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Assessment of physico-chemical properties of ground and surface water under Chiephobozou, Kohima District, Nagaland.

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ABSTRACT
This paper involves the analysis of water samples from Chiephobozou. The following parameters (pH, EC, TDS, TH, Ca, Mg, Cl and DO) were carried out. It was found that majority of the pH values were less than 7.0 indicating that the water samples inclined towards basic nature. As for the EC (electrical conductivity), the values for all 10 samples were found to be within the limit, for the TDS (Total Dissolved Solids) values, it was found to be below the harmful range. For the TH (total hardness) values, some of the samples were found to have comparatively higher values making the water very hard. In the case of calcium, all 10 samples were found to have low amount of calcium. Similarly for magnesium, the values that were found were within the permissible limits. In the case of testing for chloride, the samples all had values which did not exceed 250mg/.Finally for DO(dissolved Oxygen) only samples 5,6 and 7 were found to have the values less the 2mg/L which is the min reqd. level while the remaining samples all had values more than the required minimum.

Key words – water analysis, pH, EC, TDS (total dissolved solids), TH(total hardness), Ca, Mg, Cl and DO

I. INTRODUCTION

Water (H_2O) is an inorganic, transparent, tasteless, odorless, and nearly colorless chemical substance, which is the main constituent of Earth's hydrosphere and the fluids of all known living organisms. Next to oxygen, water is the most important substance for human existence [1]. Water is essential for life on earth. For human it would be very hard to perform daily useful activities like industrial work, domestic purposes, agriculture etc. it is the most abundant substance on earth, covering about 70.9% of the earth surface(oceans and seas) [2]. The main sources of water are rain water, surface water such as lakes, streams and ground water such as wells, springs. Surface water is basically water located on the top of the earth's surface (also referred to as blue water). The vast majority of which is produced by the process of precipitation and run off from nearby higher areas. It is also noted that the levels of surface water decrease or lessen as a result of evaporation as well as water moving or seeping underground which the goes on to become ground water. It is specifically used for terrestrial water bodies and generally used for irrigation wastewater treatment , livestock, industrial uses, hydropower and recreation[3].According to EPA , approx. 68% of water provided to communities come from surface water[4].

There are three major types of surface water

(a) Permanent (perennial) surface waters which are present all year round (lakes, rivers and wetlands (marshes and swamps).

(b)Semi-permanent (ephemeral) surface water refers to bodies of water that are only present at certain times of the year (seasonally dry channels such as creeks, lagoons and waterholes).

(c) Man-made surface water is water that can be contained by infrastructures that humans have assembled. It consists of dammed artificial lakes, canals and artificial ponds (e.g. garden ponds) or swamps. The surface water held by dams can be used for renewable energy in the form of hydropower. Hydropower is the forcing of surface water sourced from rivers and streams to produce energy [5]. But Global warming, which has a direct connection with the hydrologic cycle (water cycle) has lead to increased evaporation yet decreased precipitation, runoff, groundwater, and soil moisture. All this has altered surface water levels. Furthermore climate change has also enhanced the

current challenges we face in water quality. When the quality of surface water which is based on the chemical inputs from the surrounding elements such as the air and the nearby landscapes are polluted due to human activity, it alters the chemistry of the water [6]. Now, groundwater is the water present beneath the earth's surface in rock and soil pore spaces and in the fractures of rock formations. Groundwater is recharged or replenished naturally from the surface water by precipitation, streams, and rivers when it reaches the water table and may discharge from the surface naturally at springs and occasionally forming oases or wetlands. Groundwater is also often withdrawn for Agricultural, municipal, and industrial use by constructing and operating extraction wells. It is considered a reliable source of fresh water which is easy to access for various purposes such as domestic, industrial, irrigation etc [7], since it is often cheaper, more convenient and less vulnerable to pollution than surface water. Therefore, it is commonly used for public water supplies. But that does not mean that it is not prone to pollution. It often results from improper disposal of wastes on land, industrial and household chemicals and garbage landfills, industrial waste lagoons, tailings and process wastewater from mines, oil field brine pits, leaking underground oil storage tanks and pipelines, sewage sludge and septic systems. Fresh water is already a limiting water resource in many parts of the world and in the next century, it will continue to become even more limiting due to increased population, urbanization and climate change [8].Furthermore it is a finite resource, essential for agriculture, industry and even human existence, without fresh water of adequate quantity and quality, sustainable development will not be possible [9]. The contamination of these water sources by various human activities can cause adverse effects on the water system. It increases or decreases the amount of certain substances in the water which may cause adverse negative impacts on the organisms that need water to sustain life and life processes. This leads to the need to assess the water quality parameters which include chemical, physical, and biological properties, based on the desired parameters of concern. Parameters that are frequently sampled or monitored for water quality include temperature, dissolved oxygen, pH, conductivity, and turbidity [10]. However it may also include measuring ammonia, nitrate, chloride, or laboratory parameters such as BOD, titration, or TDS. Therefore it is important to investigate other potential water contaminations such as chemicals and microbial and radiological materials for a longer period of time, including human body fluids, in order to assess the overall water quality [11]. The present world now faces one of the greatest dangers of natural springs, ground water and other natural source of fresh and clean water drying up which is now being seen as a major global risk. Therefore, the present study was taken up to determine the potability of the surface and ground water by assessing the levels of certain physicochemical parameters like the pH which can be considered as one of the most important water quality parameter [12],the electrical conductivity which is related to the concentration of ionic mobility and temperature[13], the Total Dissolved Solids (TDS), the total hardness which is another important parameter of water which shows whether it can be used for domestic, industrial or agricultural purposes. Other parameters like Calcium, magnesium, chloride and DO (dissolved oxygen) are all additional parameters which indicate or show whether the water is fit to be consumed, used for domestic, industrial and other applications.

1.1 Study Area:

Chiephobozou is a Sub-division in Kohima district of Nagaland state India. It has an area of approx.330.59 km². Thegeo-coordinates are latitude 25.781448°N and longitude 94.0985029°E and have an elevation/Altitude of 154 meters above sea level.As per the 2021 Aadhar estimates, Chiephobozou Subdivision population in 2021 is 24,418. According to 2011 census of India, the total population is 19,692 people living in this Subdivision, of which 10,400 are male and 9,292 are female. Population of Chiephobozou in 2020 is 23,630 Literate people are 13,940 out of 7,844 are male and 6,096 are female. Total workers are 9,423 depends on multi skills out of which 5,623 are men and 3,800 are women. Total 4,889 Cultivators are depended on agriculture farming out of 2,227 are cultivated by men and 2,662 are women.

It is situated 26km away from district headquarter Kohima[14].

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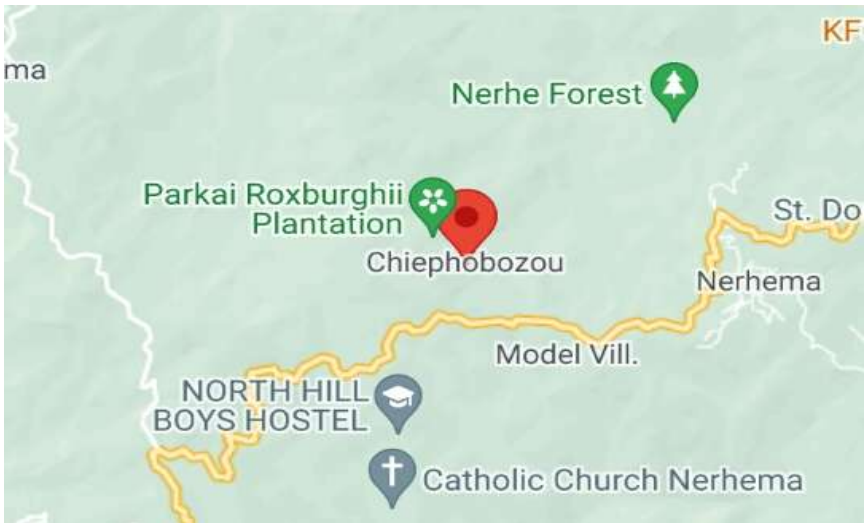


Sample 1(Sadzukhu 1)


Sample 2(sadzukhu 2)


Sample 3 (residential home below highway)


samples 4 (below petrol pump - Merhadzukhu)

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Sample 5 (Seikharu)


Sample 6 (Seikredzukhu)


Sample 7(Kerudzukhu)


sample 8(near Chairman's residence)


Sample 9(near Police camp)


Sample 10 (residential home near guest house)

II. MATERIAL AND METHODS:

2.1Sampling method: In this study, the water samples were collected from 10 different sites in a good quality polyethylene bottle of 500ml capacity .Some of the experimental works were done on site (temperature and pH), while the rest were done in the college department laboratory.

The following parameters were considered:

1. Temperature
2. pH
3. Electrical conductivity(EC)
4. TDS(Total dissolved Solids)
5. Total Hardness
6. Calcium
7. Magnesium
8. Chloride
9. DO (Dissolved Oxygen).

The results obtained after analysis were compared with standard limit recommended by the BIS and WHO.

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Table 1: Method of determination of water quality parameters

Parameters	Methods of determination
Temperature	Thermometer
pH	ph Meter
EC(electrical conductivity)	Conductivity meter
TDS(Total Dissolved Solids)	Evaporation method
TH(Total Hardness)	EDTA – Titrimetry
Calcium	EDTA – Titrimetry
Magnesium	EDTA - Titrimetry
Chloride	Conductometry
DO(Dissolved Oxygen)	Titrimetry

Table 2: Values obtainedfor various water parameters

Sample	pH	Temp.	EC(µ S/cm)	TDS (mg/L)	TH (mg/L)	Calcium (mg/L)	Magnesium (mg/L)	Chloride (mg/L)	DO (mg/L)
1	7.20(SW)	15.3	226	9.6	200	25.65	33.14	32.66	4.73
2	6.80(SW)	19.6	98.7	12.54	160	4.00	36.54	63.9	9.46
3	4.80(GW)	21.5	390	11.98	230	24.04	41.42	75.26	3.15
4	6.60(SW)	21.1	290	12.26	172	11.22	35.08	78.2	3.15
5	6.30(SW)	22.3	222	10.48	90	7.21	17.54	26.98	1.57
6	5.0(GW)	21.1	170.5	14.22	120	16.03	19.49	32.66	1.57
7	5.10(SW)	21.5	126.5	11.02	90	8.02	17.06	28.4	1.57
8	6.50(GW)	20.6	600	11.76	290	56.91	36.06	79.52	4.73
9	6.10(SW)	19.4	106.4	15.72	100	9.62	18.52	28.4	6.31
10	5.0(GW)	20.5	316	9.72	190	18.43	35.09	80.94	4.72

(SW- surface water, GW- ground water)

III. RESULTS AND DISCUSSION

pH: The pH is the measurement of hydrogen ion concentration in water. It indicates whether the water is acidic or alkaline [15]. For the group of samples taken for analysis, the maximum pH was noted at 7.20(sample-1) and the minimum pH was noted at 4.80(sample 3). Out of all the 10 samples which were analyzed, only 4 out of the 10 samples had pH within the safe limit of 6.5 – 8.5 standard set by the BIS and WHO. The remaining 6 samples all had pH values under 6.5 making it slightly acidic in nature, below the desirable limit. Thus, these low pH values indicate the corrosive nature of the water. It also indicates that the water maybe naturally soft but acidic[15].

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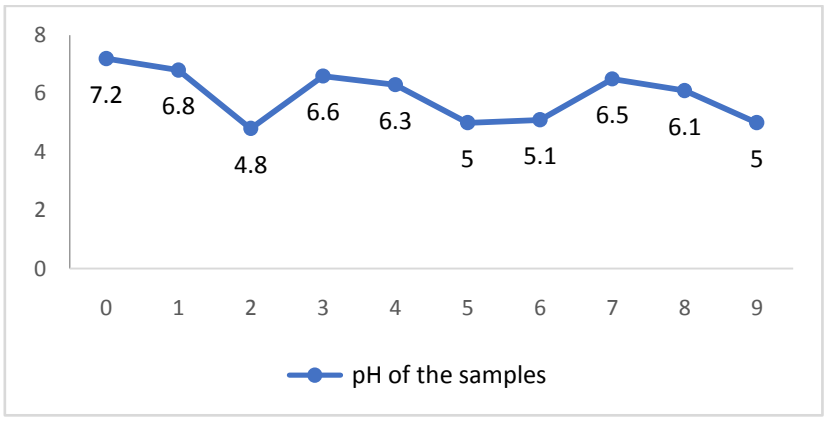

Chart (A) - pH

Electrical Conductivity: Conductivity is an important parameter in determining the suitability of water for a specific purpose[16]. It is a measurement of the ability of a solution to carry electrical current. Electrical conductivity is affected by the presence of inorganic dissolved solids such as chloride, sulphate, nitrate and phosphate anions(ions that carry a negative charge) or sodium, magnesium, calcium,etc(ions that carry a positive charge). In this case, the values of electrical conductivity of all the samples sites ranged from 98.7-600 µS/cm which is within the standard value of WHO (2500 µs/cm).

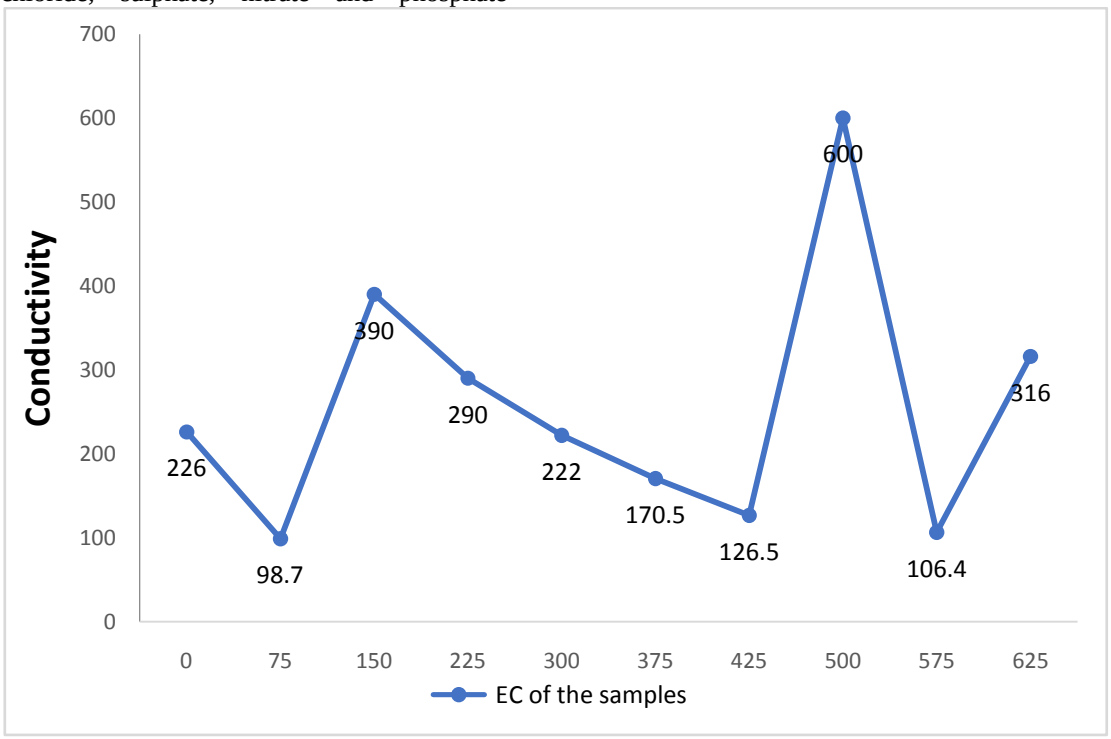

Chart (B) - EC

Total Dissolved Solids (TDS): Total Dissolved Solids (TDS) is a measure of the dissolved combined content of all inorganic and organic substances in molecular, ionized, or micro-granular (colloidal sol) suspended form in water[17]. It measures all the materials dissolved in water. One of the main sources of TDS in water is pollution in the form of industrial waste water, sewage, etc[17]. In the present study, the concentration of TDS in all sampling sites was found to range from 9.6-15.72 ppm which can be considered to be very low, lacking essential minerals. But this low level of TDSs in all samples still allows the water to be used for drinking domestic uses.

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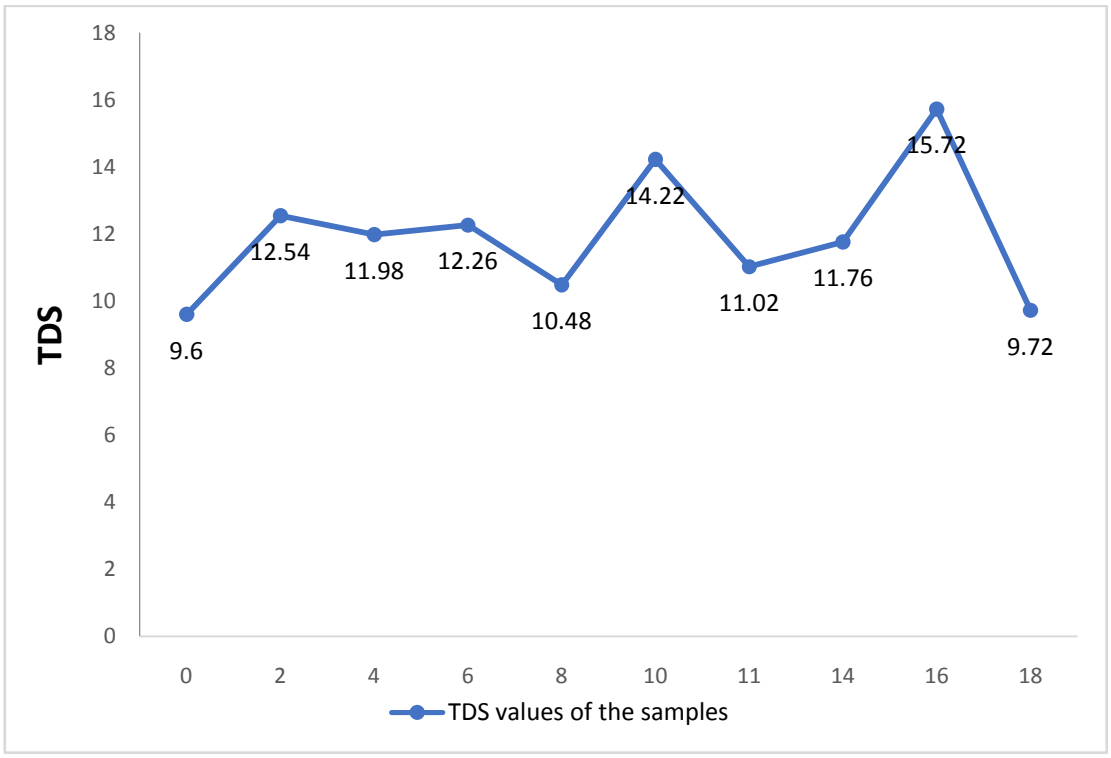

Chart (C) - TDS

Total Hardness: The Total Hardness is the property of water which prevents the lather formation with soap[18]. This is due to the presence of calcium and magnesium concentration expressed as mg/L $CaCO_3$. Hardness is of two types: Temporary hardness, which is caused by carbonate and bicarbonate ions and may be removed by just boiling the water. However, the permanent hardness which is caused mainly by chlorides and sulphates of the metals is difficult to remove[18]. In the present study the values of total hardness for all sampling sites ranged from 90- 290 mg/L. The max value was observed in sample 8 and the minimum values were observed in sample 5 and 7which is within the permissible limits making it safe for use.

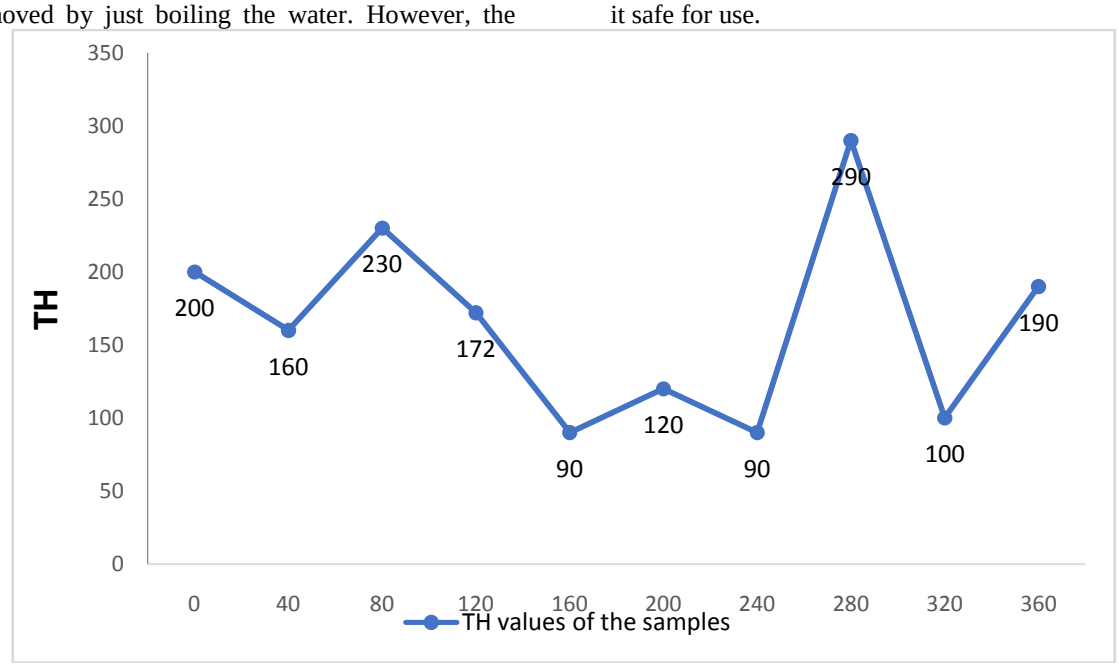

Chart (D) - TH

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Calcium: Calcium is present in all water bodies, making it one of the most abundant elements found in natural water[19]. The source of calcium is sewage disposal, industrial waste, rocks such as limestone, etc. the increase of all these pollutants increases the conc. of calcium in water. If there is n excess in the calcium, it can alter the water taste. In this case, the values of calcium in all 10 samples ranged from 4.01 – 56.91mg/L which is within the permissible limit of BIS (250 mg/L). This indicates that the water samples are safe for drinking and other domestic purposes.

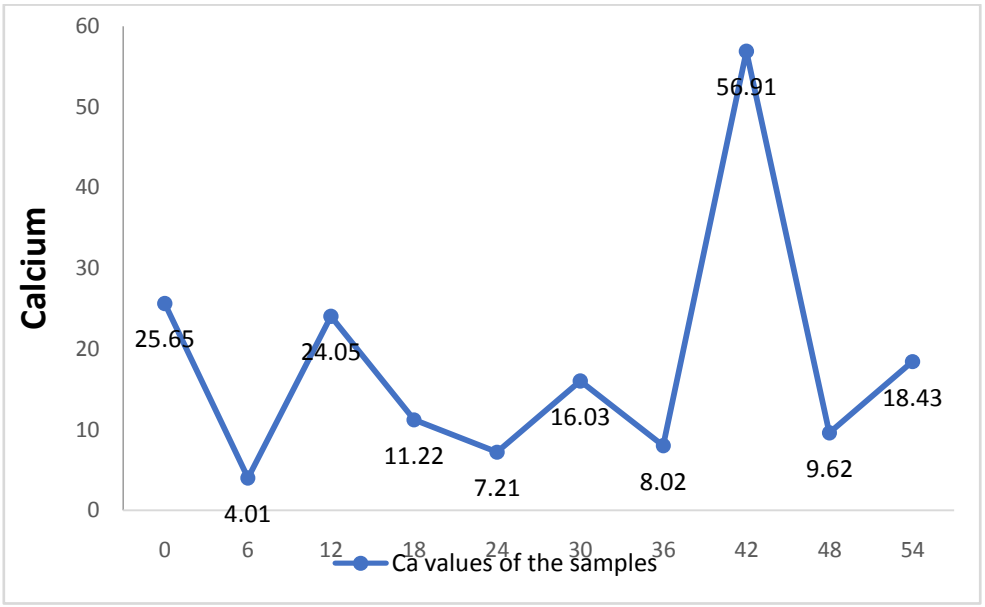

Chart (E) - Calcium

Magnesium (Mg): Comparatively the tolerance of magnesium by the human body is lower than that of calcium[19]. It adds to the hardness of water. It is also a mild laxative. The concentration of magnesium in drinking water and beverage ranges from 10-100 mg/L. Keeping this in mind, we observe that the values of all the samples are within the permissible limits, the max being observed in sample 3 i.e. 41.42 and the min being observed in sample 7 i.e. 17.06.

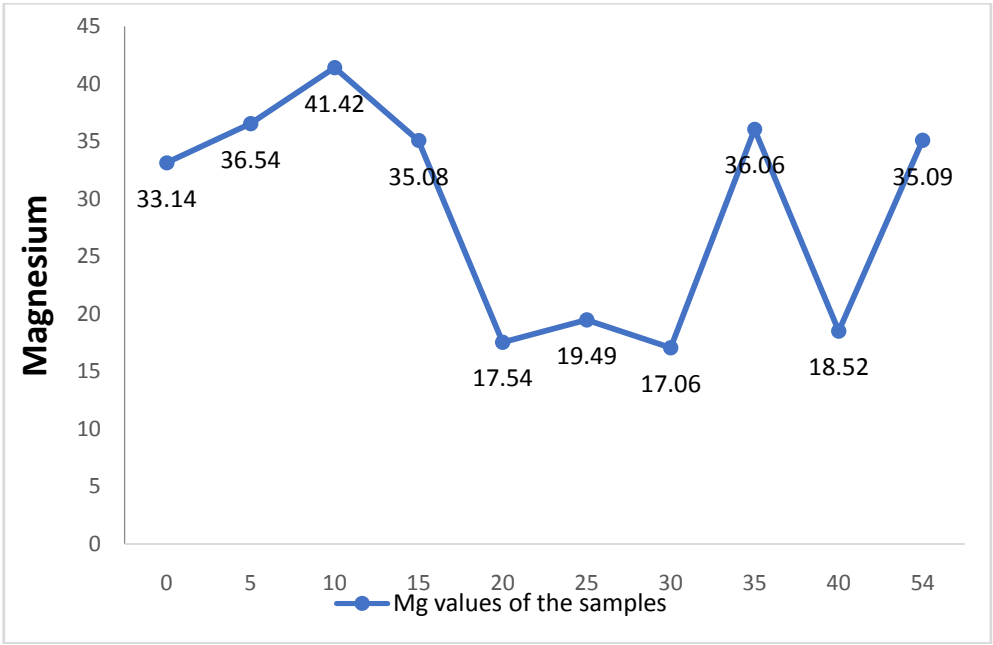

Chart (F) - Magnesium

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Chloride (Cl): Chloride in surface and groundwater from both natural and anthropogenic sources, such as run-off containing road de-icing salts, the use of inorganic fertilizers, landfill leachates, septic tank effluents, animal feeds, industrial effluents, irrigation drainage, and seawater intrusion in coastal area[20]. Water pollution greatly adds to the quantity of chlorides. Chloride imparts a salty taste to water. The optimum limit for chloride is 250 mg/L at which level water does not taste salty.Based on the values found forthe concentration of chloride in all the samples in the study area, it ranges from 26.98-79.52 mg/L. The max value was found in sample 8 which was 80.94 and the min value was found in sample 5 which was 26.98.

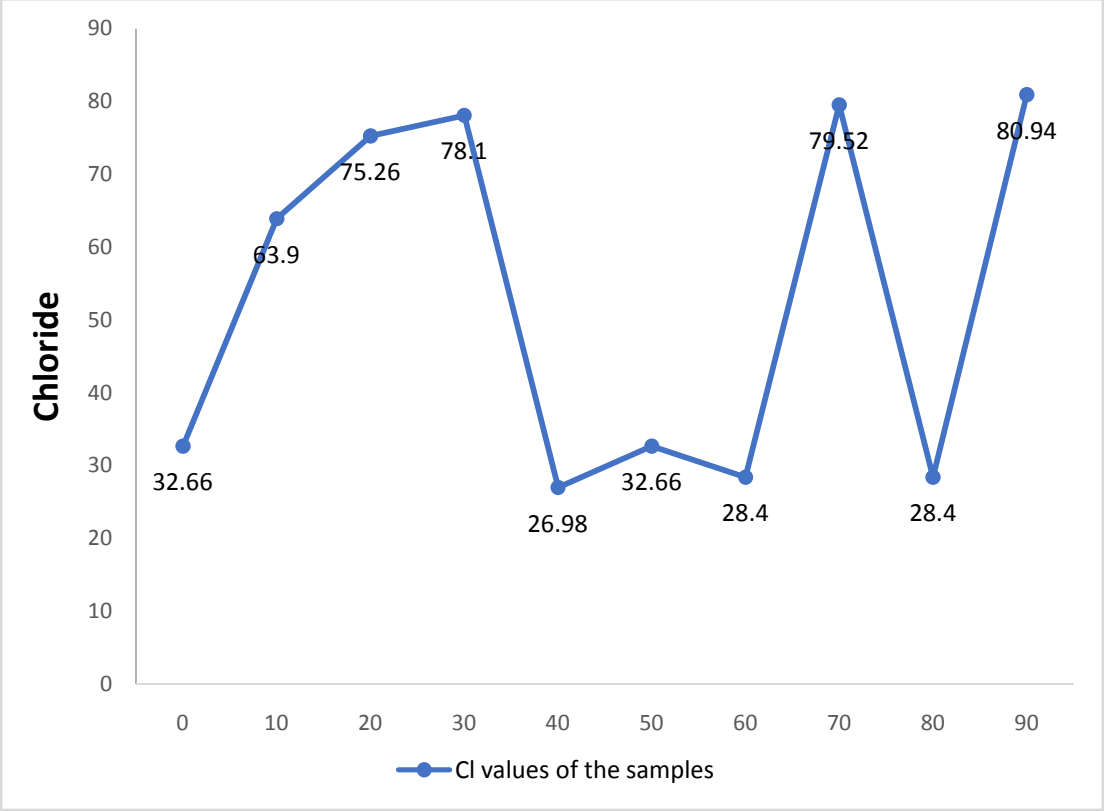

Chart (G) - Chloride

Dissolved Oxygen: Dissolved oxygen refers to the level of free, non-compound oxygen present in water or other liquids which also indicates the ability of the water body to sustain aquatic life[21]. It is an important parameter in assessing water quality because of its influence on the organisms living within a body of water. It reflects the physical and biological process taking place in the water body. In this study, the dissolved oxygen (DO) levels varied from 1.57-9.46mg/L. The maximum value of DO was observed in sample 2 and minimum value was observed in sample 5, 6 and 7. Only three of the water samples are below the permissible limit of WHO (2mg/L).

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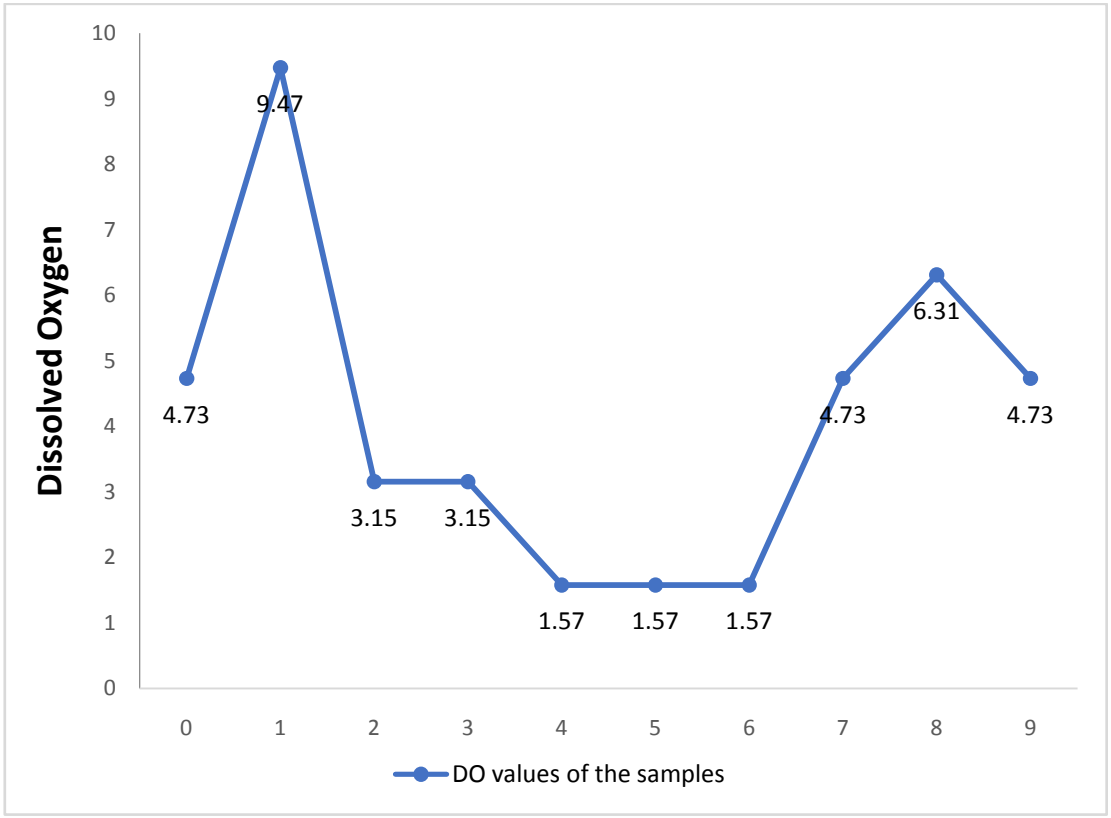

Chart (H) - DO

IV. CONCLUSION

For the study area Chiephobozou, the following conclusions can be drawn from the parameters that were considered. The pH values ranged from 4 -7.20. It was further noticed that majority of the pH values were less than 7.0 indicating that the water samples inclined towards basic nature. As for the EC (electrical conductivity), the values for all 10 samples were found to be within the limit, making it safe for domestic uses and such. Now for the TDS (Total Dissolved Solids) values, it was found to be below the harmful range. For the TH (total hardness) values, samples 1, 3, 8 and 10 were found to have comparatively higher values making the water very hard, these samples may need to be treated before consumption. In the case of calcium, all 10 samples were found to have low amount of calcium present making it soft in nature. Similarly for magnesium, the values that were found were within the permissible limits. In the case of testing for chloride, the samples all had values which did not exceed 250mg/L making it safe for consumption. Finally for DO(dissolved Oxygen) only samples 5,6 and 7 were found to have values less than the 2mg/L which is the min reqd. level while the remaining samples all had values more than the required minimum. An important thing that needs to be taken into consideration for the case of DO is that the test was conducted 72 hours after the collection of the sample from the site which may have caused an alteration or change in the levels of DO from the actual level. Thus, based on all the above findings we can conclude by stating that the water found in and around the study area is fit for domestic uses and upon treatment for certain parameters, most of it will be suitable for consumption.

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