**	**pH**	**Turbidity**	**EC (MicS/cm)**	**TDS (mg/L)**	**Sodium (mg/L)**	**Potassium (mg/L)**	**Alkalinity (mg/L)**
Well	29	7.8	7	490	490	33.1	14.1	231
Bore hole	30	7.2	8.2	136	390	26.1	13.1	180
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	56	70	0.4	330	4.9	0.9	6.9	0.9
Bore hole	70	41	0.3	380	4.6	0.6	0.6	1.6
Water	**Phosphate (mg/L)**	**Total P (mg/L)**	**Salinity (ppm)**	**DO (mg/L)**	**BOD (mg/L)**	**OXREDPot (mV)**		
Well	0.8	0.9	91	8	7	561		
Bore hole	0.5	0.6	96	9	6.6	578		

ZONE : FROM COLACHEL TO MELMIDALAM Season : Post monsoon November 2020 Area: Melmidalam

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pH

pH is an indicative of acidity or basicity of water. The pH values of well water varied between 6.8 to 7.9 for WPRA19CO to WPON19ME, 6.5 to 8.1 for WPRA20CO to WPON20ME (Figures: 2,4). The pH values of bore hole water varied between 7.0 to 8.0 for BPRA19CO to BPON19ME, 7.2 to 7.9 for BPRA20CO to BPON20ME (Figures : 3,5). 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.

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 6.8 to
8.9 for WPRA19CO to WPON19ME, 7.0 to 9.0 for WPRA20CO to WPON20ME (Figures: 2,4). The turbidity values of bore hole water varied between 6.0 to 8.9 for BPRA19CO to BPON19ME, 7.0 to 11.0 for BPRA20CO to BPON20ME (Figures : 3,5). The limit of turbidity value for drinking water is specified as 5 to 10 NTU. The observed turbidity values are within the permissible limits.

Dissolved Oxygen

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 4.9 to 9.0 for WPRA19CO to WPON19ME, 7.0 to 9.0 for WPRA20CO to WPON20ME (Figures: 2,4). DO values of bore hole water varied between 7.0 to 8.0 for BPRA19CO to BPON19ME, 6.0 to 9.0 for BPRA20CO to BPON20ME (Figures: 3,5). In all the cases, dissolved oxygen is present more.

Biochemical oxygen demand

The permissible limit for BOD as per WHO is 5 mg/L. BOD values of well water varied between 4.9 to 9.0 for WPRA19CO to WPON19ME, 7.0 to 9.0 for WPRA20CO to WPON20ME (Figures: 2,4). BOD values of bore hole water varied between 0.5 to 8.0 for BPRA19CO to BPON19ME, 6.2 to 9.1 for BPRA20CO to BPON20ME (Figures: 3,5).

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 4.5 to 104 for WPRA19CO to WPON19ME, 13.0. to 70 for WPRA20CO to WPON20ME (Figures: 2,4). Magnesium content in bore hole water varied between 3.0 to 71 for BPRA19CO to BPON19ME, 6.0 to 48 for BPRA20CO to BPON20ME (Figures: 3,5). The observed values are not within the permissible limits except for WPRA19CO to WPON19ME

Sulphate

Sulphate is the major anion occurring in natural waters. The upper limit for sulphtae concentration for drinking water is 150 mg/L. The Sulphate values of well water varied between 0.1 to 8.0 for WPRA19CO to WPON19ME, 0.9 to 7.0 for WPRA20CO to WPON20ME (Figures: 2,4). The sulphate values of bore hole water varied between 0.65 to 8.0 for BPRA19CO to BPON19ME, 0.6 to 7.8 for BPRA20CO to BPON20ME (Figures: 3,5).
The observed sulphate values are within the permissible limits.

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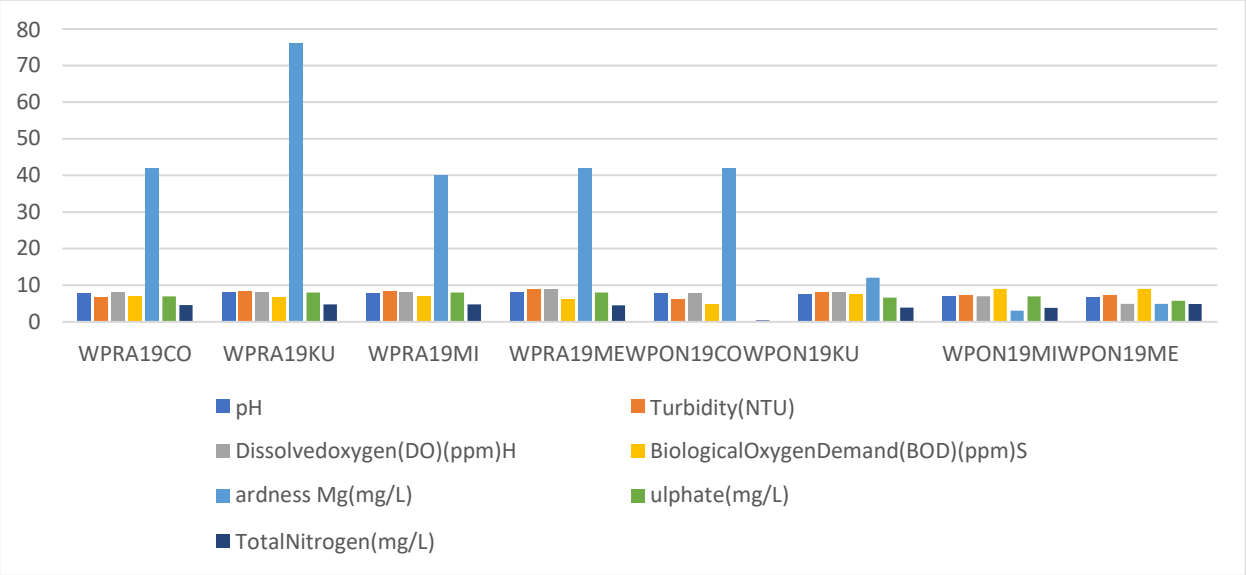
Nitrate

The nitrate values of well water varied between 0.3 to 8.0 for WPRA19CO to WPON19ME, 0.1 to 0.9 WPRA20CO to WPON20ME (Figures: 6,8). The nitrate values of bore hole water varied between 0.3 to 9.0 for BPRA19CO to BPON19ME, 0.1 to 1.9 for BPRA20CO to BPON20ME (Figures: 7,9). The observed values are within the permissible limits.



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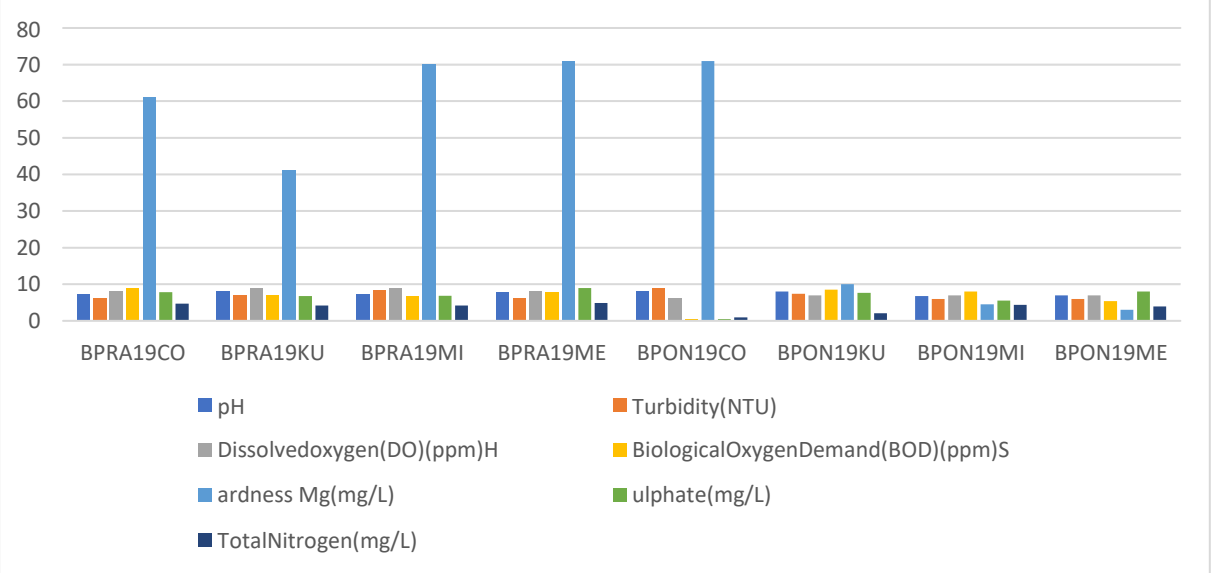

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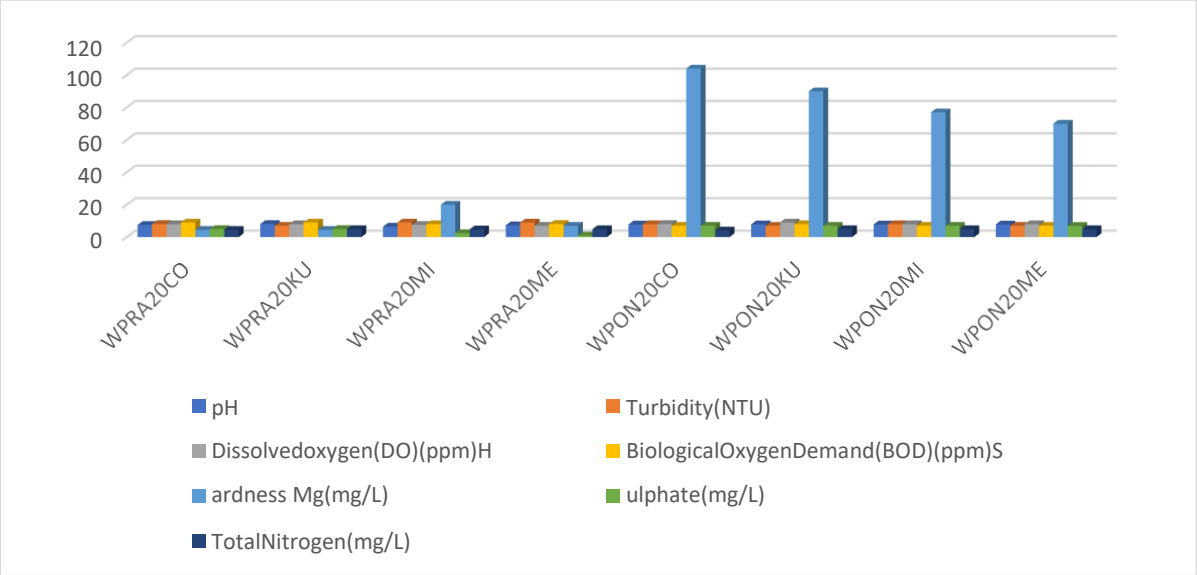

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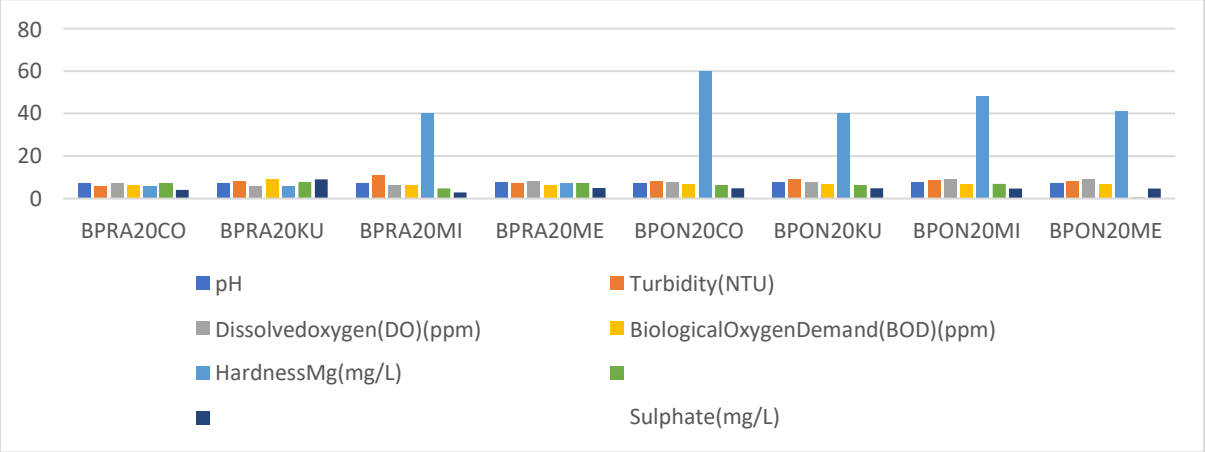

Figure:5

Phosphate

The phosphate ion in the water samples due to agriculture land composition of organic matter. The phosphate values of well water varied between 0.4 to 0.9 for WPRA19CO to WPON19ME, 0.1 to 0.8 for WPRA20CO to WPON20ME (Figures: 6,8). The phosphate values of bore hole water varied between 0.3 to 1.5 for BPRA19CO to BPON19ME, 0.1 to 0.8 for BPRA20CO to BPON20ME (Figures: 7,9). These values are within the permissible limits.

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 0.1 to 7.6 for WPRA19CO to WPON19ME, 0.2 to 0.9 for WPRA20CO to WPON20ME (Figures: 6,8). Fluoride values observed in bore hole water varied between 0.1

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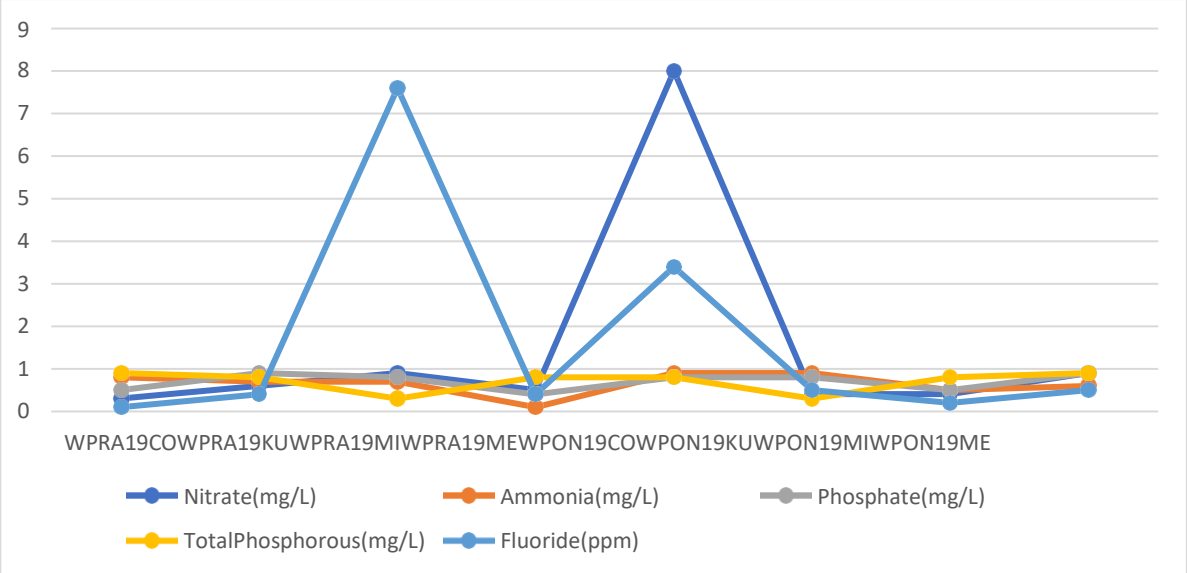
to 3.6 for BPRA19CO to BPON19ME, 0.2 to 0.7 for BPRA20CO to BPON20ME (Figures: 7,9).



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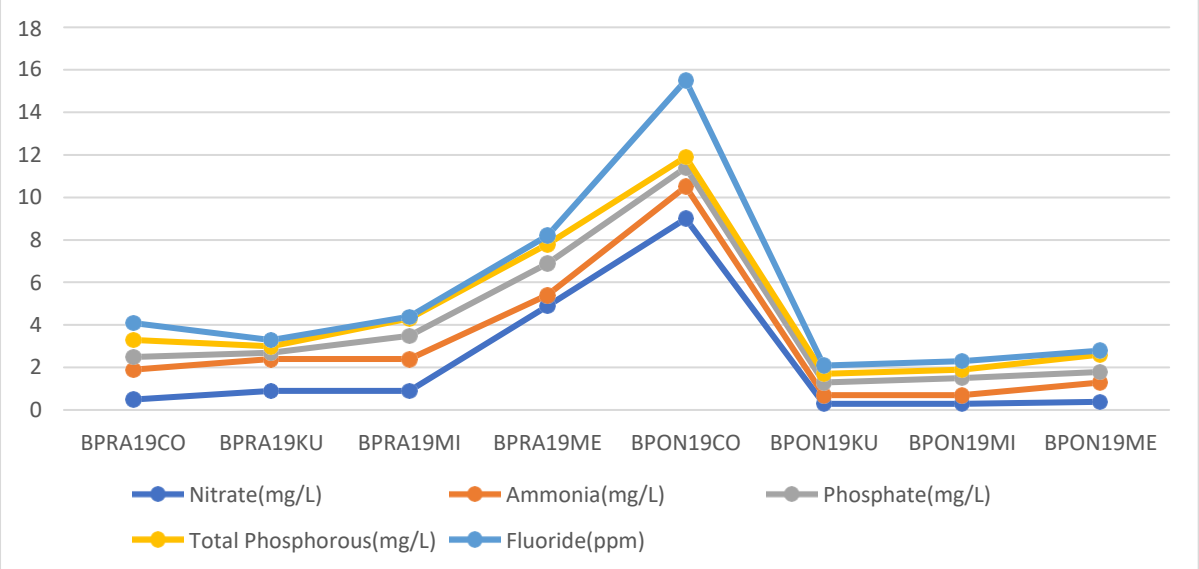

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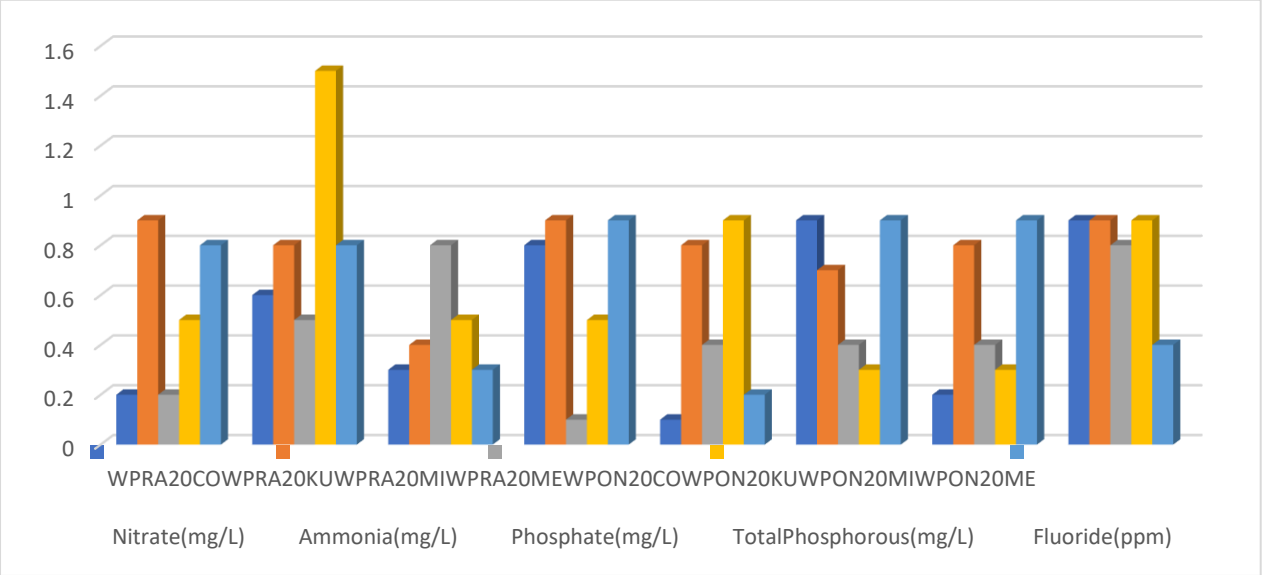

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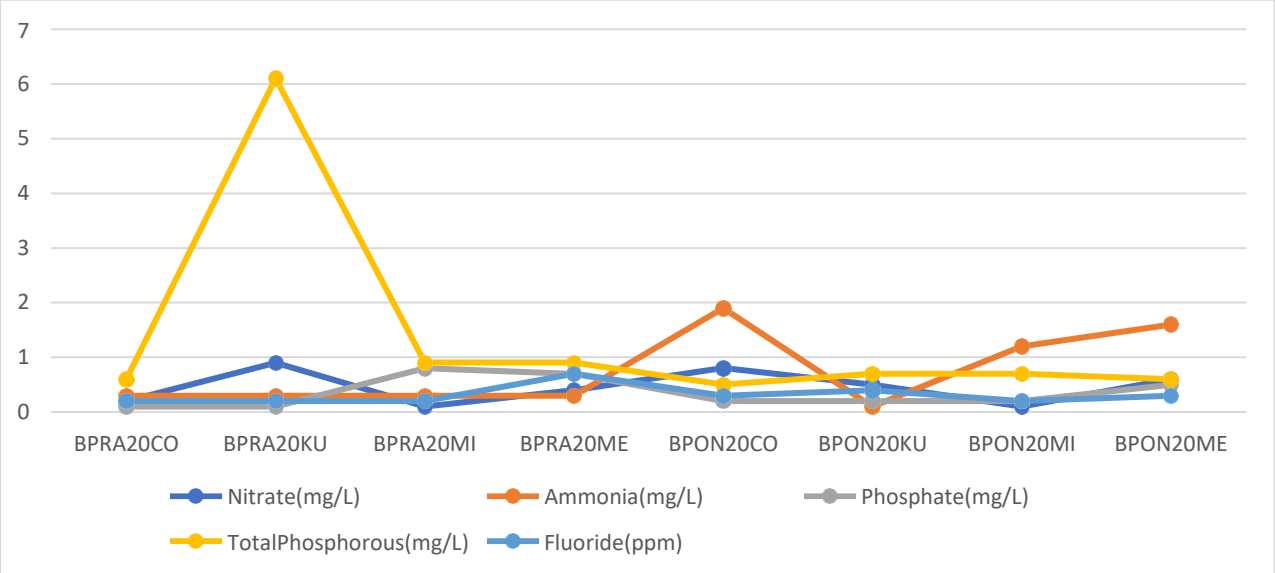

Figure:9

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 211 to 830 for WPRA19CO to WPON19ME, 180 to 390 for WPRA20CO to WPON20ME (Figures: 10,12). Chloride values observed in bore hole water varied between 180 to 392 for BPRA19CO to BPON19ME, 170 to 380 for BPRA20CO to BPON20ME
(Figures: 11,13). The observed values are within the permissible limits.

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Total dissolved solids (TDS)

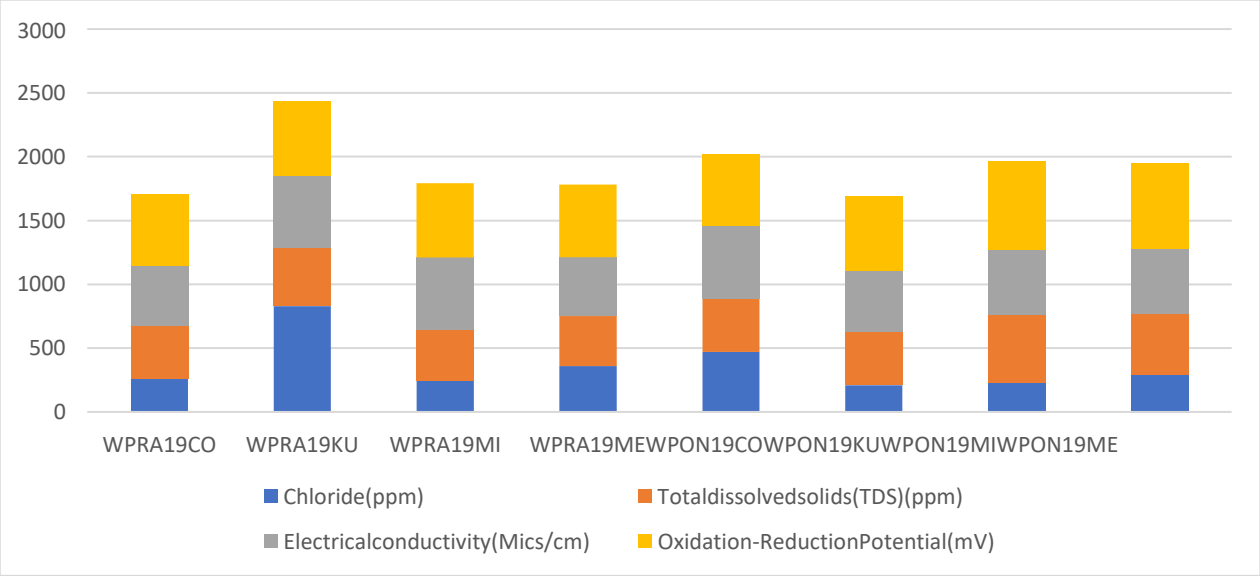
ISI prescribed desirable limit of TDS is 500 mg/L. The TDS values of in well water varied between 390 to 480 for WPRA19CO to WPON19ME, 190 to 592 for WPRA20CO to WPON20ME (Figures: 10,12). TDS values observed in bore hole water varied between 180 to 392 for BPRA19CO to BPON19PME, 380 to 691 for BPRA20CO to BPON20ME (Figures: 11,13). The observed values are within the permissible limits.

Electrical conductivity (EC)

The EC values of in well water varied between 460 to 570 for WPRA19CO to WPON19ME, 420 to 692 for WPRA20CO to WPON20ME (Figures: 10,12). EC values observed in bore hole water varied between 460 to 640 for BPRA19CO to BPON19ME, 136 to 592 for BPRA20CO to BPON20ME (Figures: 11,13). The observed values are within the permissible limits.

Oxidation Reduction potential

ORP values of well water varied between 560 to 671 for WPRA19CO to WPON19ME, 561 to 765 for WPRA20CO to WPON20ME (Figures: 10,12). ORP values observed in bore hole water varied between 630 to 721 for BPRA19CO to BPON19ME, 491 to 792 for BPRA20CO to BPON20ME (Figures: 11,13). The observed values are within the permissible limits.



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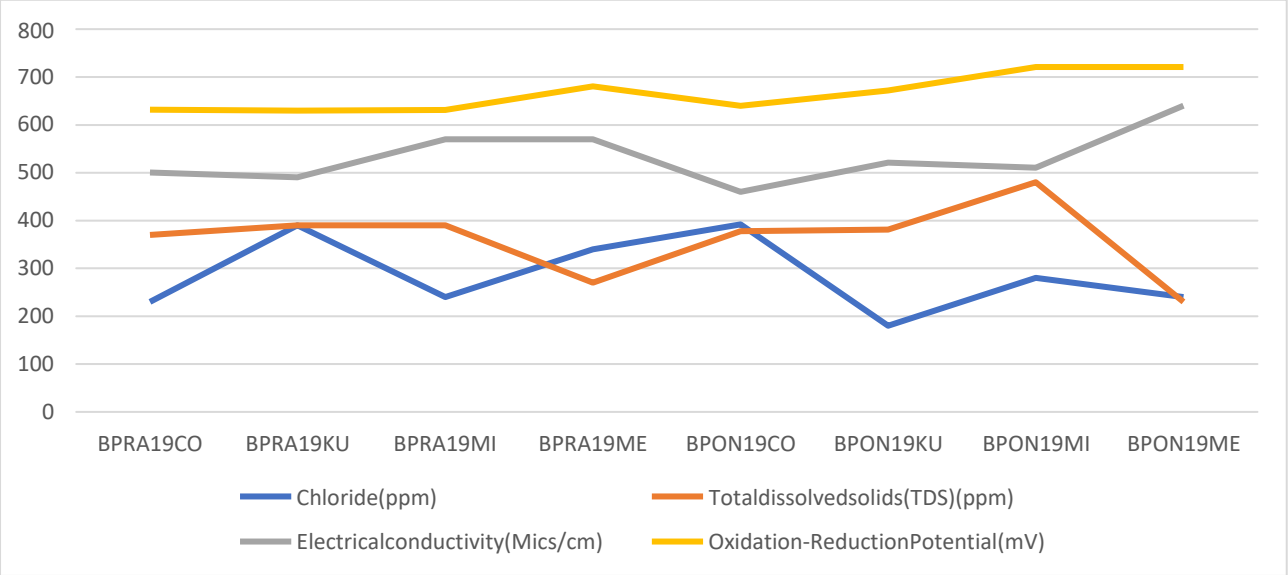

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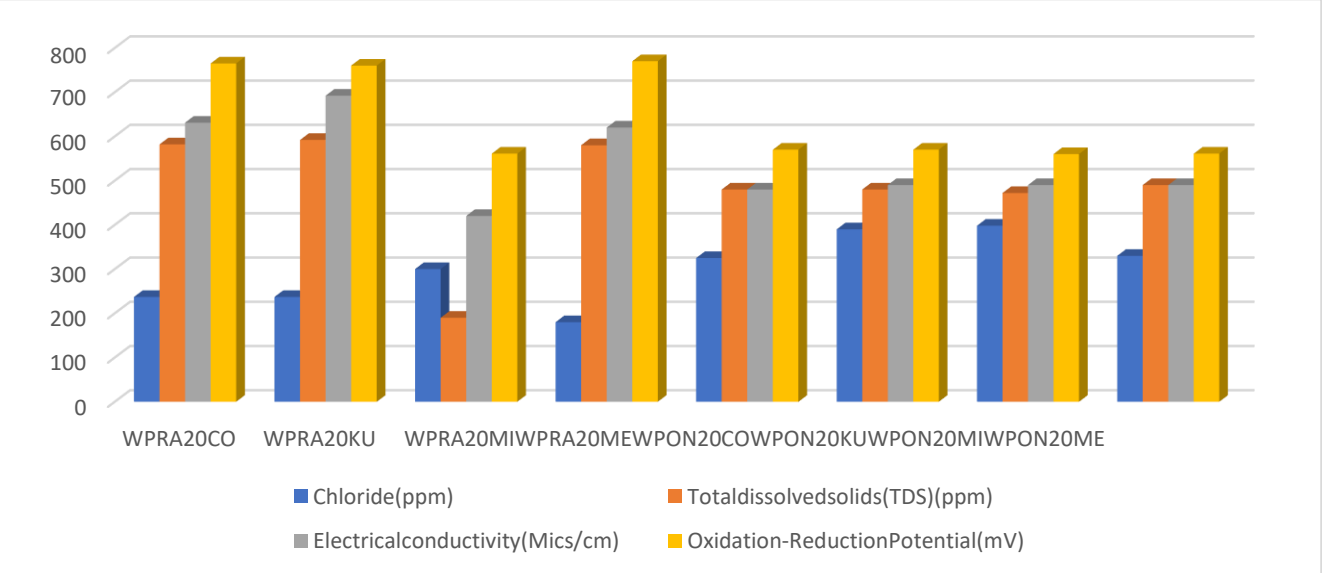

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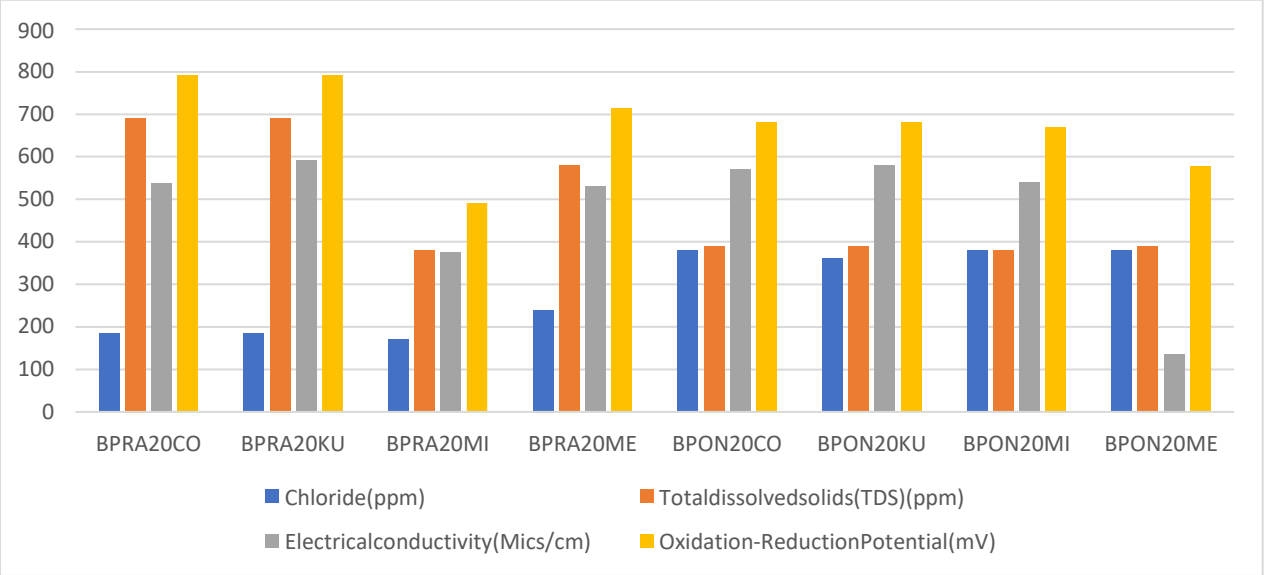

Figure:13

Temperature

The temperature of well water varied between 27 to 30 for WPRA19CO to WPON19ME, 25 to 30 for WPRA20CO to WPON20ME (Figures: 14,16). The temperature of bore hole water varied between 27 to 30 for BPRA19CO to BPON19ME, 27 to 30 for BPRA20CO to BPON20ME (Figures: 15,17).

Sodium (Na^+) and potassium (K^+)

The concentration of sodium in well water varied between 16.8 to 33.5 for WPRA19CO to WPON19ME, 19.3 to 33.5 for WPRA20CO to WPON20ME (Figures: 14,16). The concentration of sodium in bore hole water varied between 17.8 to 33.1 for BPRA19CO to BPON19ME, 11.4 to 31.8 for BPRA20CO to BPON20ME (Figures: 15,17). The observed values are within the permissible limits.

The concentration of potassium in well water varied between 12.4 to 13.9 for WPRA19CO to WPON19ME, 11.3 to 19.6 for WPRA20CO to WPON20ME (Figures: 14,16). The concentration of potassium in bore hole water varied between 11.4 to 20.1 for BPRA19CO to BPON19ME, 11.6 to 18.0 for BPRA20CO to BPON20ME (Figures: 15,17). The observed values are within the permissible limits.

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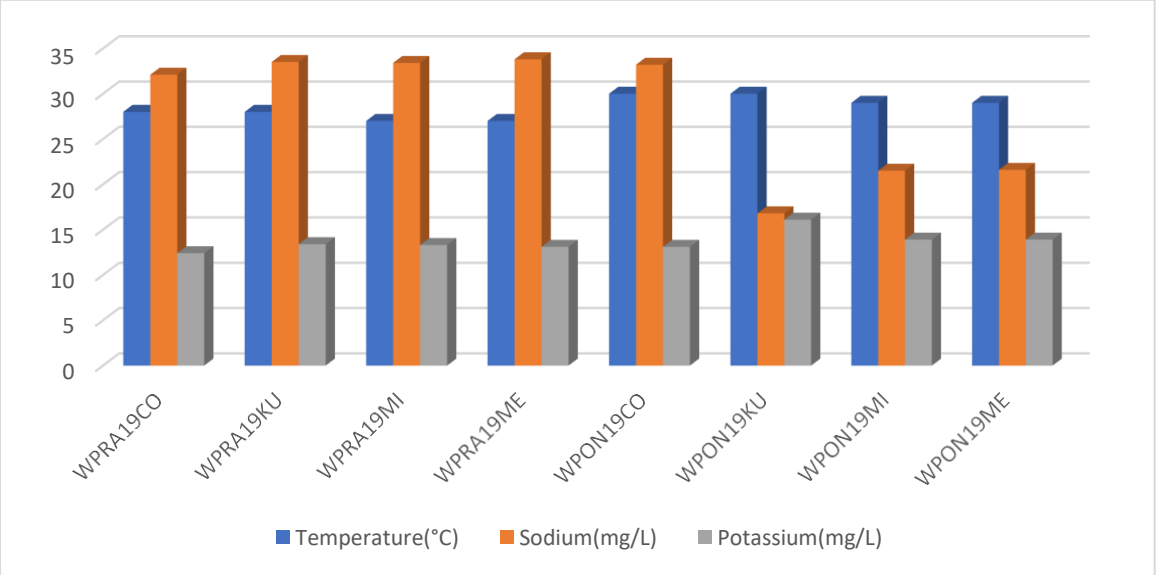

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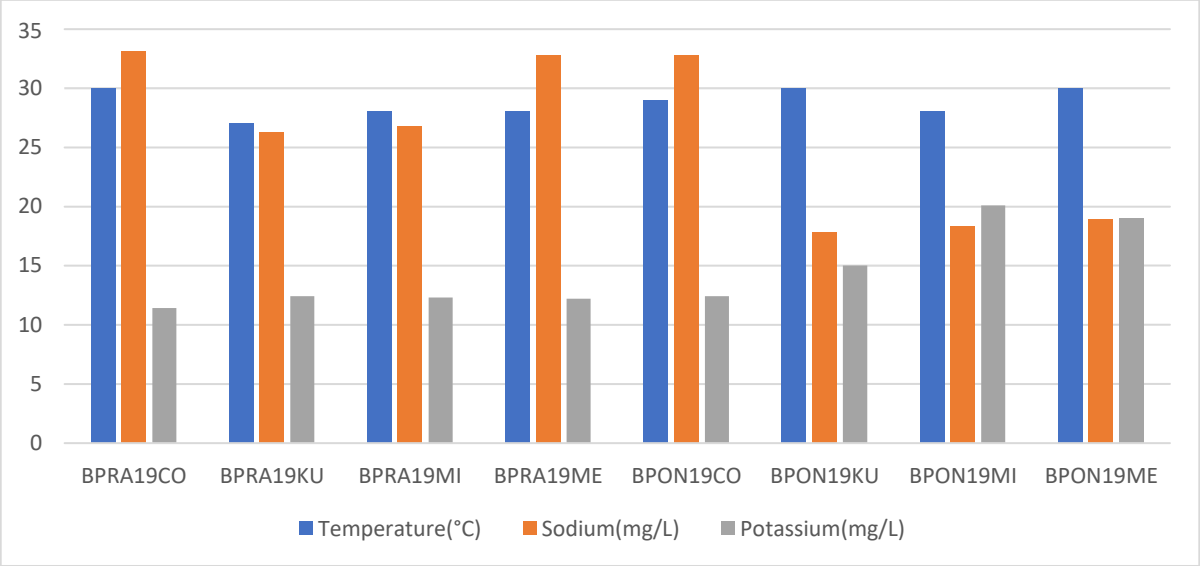

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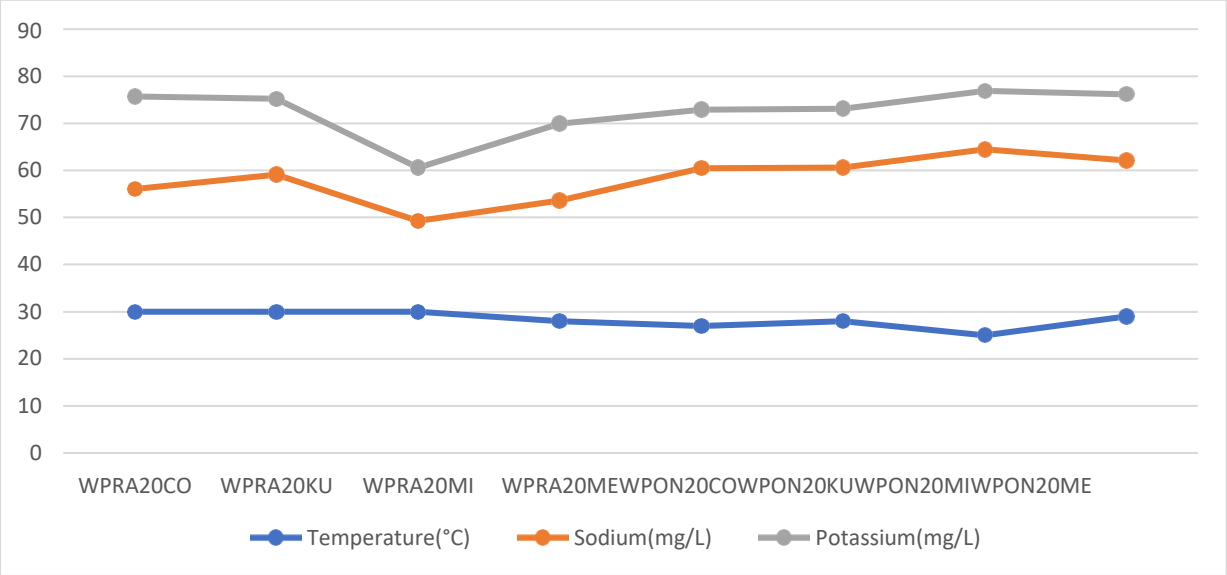

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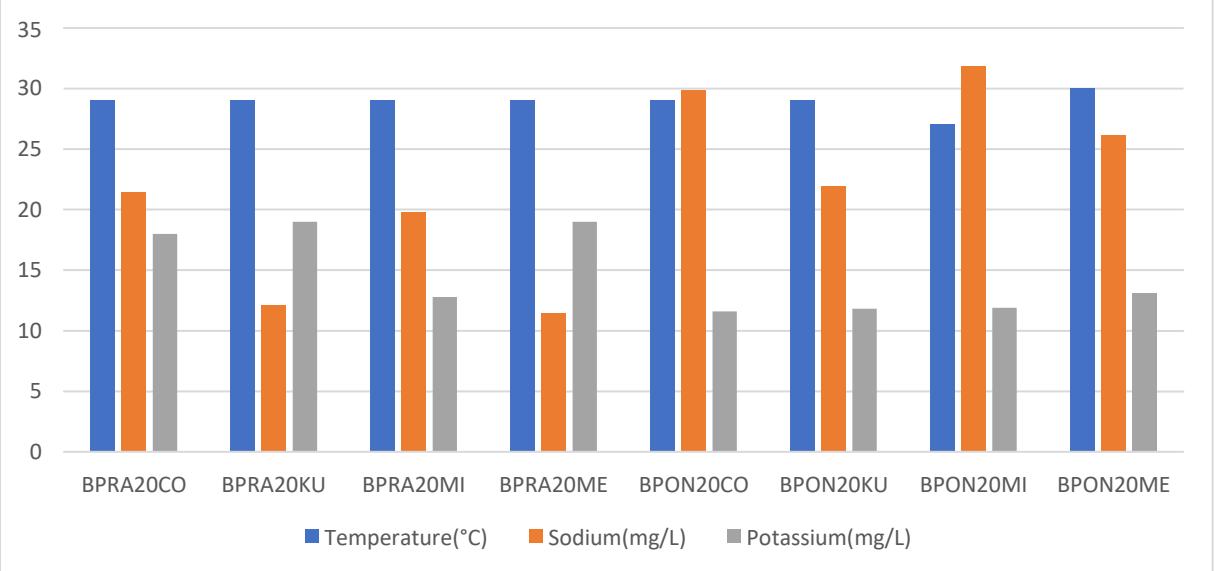

Figure:17

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 168 to 231 for WPRA19CO to WPON19ME, 185 to 330 for WPRA20CO to WPON20ME (Figures: 18,20). The alkalinity values bore hole water varied between 176 to 231 for BPRA19CO to BPON19ME, 154 to 230 for BPRA20CO to BPON20ME (Figures: 19,21). The observed values are within the permissible limits.

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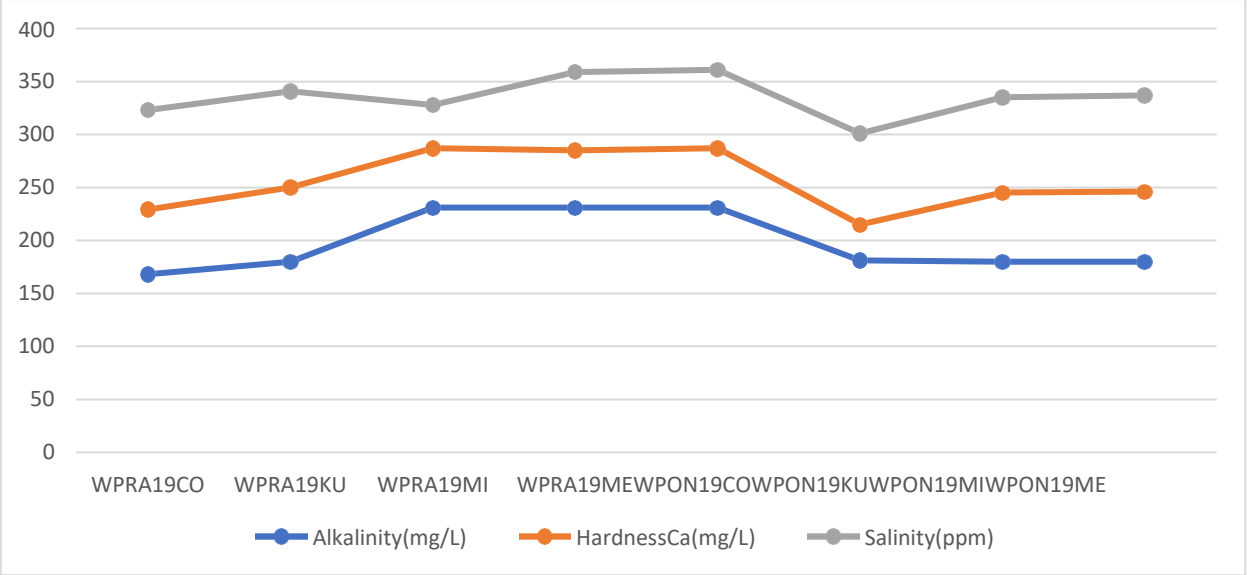
Calcium

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 34 to 70 for WPRA19CO to WPON19ME, 40 to 80 for WPRA20CO to WPON20ME (Figures: 18,20). The Ca content of bore hole water varied between 62 to 86 for BPRA19CO to BPON19ME, 30 to 70 for BPRA20CO to BPON20ME (Figures: 19,21). The observed values are within the permissible limits.

Salinity

The salinity values of well water varied between 41 to 91 for WPRA19CO to WPON19ME, 85 to 110 for WPRA20CO to WPON20ME (Figures: 18,20). The salinity values of bore hole water varied between 70 to 381 for BPRA19CO to BPON19ME, 55 to 161 for BPRA20CO to BPON20ME (Figures: 19,21). The observed values are within the permissible limits.



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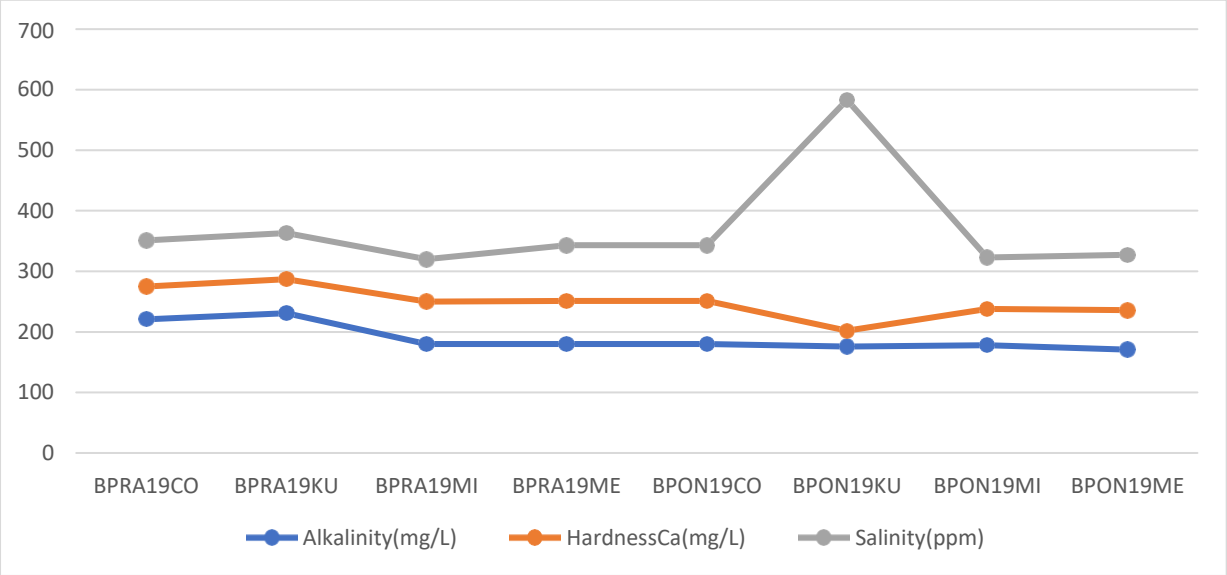

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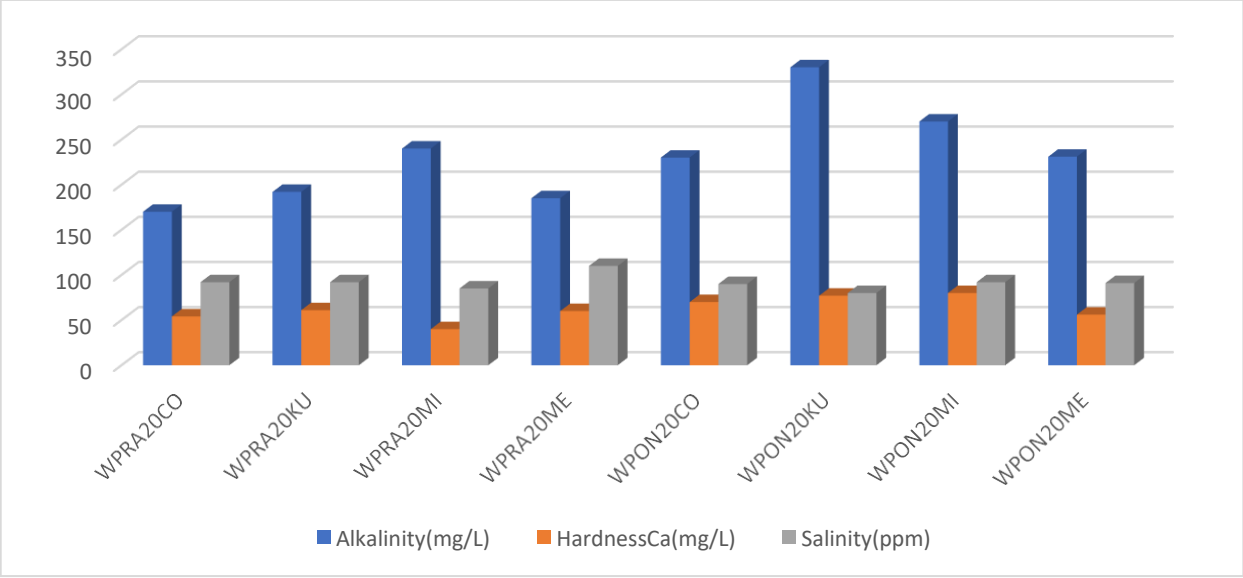

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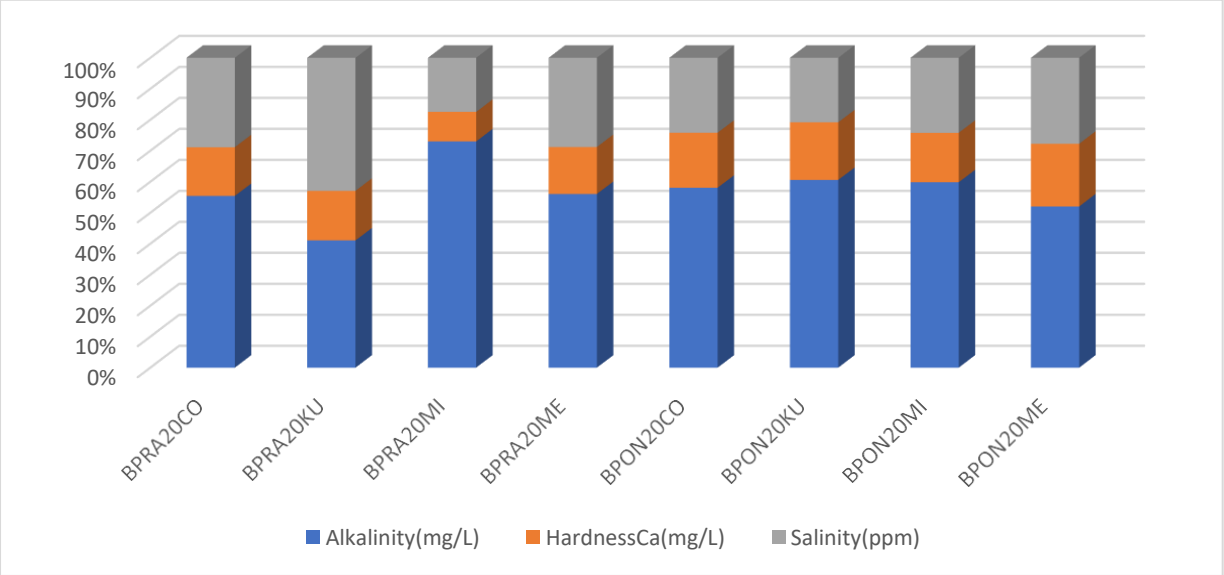

Figure:21

CONCLUSIONS

Conclusively, in this study the water quality properties in terms of its physico- chemical parameters of Colachel, Kurumbanai, Midalam, Melmidalam in Kanyakumari District of 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 (except hardness due to Magnesium) of the World Health Organization (WHO).

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