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ASSESSMENT OF PHYSICO-CHEMICAL PARAMETERS OF GROUND WATER FROM KANYAKUMARI TO PALLAM

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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) Kanyakumari, Keezha manakudy, Chothavilai and Pallam in 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, 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. Overall water quality was found satisfactory for drinking purpose without prior treatment.

Key Words: Well water, bore hole water, Kanyakumari, Keezhamanakudy, Chothavilai, Pallam 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

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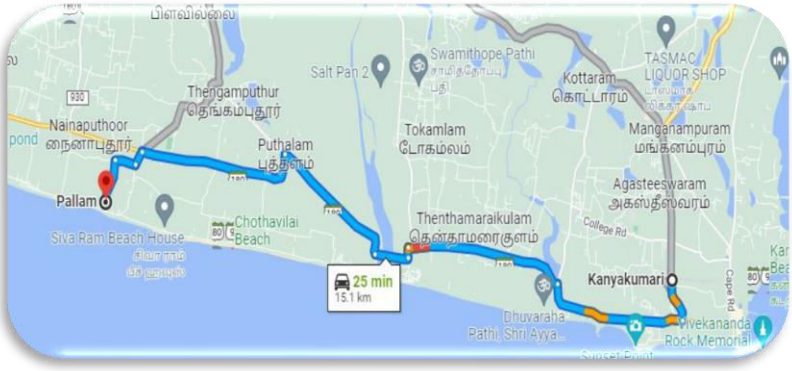
district is divided into four Taluks. The district is part of the composite east flowing river basin "between Pazhayar and Tamirabarani" as per the irrigation Atlas of India[12]. People in Kanya Kumari district depends on well and bore holes for domestic purpose. The quality of ground water from well 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 Kanyakumari, Keezhamanakudy, Chothavilai, and Pallam.

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 Kanyakumari, Keezhamanakudy, Chothavilai, and Pallam in different seasons pre moon and post moon in two years. The stations are referred as KA for Kanykumari, KE for Keezhamanakudy, CH for Chothavilai, PA for Pallam. Well water collected in pre moon season during 2019 are labelled as WPRA19KA, WPRA19KE, WPRA19CH, WPRA19PA. Well water collected in post moon season during 2019 are labelled as WPON19KA, WPON19KE, WPON19CH, WPON19PA. Well water collected in pre moon season during 2020 are labelled as WPRA20KA, WPRA20KE, WPRA20CH, WPRA20PA. Well water collected in post moon season during 2020 are labelled as WPON20KA, WPON20KE, WPON20CH, WPON20PA.

Bore hole water collected in pre moon season during 2019 are labelled as BPRA19KA, BPRA19KE, BPRA19CH, BPRA19PA. Bore hole water collected in post moon season during 2019 are labelled as BPON19KA, BPON19KE, BPON19CH, BPON19PA. Bore hole water collected in pre moon season during 2020 are labelled as BPRA20KA, BPRA20KE, BPRA20CH, BPRA20PA. Bore hole collected in post moon season during 2020 are labelled as BPON20KA, BPON20KE, BPON20CH, BPON20PA.

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,

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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). 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).

ZONE : FROM KANYAKUMARI TO PALLAM Season : Pre monsoon April 2019

Area: Kanyakumari

Table 1 : Physical and Chemical Parameters of well water and bore hole water from Kanyakumari (Pre- April 2019) WPRA19KA, BPRA19KA

	Parameters							
Water	**Temp(°C)**	**pH**	**Turbidity**	**EC (MicS/cm)**	**TDS (mg/L)**	**Sodium (mg/L)**	**Potassium (mg/L)**	**Alkalinity (mg/L)**
Well	26	7	6	510	460	13.8	21.5	17.9
Bore hole	28	8	7.4	640	530	19	19.1	17
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	4.6	0.9	290	460	0.4	0.1	0.8
Bore hole	66	4	0.2	230	530	0.1	7	0.5
Water	**Phosphate (mg/L)**	**Total P (mg/L)**	**Salinity (ppm)**	**DO (mg/L)**	**BOD (mg/L)**	**OXREDPot (mV)**		
Well	0.4	21.5	86	8	9	680		

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Bore hole	0.8	18.7	92	7	5.4	720		

ZONE : FROM KANYAKUMARI TO PALLAM Season : Pre monsoon April 2019

Area: Keezha manakudy

Table 2 : Physical and Chemical Parameters of well water and bore hole water from Keezha manakudy (Pre- April 2019) WPRA19KE, BPRA19KE

	Parameters							
Water	**Temp(°C)**	**pH**	**Turbidity**	**EC (MicS/cm)**	**TDS (mg/L)**	**Sodium (mg/L)**	**Potassium (mg/L)**	**Alkalinity (mg/L)**
Well	27	8	7	509	481	13.9	13.8	187
Bore hole	30	6.5	7.3	650	531	19	19.1	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	61	4.6	0.5	290	4.9	0.5	5.9	0.6
Bore hole	66	3	0.2	231	3.8	0.3	7	0.8
Water	**Phosphate (mg/L)**	**Total P (mg/L)**	**Salinity (ppm)**	**DO (mg/L)**	**BOD (mg/L)**	**OXRED Pot (mV)**		
Well	0.9	0.6	86	7	9	680		
Bore hole	0.5	21.5	91	8	5.5	720		

ZONE : FROM KANYAKUMARI TO PALLAM Season : Pre monsoon April 2019

Area: Chothavilai

Table 3 : Physical and Chemical Parameters of well water and bore hole water from Chothavilai (Pre-April 2019)WPRA19CH, BPRA19CH

	Parameters							
Water	**Temp(°C)**	**pH**	**Turbidity**	**EC (MicS/cm)**	**TDS (mg/L)**	**Sodium (mg/L)**	**Potassium (mg/L)**	**Alkalinity (mg/L)**
Well	28	8	7	510	460	21.6	18.9	168
Bore hole	27	6.7	7.8	680	530	18.9	18	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	61	4.6	0.5	290	4.9	0.5	5.6	0.6
Bore hole	65	3	0.2	280	3.9	0.4	7	0.4
Water	**Phosphate (mg/L)**	**Total P (mg/L)**	**Salinity (ppm)**	**DO (mg/L)**	**BOD (mg/L)**	**OXRED Pot (mV)**		
Well	0.9	0.4	85	8	9	690		
Bore hole	0.5	0.9	90	7	5.8	780		

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ZONE : FROM KANYAKUMARI TO PALLAM Season : Pre monsoon April 2019

Area: Pallam

Table 4 : Physical and Chemical Parameters of well water and bore hole water from Pallam (Pre -April 2019) WPRA19PA, BPRA19PA

	Parameters							
Water	**Temp(°C)**	**pH**	**Turbidity**	**EC (MicS/cm)**	**TDS (mg/L)**	**Sodium (mg/L)**	**Potassium (mg/L)**	**Alkalinity (mg/L)**
Well	26	8	4	610	560	12.4	24	189
Bore hole	25	6.8	3	520	720	17.1	26	169
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	76	3.5	0.4	289	4.3	0.1	0.1	0.2
Bore hole	86	4.5	0.1	200	2.3	0.3	0.2	0.6
Water	**Phosphate (mg/L)**	**Total P (mg/L)**	**Salinity (ppm)**	**DO (mg/L)**	**BOD (mg/L)**	**OXRED Pot (mV)**		
Well	0.3	25.4	80	7	9	800		
Bore hole	0.8	16.6	95	6	6	610		

ZONE : FROM KANYAKUMARI TO PALLAM Season : Post monsoon November 2019

Area: Kanyakumari

Table 5 : Physical and Chemical Parameters of well water and bore hole water from Kanyakumari (Post-November 2019) WPON19KA, BPON19KA

	Parameters							
Water	**Temp(°C)**	**pH**	**Turbidity**	**EC (MicS/cm)**	**TDS (mg/L)**	**Sodium (mg/L)**	**Potassium (mg/L)**	**Alkalinity (mg/L)**
Well	27	8	6	510	481	21.5	13.8	178
Bore hole	26	6.8	7.3	641	531	18.7	19	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	61	4.5	0.4	281	4.5	0.5	5.6	0.5
Bore hole	65	3	0.9	230	3.9	0.3	7	0.4
Water	**Phosphate (mg/L)**	**Total P (mg/L)**	**Salinity (ppm)**	**DO (mg/L)**	**BOD (mg/L)**	**OXREDPot (mV)**		
Well	0.9	0.6	85	8	9	680		
Bore hole	0.5	0.8	90	7	5.6	920		

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ZONE : FROM KANYAKUMARI TO PALLAM Season : Post monsoon November 2019

Area: Keezha Manakudy

Table 6 : Physical and Chemical Parameters of well water and bore hole water from Keezha Manakudy (Post -November 2019), WPON19KE, BPON19KE

	Parameters							
Water	**Temp(°C)**	**pH**	**Turbidity**	**EC (MicS/cm)**	**TDS (mg/L)**	**Sodium (mg/L)**	**Potassium (mg/L)**	**Alkalinity (mg/L)**
Well	28	7	7	510	490	21.5	18.8	187
Bore hole	30	6.9	8.3	640	530	22.1	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	61	4.6	0.9	290	490	21.5	5.6	0.6
Bore hole	62	3	0.2	530	530	22.1	7	0.9
Water	**Phosphate (mg/L)**	**Total P (mg/L)**	**Salinity (ppm)**	**DO (mg/L)**	**BOD (mg/L)**	**OXREDPot (mV)**		
Well	0.8	2.4	85	8	9	680		
Bore hole	0.9	0.8	90	7	5.4	780		

ZONE : FROM KANYAKUMARI TO PALLAM Season : Post monsoon November 2019

Area: Chothavilai

Table 7 : Physical and Chemical Parameters of well water and bore hole water from Chothavilai (Post - November 2019), WPON19CH, BPON19CH

	Parameters							
Water	**Temp(°C)**	**pH**	**Turbidity**	**EC (MicS/cm)**	**TDS (mg/L)**	**Sodium (mg/L)**	**Potassium (mg/L)**	**Alkalinity (mg/L)**
Well	27	7	6	510	480	21.2	13.9	178
Bore hole	28	6.9	7.3	640	530	18.1	19	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	60	4.5	0.4	290	4.3	0.4	5.6	0.8
Bore hole	365	3	0.2	230	3.9	0.9	7	0.4
Water	**Phosphate (mg/L)**	**Total P (mg/L)**	**Salinity (ppm)**	**DO (mg/L)**	**BOD (mg/L)**	**OXREDPot (mV)**		
Well	0.9	0.4	85	8	9	690		
Bore hole	0.6	0.9	90	7	5.4	730		

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ZONE : FROM KANYAKUMARI TO PALLAM Season : Post monsoon November 2019

Area: Pallam

Table 8 : Physical and Chemical Parameters of well water and bore hole water from Pallam (Post-November 2019) WPON19PA, BPON19PA

	Parameters							
Water	**Temp(°C)**	**pH**	**Turbidity**	**EC (MicS/cm)**	**TDS (mg/L)**	**Sodium (mg/L)**	**Potassium (mg/L)**	**Alkalinity (mg/L)**
Well	29	6	7	410	480	21.4	13.9	179
Bore hole	30	6.9	7.8	641	530	18.7	19	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	60	4.5	0.4	290	4.3	0.4	5.6	0.5
Bore hole	66	3	0.2	230	3.8	0.3	7	0.8
Water	**Phosphate (mg/L)**	**Total P (mg/L)**	**Salinity (ppm)**	**DO (mg/L)**	**BOD (mg/L)**	**OXREDPot (mV)**		
Well	0.9	0.4	85	8	9	680		
Bore hole	0.5	0.8	92	7	5.4	721		

ZONE : FROM KANYAKUMARI TO PALLAM Season : Pre monsoon April 2020

Area: Kanyakumari

Table 9 : Physical and Chemical Parameters of well water and bore hole water from Kanyakumari (Pre -April 2020) WPRA20KA, BPRA20KA

	Parameters							
Water	**Temp(°C)**	**pH**	**Turbidity**	**EC (MicS/cm)**	**TDS (mg/L)**	**Sodium (mg/L)**	**Potassium (mg/L)**	**Alkalinity (mg/L)**
Well	29	7	7.3	480	420	18.1	16	180
Bore hole	28	7.5	8	520	390	19.2	15	175
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	39	13	0.3	210	2.9	0.4	7.8	0.4
Bore hole	20	11	0.2	190	3.8	0.3	6.5	0.3
Water	**Phosphate (mg/L)**	**Total P (mg/L)**	**Salinity (ppm)**	**DO (mg/L)**	**BOD (mg/L)**	**OXREDPot (mV)**		
Well	0.6	0.8	85	7	7.5	591		
Bore hole	0.9	0.3	40	8	8.3	652		

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ZONE : FROM KANYAKUMARI TO PALLAM Season : Pre monsoon April 2020

Area: Keezha manakudy

Table 10 : Physical and Chemical Parameters of well water and bore hole water from Keezha manakudy (Pre-April 2020) WPRA20KE, BPRA20KE

	Parameters							
Water	**Temp(°C)**	**pH**	**Turbidity**	**EC (MicS/cm)**	**TDS (mg/L)**	**Sodium (mg/L)**	**Potassium (mg/L)**	**Alkalinity (mg/L)**
Well	28	8.5	8	480	391	19.3	16.1	191
Bore hole	29	8	7.8	521	421	18.5	15.2	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	38	13	0.9	190	3.9	0.4	7.8	0.4
Bore hole	21	14	0.2	210	2.9	0.3	6.5	0.3
Water	**Phosphate (mg/L)**	**Total P (mg/L)**	**Salinity (ppm)**	**DO (mg/L)**	**BOD (mg/L)**	**OXRED Pot (mV)**		
Well	0.6	0.8	40	7	7.8	592		
Bore hole	0.9	0.3	85	8	8.3	692		

ZONE : FROM KANYAKUMARI TO PALLAM Season : Pre monsoon April 2020

Area: Chothavilai

Table 11 : Physical and Chemical Parameters of well water and bore hole water from Chothavilai (Pre-April 2020) WPRA20CH, BPRA20CH

	Parameters							
Water	**Temp(°C)**	**pH**	**Turbidity**	**EC (MicS/cm)**	**TDS (mg/L)**	**Sodium (mg/L)**	**Potassium (mg/L)**	**Alkalinity (mg/L)**
Well	29	7.5	8.5	562	382	32.9	13.4	241
Bore hole	27	7.6	9	482	462	31.1	11.6	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	57	62	0.6	361	4.4	0.8	5.4	0.9
Bore hole	82	44	0.5	381	4.5	0.6	6	0.2
Water	**Phosphate (mg/L)**	**Total P (mg/L)**	**Salinity (ppm)**	**DO (mg/L)**	**BOD (mg/L)**	**OXRED Pot (mV)**		
Well	0.6	0.8	78	8	8	563		
Bore hole	0.5	0.7	93	9	6.2	672		

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ZONE : FROM KANYAKUMARI TO PALLAM Season : Pre monsoon April 2020

Area: Pallam

Table 12 : Physical and Chemical Parameters of well water and bore hole water from Pallam (Pre-April 2020) WPRA20PA, BPRA20PA

	Parameters							
Water	**Temp(°C)**	**pH**	**Turbidity**	**EC (MicS/cm)**	**TDS (mg/L)**	**Sodium (mg/L)**	**Potassium (mg/L)**	**Alkalinity (mg/L)**
Well	29	7.5	8.9	492	460	38.1	13.1	190
Bore hole	30	7.6	6	591	380	34.1	10.4	240
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	0.5	321	4.8	0.8	6	0.9
Bore hole	71	61	0.4	281	4.9	0.1	5.3	1.3
Water	**Phosphate (mg/L)**	**Total P (mg/L)**	**Salinity (ppm)**	**DO (mg/L)**	**BOD (mg/L)**	**OXRED Pot (mV)**		
Well	0.6	0.5	76	8	7	580		
Bore hole	0.7	0.8	92	9	6.2	610		

ZONE : FROM KANYAKUMARI TO PALLAM Season : Post monsoon November 2020

Area: Kanyakumari

Table 13 : Physical and Chemical Parameters of well water and bore hole water from Kanyakumari (Post-November 2020) WPON20KA, BPON20KA

	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	8.9	472	492	31.1	12.3	191
Bore hole	29	7.5	7.1	561	380	38.2	11.4	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	56	69	0.9	391	4.9	0.9	8	0.9
Bore hole	78	42	0.1	462	4.8	0.3	5.8	0.2
Water	**Phosphate (mg/L)**	**Total P (mg/L)**	**Salinity (ppm)**	**DO (mg/L)**	**BOD (mg/L)**	**OXREDPot (mV)**		
Well	0.6	0.8	93	8	4	530		
Bore hole	0.7	0.9	74	6	6.1	661		

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ZONE : FROM KANYAKUMARI TO PALLAM Season : Post monsoon November 2020

Area: Keezha Manakudy

Table 14 : Physical and Chemical Parameters of well water and bore hole water from Keezha Manakudy (Post- November 2020) WPON20KE, BPON20KE

	Parameters							
Water	**Temp(°C)**	**pH**	**Turbidity**	**EC (MicS/cm)**	**TDS (mg/L)**	**Sodium (mg/L)**	**Potassium (mg/L)**	**Alkalinity (mg/L)**
Well	29	7.6	6	411	460	32.1	12.4	241
Bore hole	30	7.5	8.9	561	380	33.2	11.9	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	71	71	0.4	0.4	4.9	0.8	6	0.8
Bore hole	58	42	0.5	0.5	4.6	0.1	5.2	1.2
Water	**Phosphate (mg/L)**	**Total P (mg/L)**	**Salinity (ppm)**	**DO (mg/L)**	**BOD (mg/L)**	**OXREDPot (mV)**		
Well	0.5	0.6	92	7.1	8	580		
Bore hole	0.2	0.9	76	7	6.2	661		

ZONE : FROM KANYAKUMARI TO PALLAM Season : Post monsoon November 2020

Area: Chothavilai

Table 15 : Physical and Chemical Parameters of well water and bore hole water from Chothavilai (Post - November 2020) WPON20CH, BPON20CH

	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	8.9	498	490	32.2	13.2	241
Bore hole	27	7.6	6	562	390	34.8	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	61	0.4	326	4.9	0.9	6	0.8
Bore hole	71	42	0.5	381	4.5	0.5	5.2	1.2
Water	**Phosphate (mg/L)**	**Total P (mg/L)**	**Salinity (ppm)**	**DO (mg/L)**	**BOD (mg/L)**	**OXREDPot (mV)**		
Well	0.5	0.6	92	9	7	576		
Bore hole	0.6	0.8	96	8	6.2	666		

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ZONE : FROM KANYAKUMARI TO PALLAM Season : Post monsoon November 2020

Area: Pallam

Table 16: Physical and Chemical Parameters of well water and bore hole water from Pallam (Post -November 2020) WPON20PA, BPON20PA

	Parameters							
Water	**Temp(°C)**	**pH**	**Turbidity**	**EC (MicS/cm)**	**TDS (mg/L)**	**Sodium (mg/L)**	**Potassium (mg/L)**	**Alkalinity (mg/L)**
Well	28	7.2	8.2	490	460	26.8	13.3	180
Bore hole	29	7.8	7	560	390	33.4	12.3	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	70	0.4	330	4.2	0.9	8	0.7
Bore hole	56	41	0.3	390	4.8	0.4	6.9	1.5
Water	**Phosphate (mg/L)**	**Total P (mg/L)**	**Salinity (ppm)**	**DO (mg/L)**	**BOD (mg/L)**	**OXREDPot (mV)**		
Well	0.8	0.3	91	8.1	7	581		
Bore hole	1.1	0.8	76	9.6	6.1	631		

pH

pH is an indicative of acidity or basicity of water. The pH values of well water varied between 6.0 to 8.0 for WPRA19KA to WPON19PA, 7.0 to 8.5 for WPRA20KA to WPON20PA (Figures: 2,4). The pH values of bore hole water varied between 6.5 to 6.9 for BPRA19KA to BPON19PA, 7.5 to 8.0 for BPRA20KA to BPON20PA (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 4.0 to 6.0 for WPRA19KA to WPON19PA, 6.0 to 8.9 for WPRA20KA to WPON20PA (Figures: 2,4). The turbidity values of bore hole water varied between 7.3 to 8.3 for BPRA19KA to BPON19PA, 6.0 to 8.9 for BPRA20KA to BPON20PA (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 7.0 to 8.0 for WPRA19KA to WPON19PA, 7.1 to 9.0 for WPRA20KA to WPON20PA (Figures: 2,4). DO values of bore hole water varied between 7.0 to 8.0 for BPRA19KA to BPON19PA, 7.0 to 9.6 for BPRA20KA to BPON20PA (Figures: 3,5). In all the cases, dissolved oxygen is present more.

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Biochemical oxygen demand

The permissible limit for BOD as per WHO is 5 mg/L. BOD values of well water varied between 9.0 to 9.1 for WPRA19KA to WPON19PA, 4.0 to 8.0 for WPRA20KA to WPON20PA (Figures: 2,4). BOD values of bore hole water varied between 5.4 to 6.0 for BPRA19KA to BPON19PA, 6.1 to 8.3 for BPRA20KA to BPON20PA (Figures: 3,5).

Magnesium

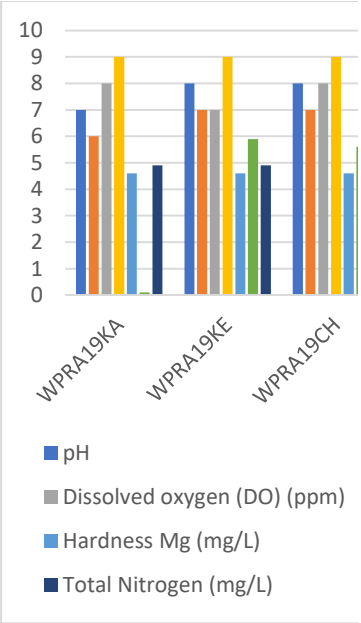
The upper limit of magnesium concentration in drinking water is specified as 30 mg/L (ISI, 1983). Magnesium content in well water varied between 3.5 to 4.5 for WPRA19KA to WPON19PA, 13.0. to 70 for WPRA20KA to WPON20PA (Figures: 2,4). Magnesium content in bore hole water varied between 3.0 to 4.5 for BPRA19KA to BPON19PA, 11.0 to 61for BPRA20KA to BPON20PA (Figures: 3,5). The observed values are not within the permissible limits except for WPRA19KA to WPON19PA

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 5.6 for WPRA19KA to WPON19PA, 6.0 to 7.8 for WPRA20KA to WPON20PA (Figures: 2,4). The sulphate values of bore hole water varied between 0.2 to 0.7 for BPRA19KA to BPON19PA, 6.0 to 7.8 for BPRA20KA to BPON20PA (Figures: 3,5). The observed sulphate values are within the permissible limits.

Nitrate

The nitrate values of well water varied between 0.1 to 0.5 for WPRA19KA to WPON19PA, 0.4 to 0.9 WPRA20KA to WPON20PA (Figures: 6,8). The nitrate values of bore hole water varied between 0.3 to 0.6 for BPRA19KA to BPON19PA, 0.1 to 0.6 for BPRA20KA to BPON20PA (Figures: 7,9). The observed values are within the permissible limits.



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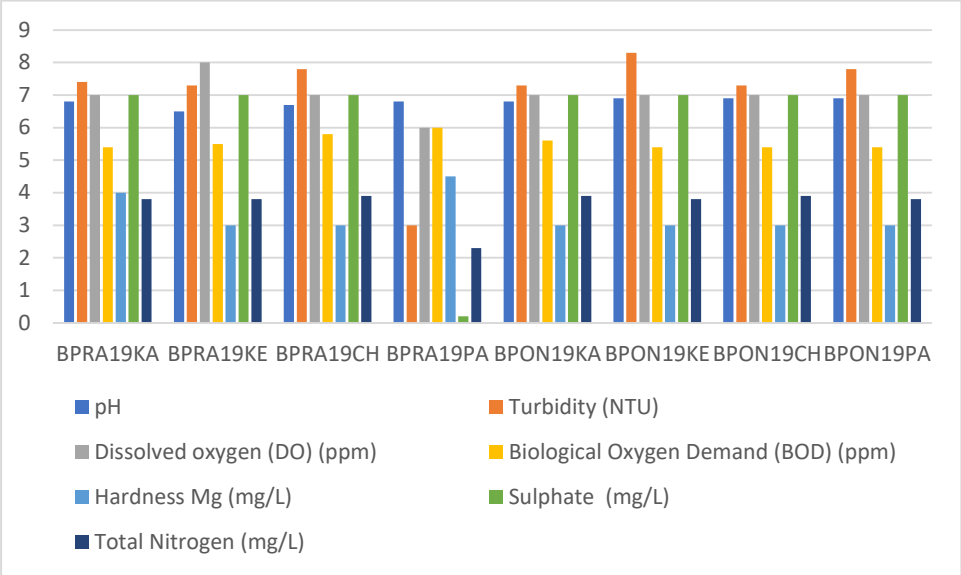

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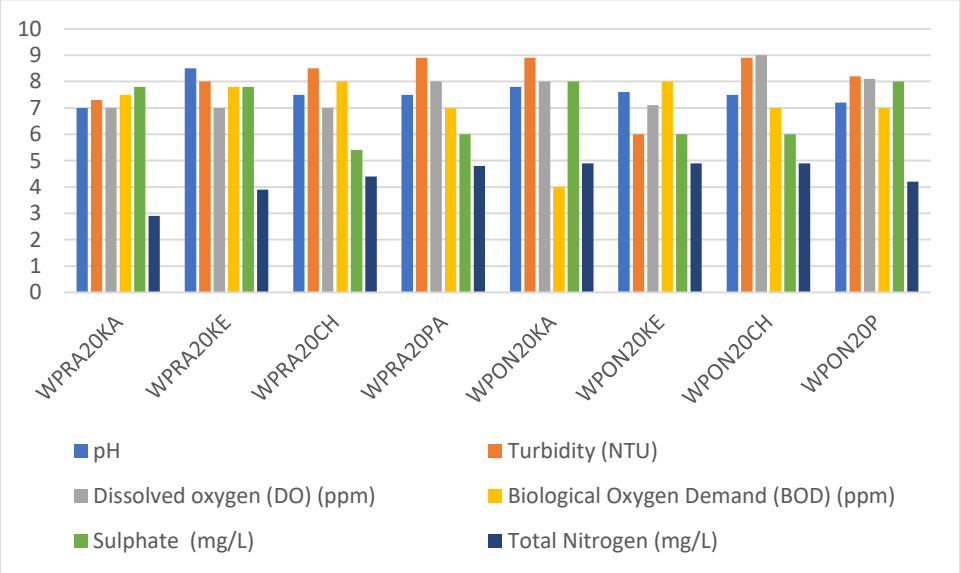

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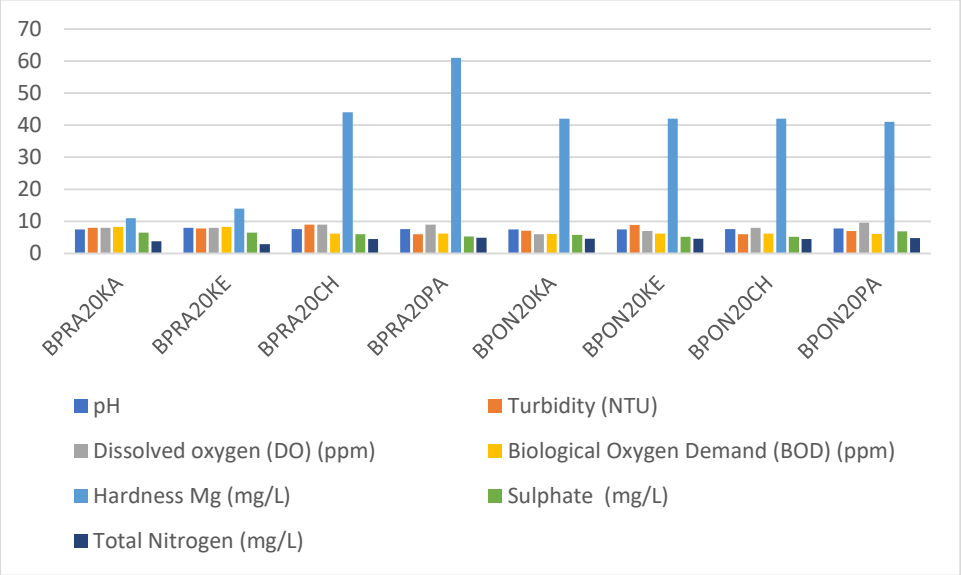

Figure : 5

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 2.4 for WPRA19KA to WPON19PA, 0.5-0.8 for WPRA20KA to WPON20PA (Figures: 6,8). The phosphate values of bore hole water varied between 0.5 to 0.9 for BPRA19KA to BPON19PA, 0.2 to1.1 for BPRA20KA to BPON20PA (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 0.4 to 0.9 for WPRA19KA to WPON19PA,0.3 to 0.9 for WPRA20KA to WPON20PA (Figures: 6,8). Fluoride values observed in bore hole water varied between0.1 to 0.9 for BPRA19KA to BPON19PA, 00.1 to 0.5 for BPRA20KA to BPON20PA (Figures: 7,9).

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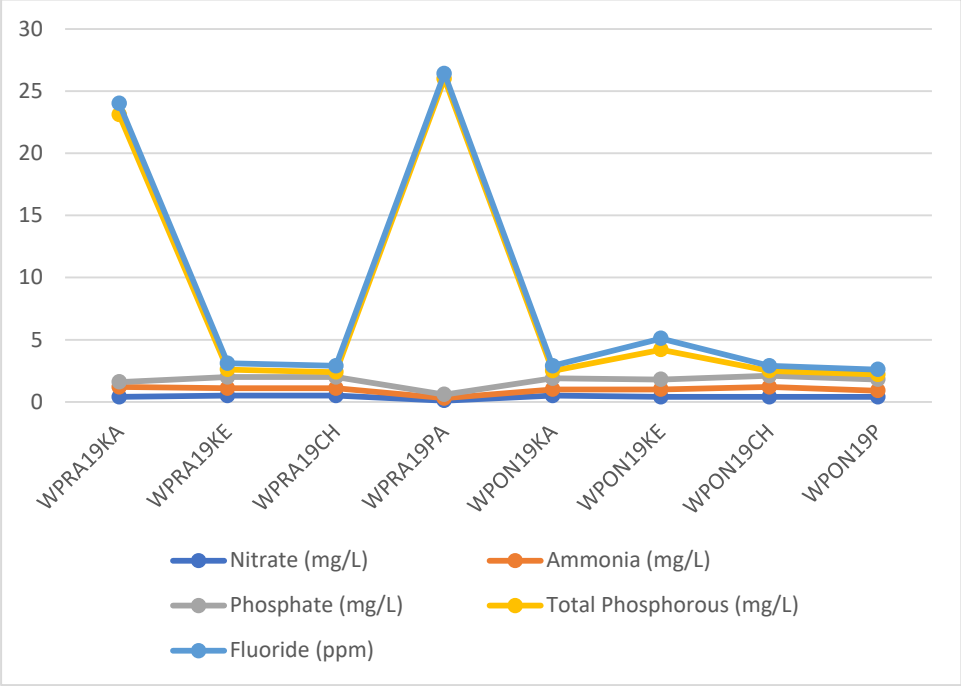

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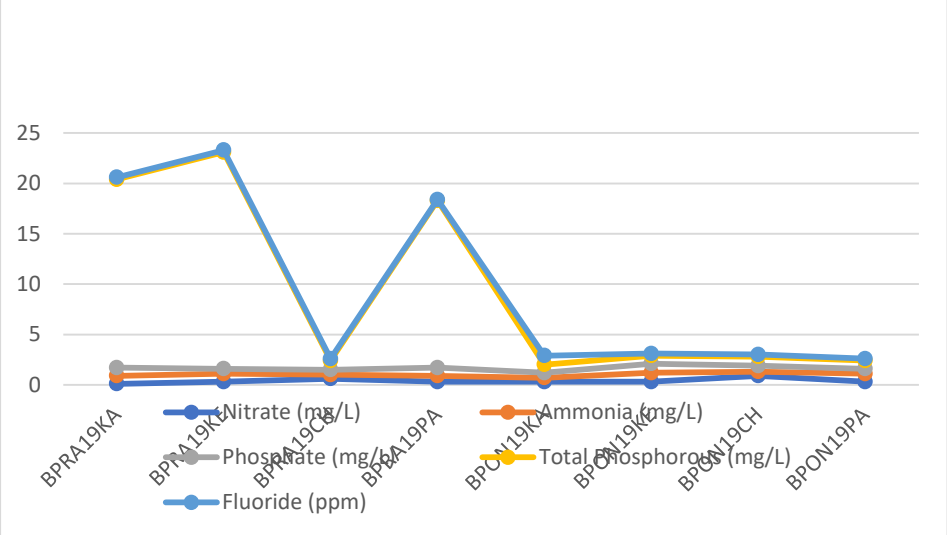

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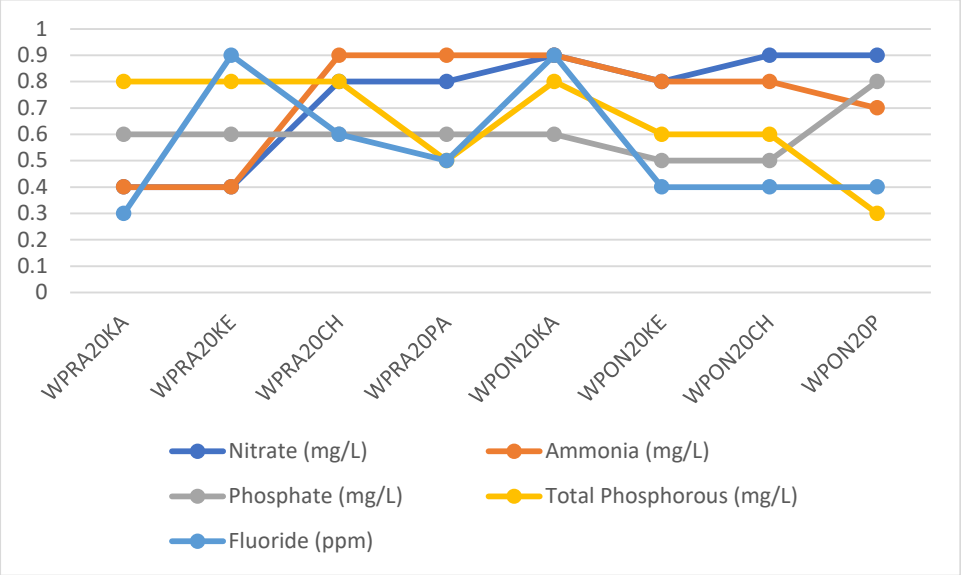

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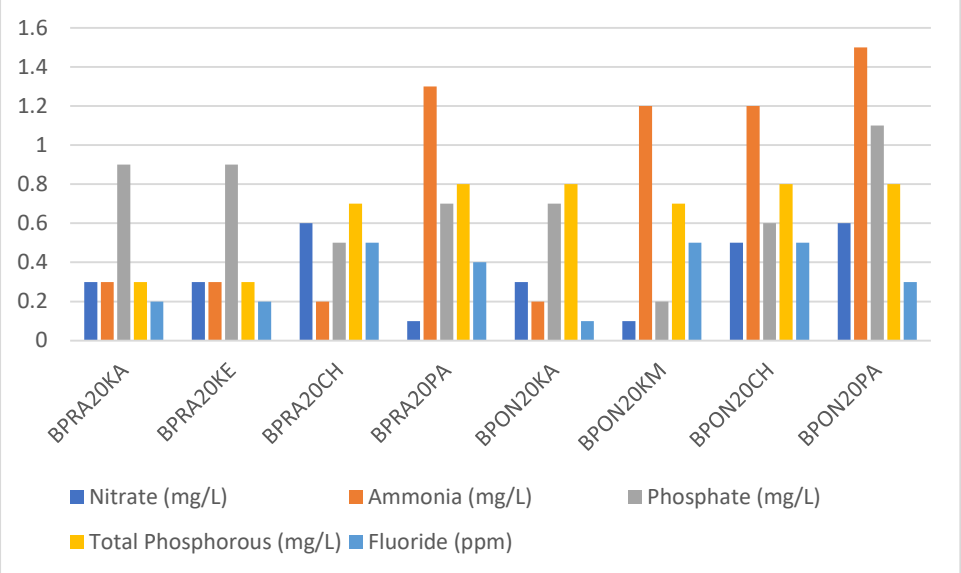

Figure : 9

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 230 to 280 for WPRA19KA to WPON19PA, 190 to 462 for WPRA20KA to WPON20PA (Figures: 10,12). Chloride values observed in bore hole water varied between 289 to 291 for BPRA19KA to BPON19PA, 190 to 462 for BPRA20KA to BPON20PA (Figures: 11,13). The observed values are within the permissible limits.

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Total dissolved solids (TDS)

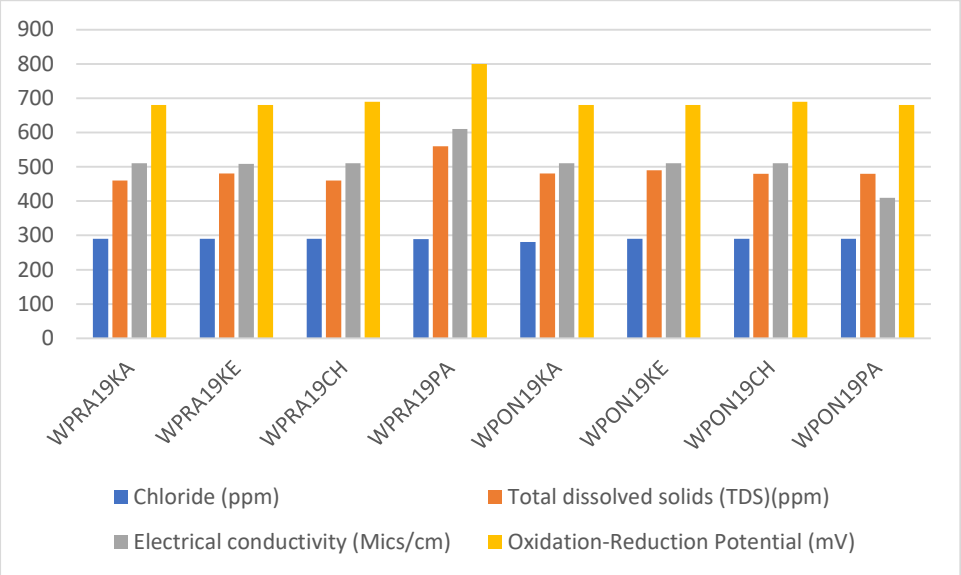
ISI prescribed desirable limit of TDS is 500 mg/L. The TDS values of in well water varied between 460 to 560 for WPRA19KA to WPON19PA, 391to 492 for WPRA20KA to WPON20PA (Figures: 10,12). TDS values observed in bore hole water varied between 530 to 720 for BPRA19KA to BPON19PA, 380 to 462 for BPRA20KA to BPON20PA (Figures: 11,13). The observed values are within the permissible limits except bore hole water for BPRA19KA to BPON19PA.

Electrical conductivity (EC)

The EC values of in well water varied between 510 to 610 for WPRA19KA to WPON19PA, 471-562 for WPRA20KA to WPON20PA (Figures: 10,12). EC values observed in bore hole water varied between 520 to 680 for BPRA19KA to BPON19PA, 482 to 562 for BPRA20KA to BPON20PA (Figures: 11,13). The observed values are within the permissible limits.

Oxidation Reduction potential

ORP values of well water varied between 680 to 690 for WPRA19KA to WPON19PA, 563 to 592 for WPRA20KA to WPON20PA (Figures: 10,12). ORP values observed in bore hole water varied between 610 to 780 for BPRA19KA to BPON19PA, 610 to 692 for BPRA20KA to BPON20PA (Figures: 11,13). The observed values are within the permissible limits.



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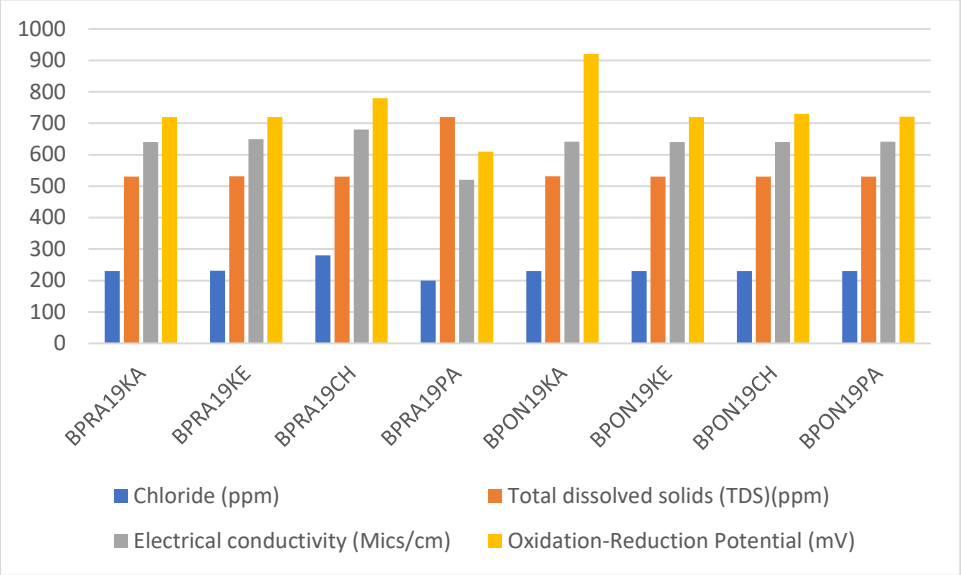

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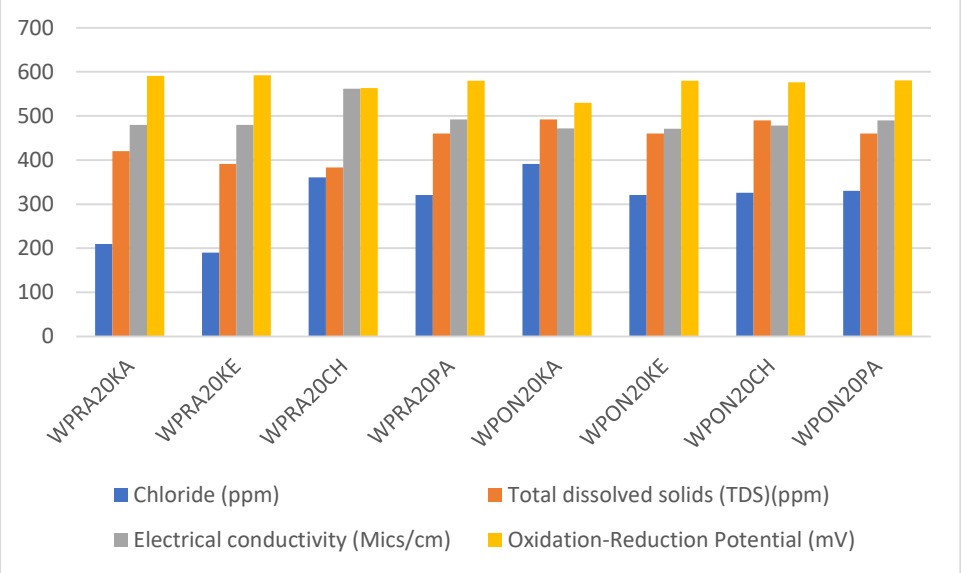

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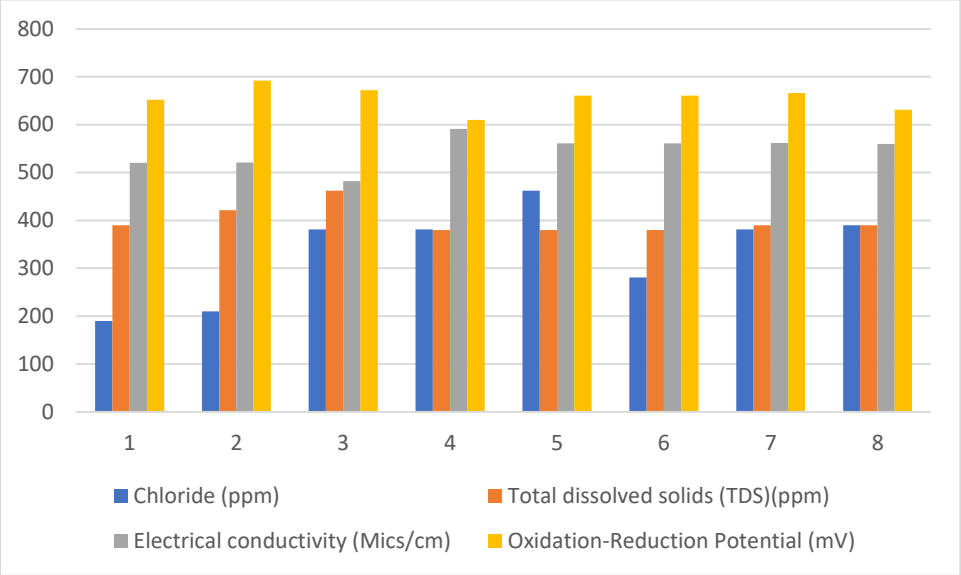

Figure : 13

Temperature

The temperature of well water varied between 27 to 29 for WPRA19KA to WPON19PA, 27 to 30 for WPRA20KA to WPON20PA (Figures: 14,16). The temperature of bore hole water varied between 25 to 30 for BPRA19KA to BPON19PA, 27 to 30 for BPRA20KA to BPON20PA (Figures: 15,17).

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

The concentration of sodium in well water varied between 12.4 to 21.5 for WPRA19KA to WPON19PA, 18.1 to 32.9 for WPRA20KA to WPON20PA (Figures: 14,16). The concentration of sodium in bore hole water varied between 17.1 to 19 for BPRA19KA to BPON19PA, 19.2 to 38.2 for BPRA20KA to BPON20PA (Figures: 15,17). The observed values are within the permissible limits.

The concentration of potassium in well water varied between 13.9 to 24 for WPRA19KA to WPON19PA, 13.4 to 16.1 for WPRA20KA to WPON20PA (Figures: 14,16). The concentration of potassium in bore hole water varied between 18 to 26 for BPRA19KA to BPON19PA, 10.4 to 15.2 for BPRA20KA to BPON20PA (Figures: 15,17). The observed values are within the permissible limits.

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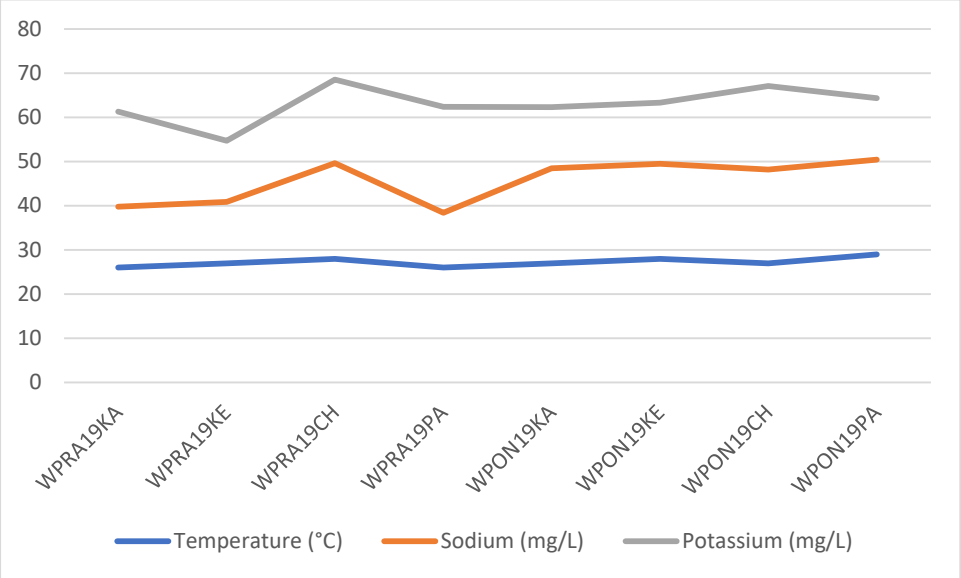

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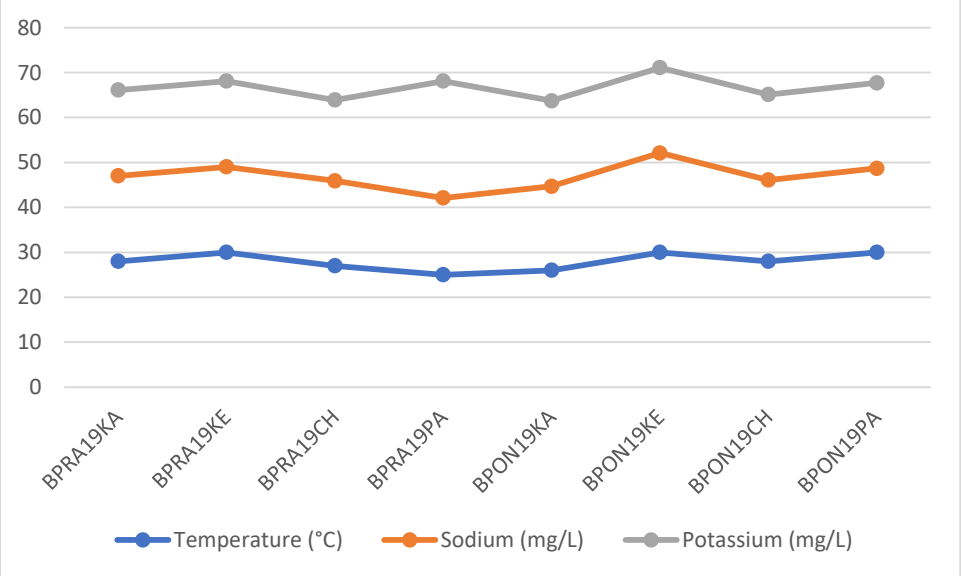

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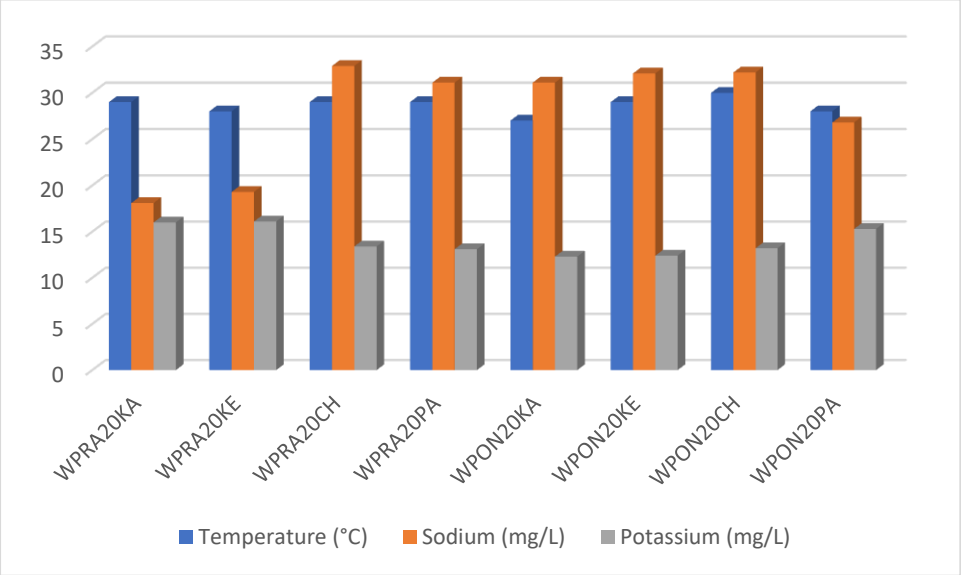

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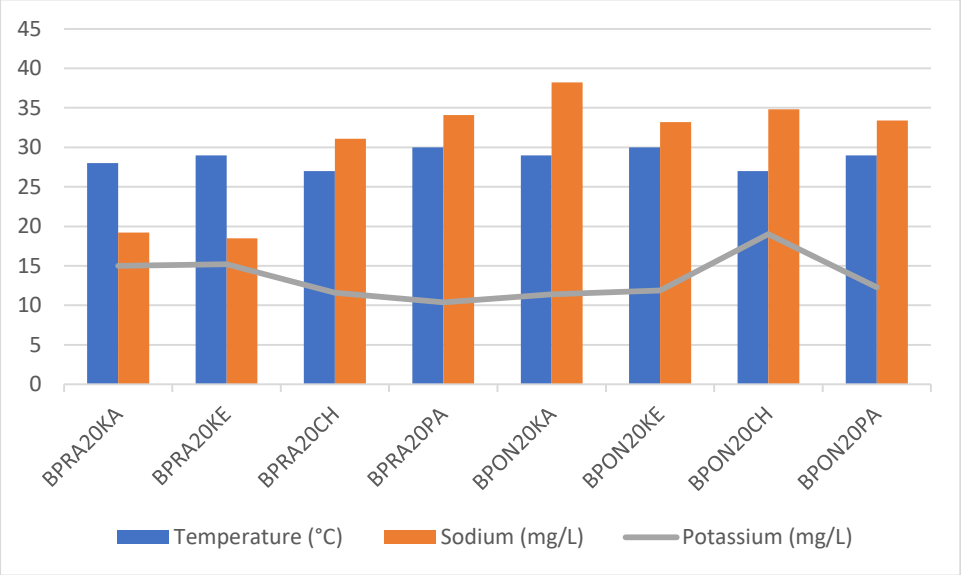

Figure : 17

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 187 for WPRA19KA to WPON19PA, 180 to 241 for WPRA20KA to WPON20PA (Figures: 18,20). The alkalinity values bore hole water varied between 169 to 192 for BPRA19KA to BPON19PA, 175 to

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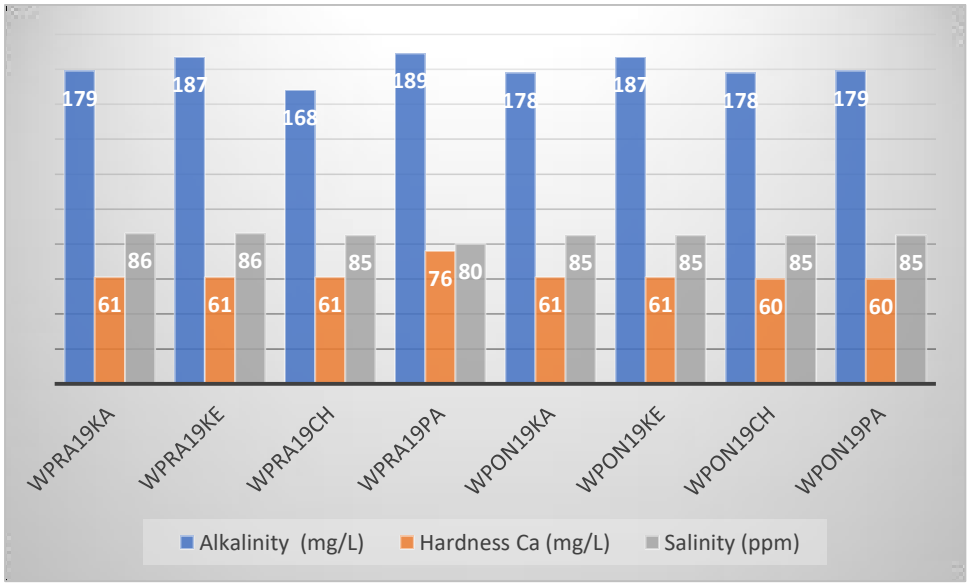
241for BPRA20KA to BPON20PA (Figures: 19,21). The observed values are within the permissible limits.

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 60 TO 76 for WPRA19KA to WPON19PA, 38 to 70 for WPRA20KA to WPON20PA (Figures: 18,20). The Ca content of bore hole water varied between 62 to 86 for BPRA19KA to BPON19PA, 20 to 82 for BPRA20KA to BPON20PA (Figures: 19,21). The observed values are within the permissible limits.

Salinity

The salinity values of well water varied between 80 to 76 for WPRA19KA to WPON19PA, 340 to 93 for WPRA20KA to WPON20PA (Figures: 18,20). The salinity values of bore hole water varied between 90 to 95 for BPRA19KA to BPON19PA, 40 to 93 for BPRA20KA to BPON20PA (Figures: 19,21). The observed values are within the permissible limits.



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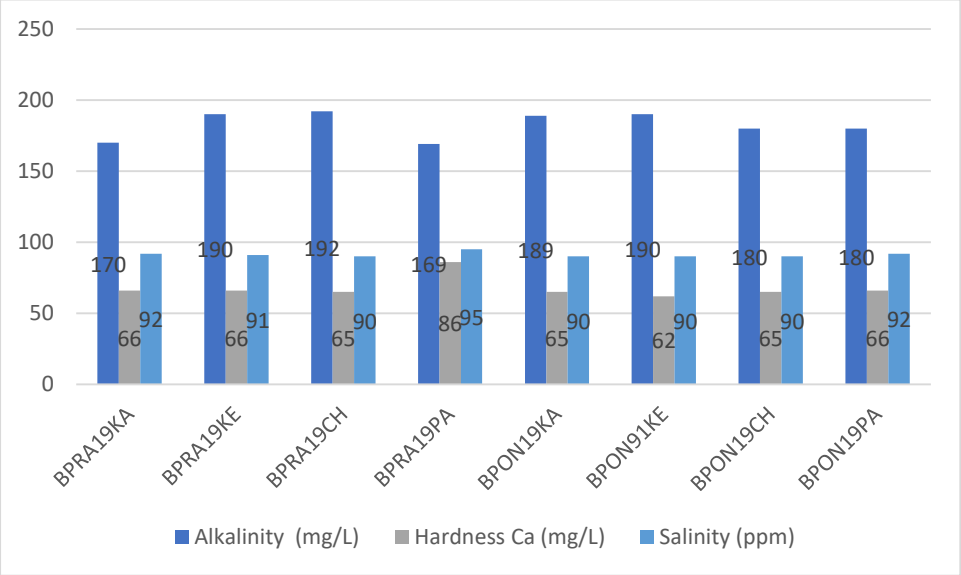

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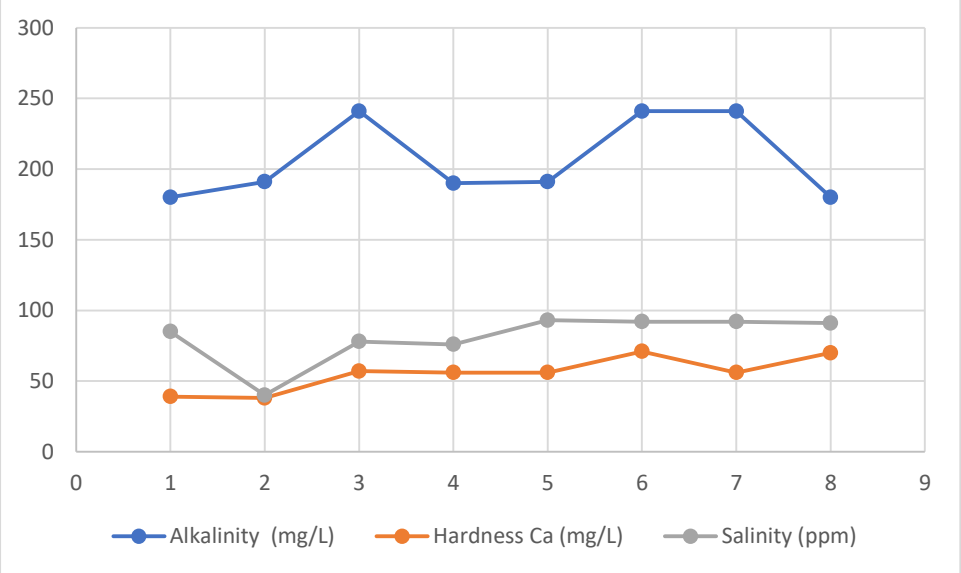

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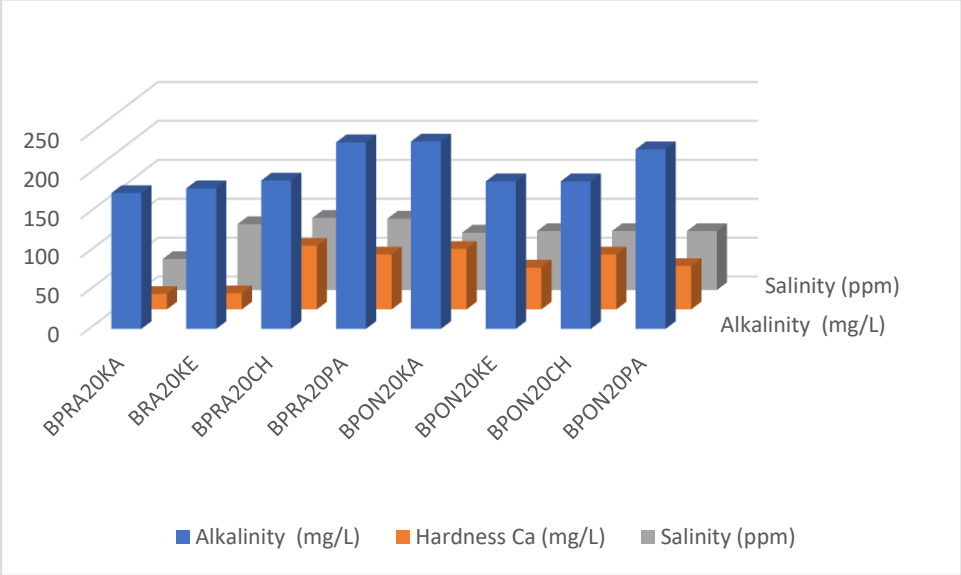

Figure : 21

CONCLUSIONS

Conclusively, in this study the water quality properties in terms of its physico-chemical parameters of Kanyakumari to Pallam 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).

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