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ASSESSMENT OF TUBE-WELL WATER QUALITY FROM KYAUKTAN VILLAGE, MINBU TOWNSHIP, MAGWAY REGION

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Abstract

This study deals with the determination of physicochemical properties, trace elements and bacteriological analysis of tube-well water. The tube-well water samples were collected from two sites of Kyauktan Village, Minbu Township. Water samples were analysed from the study area, seasonally in 2018. The physicochemical properties such as the temperature, pH, the electrical conductivity (EC), the turbidity, total dissolved solids, total alkalinity, chloride concentration and salinity of all water samples were measured. The pH values of the collected samples were higher in summer than the other two seasons. The total dissolved solids values were high in rainy season. The total hardness values, dissolved oxygen (DO), biochemical oxygen demand (BOD) and chemical oxygen demand (COD), of water samples were also determined. Some trace elements such as, lead and cadmium were analyzed by Atomic Absorption Spectrophotometer (AAS). Arsenic was detected by Arsenator. The bacteriological analysis of total coliform and *Escherichia coli* was done in the collected water samples. The total coliform and *Escherichia coli* counts were higher in rainy season than other seasons. The experimental results obtained were compared with the WHO standards for human health. The aim of this research is to study water quality for human consumptions and to prevent environmental pollution in this study area.

Keywords: drinking water quality, physicochemical properties, trace elements, bacteriological analysis

Introduction

Water is a transparent and nearly colourless chemical substance that is the main constituent of Earth's streams, lakes, and oceans, and the fluids of most living organisms. Analysis of quality of water is one of many important aspects in the environmental control. As well as the human population of water increases, the human consumption of water also increases. And then pollution of water also increases. There are many parameters that define quality of water. The most some importance of these are the temperature, pH, the electrical conductivity (EC), the turbidity, total dissolved solids, total alkalinity, chloride concentration, salinity, sulphate and nitrate. The natural water analysis for physical, chemical properties including trace element contents are very important for public health studies especially for children (Aminur, 2015).

Tube-Well is a type of ground water. Water well along 100-200 mm (3.9-7.9) inches wide stainless steel tube or pipe bored in underground aquifer (Gupta *et al.*, 2010). In this research, the physicochemical properties, the trace elements and the bacteria examination of tube-well water from Kyauktan Village were carried out.

Kyauktan Village is a village in Minbu Township, Magway Region. People who lives in this village always use these tube-well water for drinking, washing, domestic uses and agricultural purposes. Therefore, the present work is aimed to study water quality of tube-well water from Kyauktan Village, Minbu Township, Magway Region.

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Materials and Methods

Collection of Samples

Tube-well water samples were collected from two sites of Kyauktan Village, Minbu Township, Magway Region. Water samples were collected from the tube-wells at the depth of 7620 mm and 9100 mm, respectively. Three liters of each water sample was taken by means of polyethylene bottles for physicochemical determination. The samples were stored in laboratory and temperature was maintained at 25 ^{o}C (Sulieman, 2010).

Physicochemical Examination of Water Samples

The physicochemical properties of water samples were determined by the following procedures (APHA, 2012).

Determination of temperature

The temperature of water samples was measured by using a thermometer.

Determination of electrical conductivity

The conductivity of water samples was measured by using a conductivity meter within two hours after sampling.

Determination of total dissolved solids

50 mL of water sample was transferred to porcelain crucible and weighed and then evaporated to dryness in an oven to obtain constant weight.

Determination of turbidity

10 mL of distilled water was filled to the colorimeter tube. A filter (415 nm) was placed into slot of colorimeter. This tube was inserted into the chamber and covered. Then, 0 % T and 100 % T were adjusted with controls. This tube was used as the 100 % T blank. 10 mL of water sample was filled to another colorimeter tube and then capped. The test sample was inserted into chamber, covered and measured percent T as soon as reading stabilized.

Determination of pH

The pH of water samples was measured by using a pH meter within two hours after sampling.

Determination of hardness by EDTA titrimetry

10 mL of water sample was added to 100 mL conical flask. 1 to 2 mL of buffer solution at a pH of 10.0 was added to the sample. And then 1 to 2 drops of Erichrome Black T (EBT) indicator solution was added and titrated with ethylene diamine tetra acetic acid (EDTA) titrant to change in colour from wine red to blue.

Determination of total alkalinity (TA) of drinking water samples by titrimetry

Ten mL of water sample was pipetted into a 100 mL conical flask. Two drops of phenolphthalein indicator were added and titrated against 0.1 M HCl. When the solution became colourless and phenolphthalein alkalinity (PA) was calculated as $CaCO_3$ (mg/L) using the equation. A is the volume of titrant (mL) used in the titration. Methyl orange was added to the same flask and continued titration till the colour changed from yellow to orange. The total volume of titrant corresponds to total alkalinity (TA) as $CaCO_3$ (mg/ L). B is the total volume of titrant (mL) consumed with both the indicators.

$$\text{Phenolphthalein Alkalinity (PA)} = \frac{\text{A} \times \text{Molarity of acid} \times 50000}{\text{Volume of sample (mL)}}$$

$$\text{Total Alkalinity (TA)} = \frac{\text{B} \times \text{Molarity of acid} \times 50000}{\text{Volume of sample (mL)}}$$

Determination of biochemical oxygen demand (BOD)

Two bottles 100 mL with lid were taken and cleaned well. 25 mL sample was put into each bottle and 75 mL of distilled water was added to each of the bottles. Then the bottles were closed well. One bottle was kept in the incubator at (20-22) ^{o}C for 5 days. Then 10 mL of manganese sulphate solution and 2 mL of alkali-iodide solution were added to the other bottle well below the surface of the liquid by using a syringe. Then the bottle was closed and mixed by inverting the bottle several times. When the precipitate settled leaving a clear supernatant above the precipitate it was shaken again slowly by inverting the bottle, and when setting had produced at least 50 mL supernatant, 8 mL of concentrated H_2SO_4 were added. Then the bottle was closed and mixed by gentle inversion until dissolution was completed. Then 100 mL of the sample was titrated with 0.05 M $Na_2S_2O_3$ solution until a pale-yellow solution was obtained. Then 2 mL of freshly prepared starch solution was added and titration was continued until a blue colour appeared. The procedure was then repeated using 100 mL distilled water (blank). Then the procedure was repeated for incubated sample.

Determination of chemical oxygen demand by permanganate method

Water sample (10 mL) was taken in a 100 mL conical flask. Then 5 mL of concentrated H_2SO_4 was added and 1 g of copper sulphate was also added. Then 3 mL of prepared 1 M $KMnO_4$ solution was added to the mixture and the bottle was immersed in boiling water for 30 min while keeping the surface of the boiling water at the higher level than the surface of the sample. Then, 3 mL of prepared 1 M sodium oxalate solution was added and immediately titrated with 1 M potassium permanganate until violet colour appeared. Then the procedure was repeated for the blank separately under same condition using 10 mL of distilled water instead of 10 mL of sample.

Determination of some trace elements by AAS

Some elements such as lead and cadmium content of water sample were analyzed by AAS (Atomic Absorption Spectroscopy). Arsenic content was detected by using Arsenator.

Bacteriological examination of tube-well water sample

Bacteriological examination of tube-well water sample was done at the Public Health Laboratory, Ministry of Health and Sports, Mandalay.

Results and Discussion

Nature of the Sampling Sites

Tube-Well drinking water samples were collected from two sampling sites of Kyauktan Village, Minbu Township, Magway Region. Their locations and depth of tube-wells are shown in Table 1 and Figure 1.

Table 1 Location of the Sampling Sites

Sampling Site	Location	Latitude and Longitude	Depth of Tube-Well (mm)
I	Magyitan	North latitude 20˚10' and East longitude 94˚ 50'	7620
II	Yaymyetsu	North latitude 20˚45' and East longitude 95˚12˚	9100

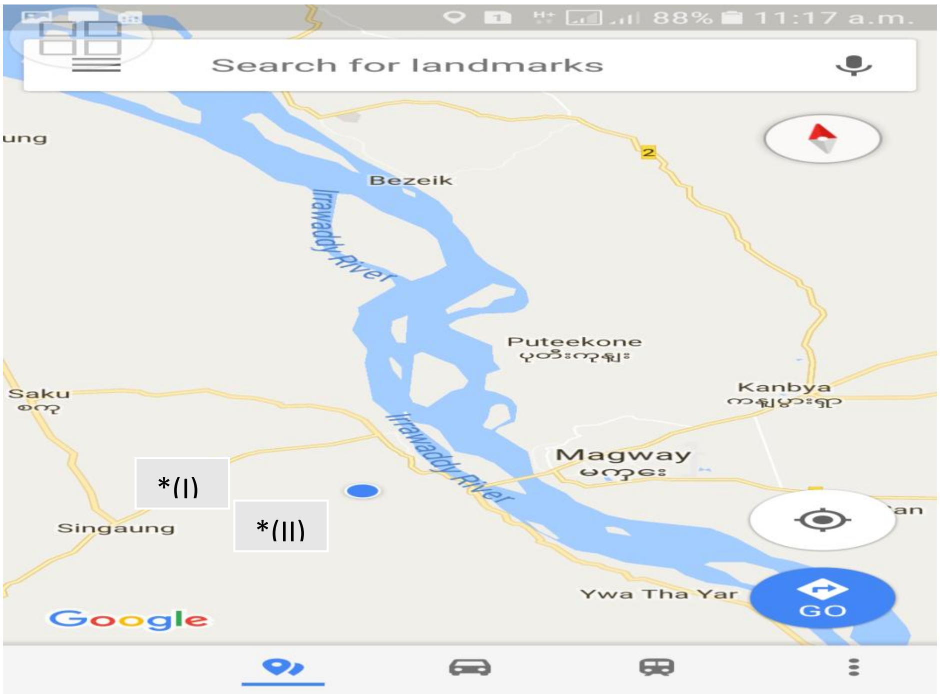


Figure 1 Map of sample collecting sites ***(I)** Magyitan, ***(II)** Yaymyetsu

Physical Parameters of Drinking Tube-Well Water from Two Sites of Kyauktan Village, Minbu Township

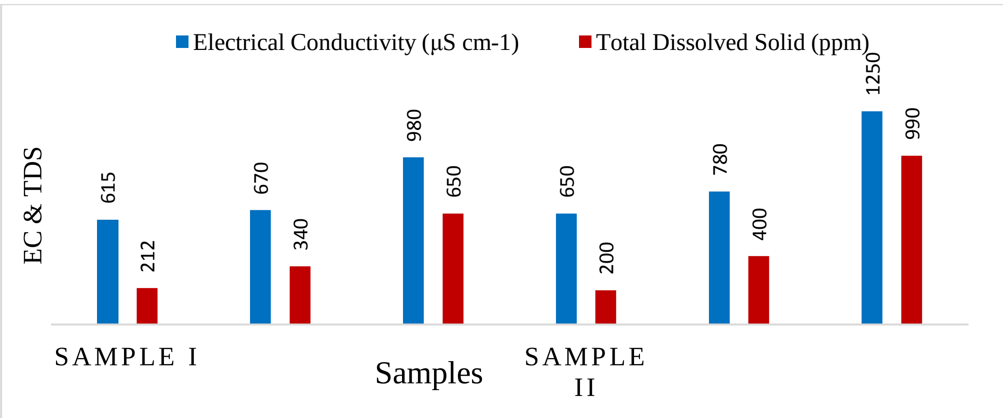
The physical parameters such as temperature, pH, electrical conductivity, total dissolved solids, and turbidity were determined at March**,** 2018 in summer, July, 2018 in rainy season and at December, 2018 in winter. The results were described in (Table 2 and Figure 2).

In Table 2, the physical properties of tube-well water samples were found to be changed in three seasons. But, the temperatures of drinking tube-well water samples were found to be same and the pH value of sample (II) was higher than that of sample (I) in all seasons. The electrical conductivity of sample (II) in rainy season was found to be the highest and the total dissolved solids of sample (II) in rainy season was also found to be the highest. The turbidity values of samples (I) and (II) were found to be < 5 FTU in all seasons.

Table 2 Some Physical Parameters of Tube-Well Water Samples in Three Seasons, 2018, Compared with WHO Standards (2008)

Parameters	Sample I			Sample II			WHO Standard (2008)
	Winter	Summer	Rainy Season	Winter	Summer	Rainy Season	
Temperature (ºC)	30	29	28	30	29	28	20-30
pH	7.3	7.1	7.3	7.8	7.5	7.6	6.5-8.5
Electrical Conductivity (μS cm^{-1})	615	670	1200	650	780	1500	<1500
Total Dissolved Solid (ppm)	212	340	870	200	400	990	1000
Turbidity (FTU)	< 5	< 5	< 5	< 5	< 5	< 5	5

The relationship between electrical conductivity and total dissolved solids is shown in Figure 2. The electrical conductivity values of sample (I) are lower than that of sample (II) in all three seasons. The total dissolved solids of sample (I) are also lower than that of sample (II). It was observed that the electrical conductivity of tube-well water sample increases, the total dissolved solids also increases in three seasons. The electrical conductivity values are directly proportional to total dissolved solids (Gorde and Jadhav, 2013).



I Magyitan II Yaymyetsu

Figure 2 The relationship between electrical conductivity and total dissolved solids of drinking tube-well water samples

Some Chemical Parameters of Drinking Tube-Well Water

The chemical parameters such as total hardness, total alkalinity, dissolved oxygen, biochemical oxygen demand, chemical oxygen demand, chloride ion concentration and salinity were determined in three seasons of 2018. The results are described in Table 3 and Figures 3, 4, 5, 6, 7 and 8. The total hardness and total alkalinity values of sample (II) were found to be higher than that of sample (I). The dissolved oxygen values of sample (I) was found to be higher than that of sample (II) at this study time. From BOD and COD determination, sample (I) has lower values than sample (II). The chloride and salinity values of sample (II) were found to be higher than that of sample (I).

Table 3 Some Chemical Parameters of Tube-Well Water Samples in Three Seasons, 2018

Parameters	Sample I			Sample II			WHO Standard (2008)
	Winter	Summer	Rainy	Winter	Summer	Rainy	
Total Hardness (mg L^{-1})	36	32	36	105	110	125	300
Total Alkalinity (ppm)	150	120	155	165	170	182	600
DO (ppm)	4.2	4.0	4.5	3.8	2.7	1.5	4-6
BOD (ppm)	1.6	0.5	1.8	1.9	2.2	4.8	2-4
COD (ppm)	2	2	3	3	2	7	15
Chloride (ppm)	33	35	106	53	40	116	250
Salinity (ppm)	0.15	0.25	0.69	0.22	0.35	0.78	0.4

The total hardness, total alkalinity and chloride values of water samples in winter are shown in Figure 3. From this Figure 3, total hardness, total alkalinity and chloride values of sample (I) are lower than that of sample (II).

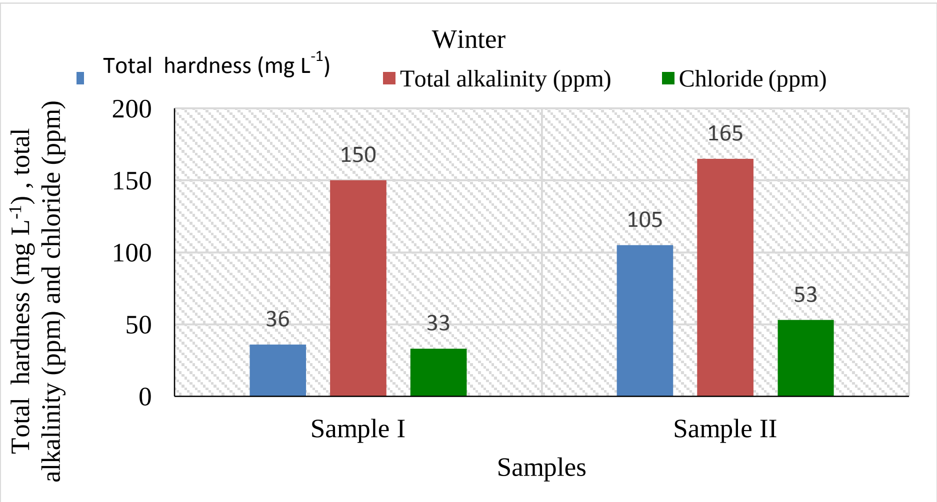


Figure 3 The total hardness, total alkalinity and chloride values of drinking tube-well water samples in winter

Figure 4 shows total hardness, total alkalinity and chloride values of water samples in summer. The total hardness and total alkalinity of sample (I) are lower than that of sample (II). But chloride value of sample (II) is slightly higher than that of sample (I).

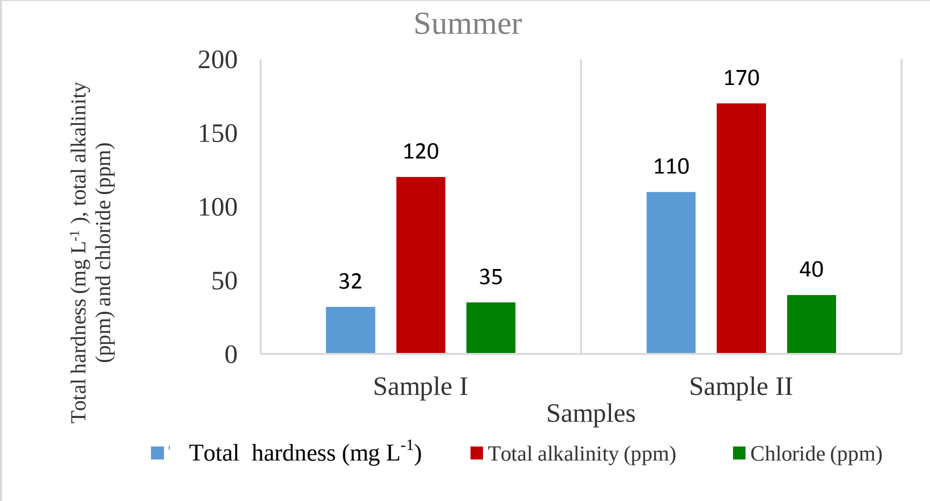


Figure 4 The total hardness, total alkalinity and chloride values of drinking tube-well water samples in summer

The total hardness, total alkalinity and chloride values of water samples in rainy season are shown in Figure 5. The total hardness and total alkalinity of sample (II) are obviously higher than that of sample (I) in rainy season. This may be due to the flooding of water near these tube-wells in rainy season.

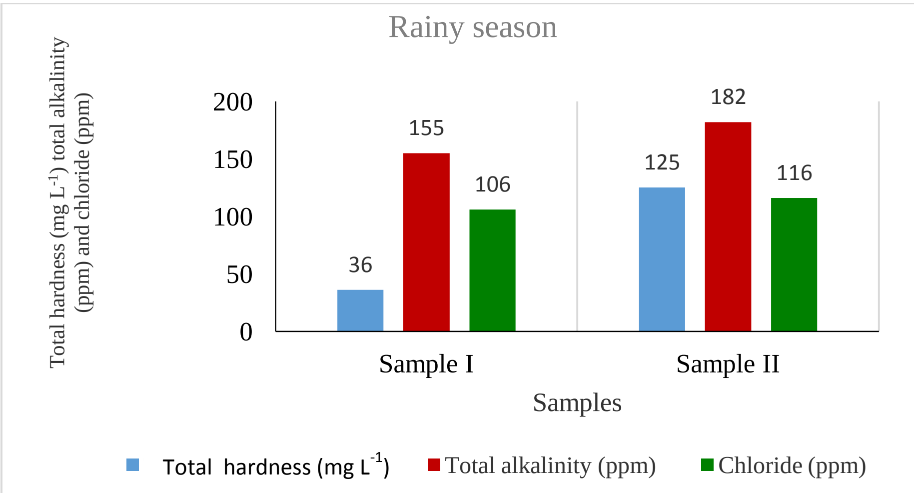


Figure 5 The total hardness, total alkalinity, chloride and salinity values of drinking tube-well water samples in rainy season

DO, BOD and COD values of water samples in winter, summer and rainy season are shown in Figure 6, 7 and 8. DO values of sample (I) are higher than that of (sample II) in all three seasons. BOD values of sample (I) are lower than that of sample (II) in all three seasons. COD values of sample (I) are lower than that of sample (II) in winter and rainy season. But COD of sample (I) and (II) are the same value of 2 ppm in summer.

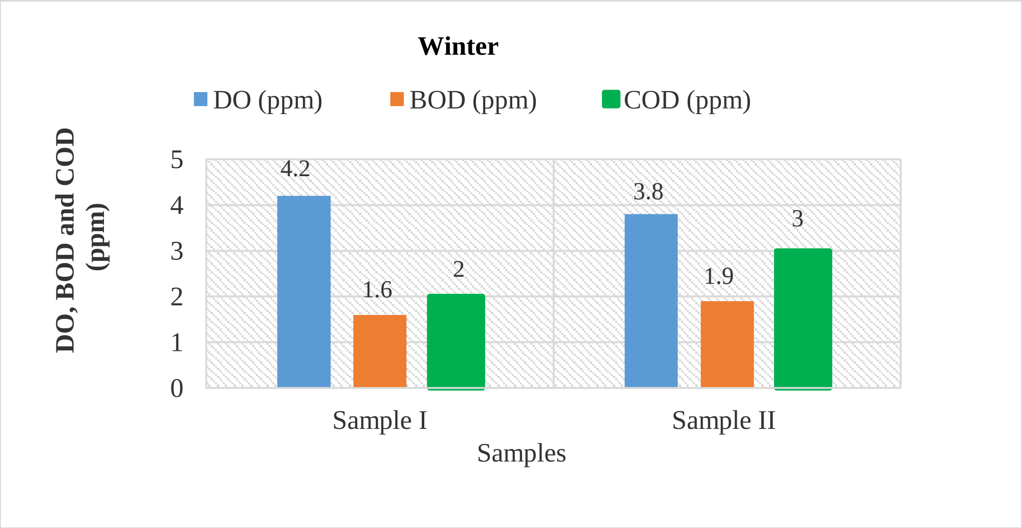


Figure 6 The DO, BOD and COD values of drinking tube-well water samples in winter

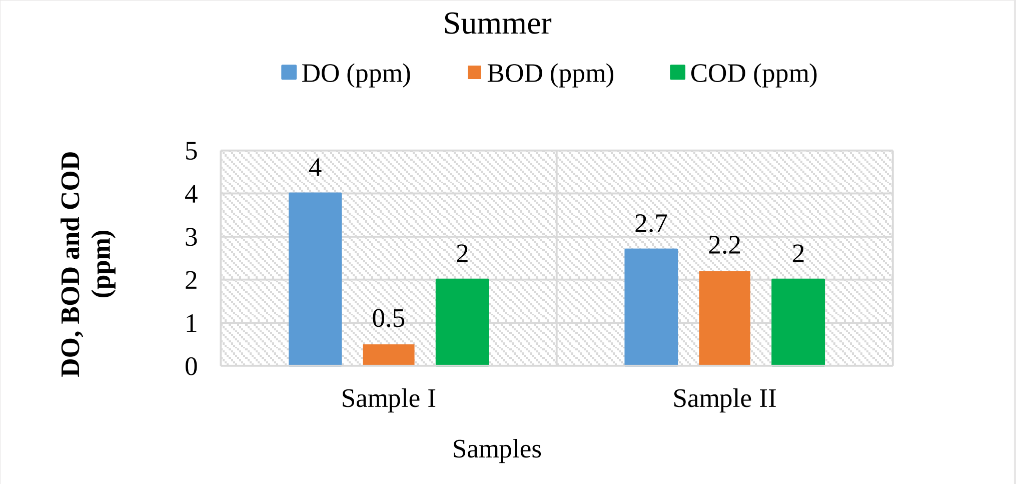


Figure 7 The DO, BOD and COD values of drinking tube-well water samples in summer

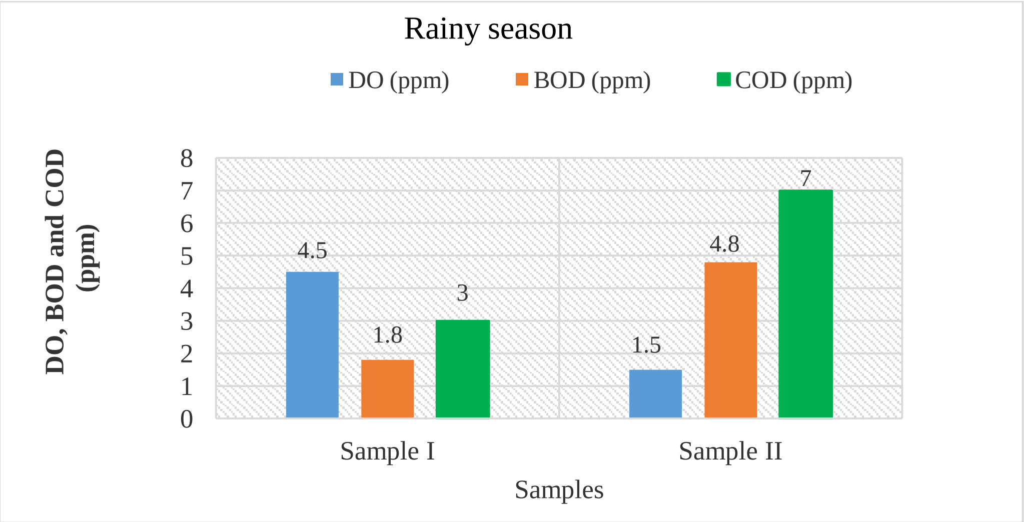


Figure 8 The DO, BOD and COD values of drinking tube-well water samples in rainy season

Trace Elements of Tube-Well Water Samples

Some elements such as lead and cadmium were analyzed by Atomic Absorption Spectrophotometer (AAS). Arsenic was detected by Arsenator. It was found that the amount of trace elements were not changed during the experimental period (2018).

Bacteriological Examination of Tube-Well Water Samples

Some bacteriological analyses such as coliform and *Escherichia coli* were done at the Ministry of Health and Sports, Public Health Laboratory. The results are described in Table 4.

Table 4 Bacteriological Examination of Water Samples in Three Seasons, 2018

Parameters	Sample I			Sample II		
	Winter	Summer	Rainy	Winter	Summer	Rainy
Probable Coliform Count (cfu/mL)	0/5	0/5	2/5	2/5	1/5	5/5
Escherichia coli Count	Non-Isolated	Non-Isolated	Isolated	Isolated	Isolated	Isolated
Remark	Satisfactory	Satisfactory	Un-Satisfactory	Un-Satisfactory	Un-Satisfactory	Un-Satisfactory

Coliform and *Escherichia coli* were not detected in Sample (I) in winter and summer. In rainy season, sample (I) was found to have 2/5 coliform count and *Escherichia coli* was also isolated. But sample (II) was found to have coliform count and *Escherichia coli* was detected in all three seasons.

Conclusion

In this research, the study of physicochemical properties of dinking tube-well water from two sites of Kyauktan Village, Minbu Township, Magway Region was done. The physicochemical parameters such as temperature, electrical conductivity, total dissolved solids, turbidity, pH, hardness, alkalinity, biological oxygen demand, chemical oxygen demand, chloride ion and salinity content were determined. In addition, some trace elements such as arsenic, lead and cadmium were analyzed. The electrical conductivity values of tube-well water samples show that this water has been good for drinking. The pH values of sample (II) were found to be slightly alkaline at three seasons. From the hardness values of water samples, sample (I) may be soft water (< 50 mg L^{-1}) and sample (II) may be slightly hard (100-150 mg L^{-1}). The total alkalinity of sample (II) was found to be higher than that of sample (I) in all seasons. The BOD value of sample (II) was found to be highest at rainy seasons. This may be due to the flooding in rainy seasons. The COD for water samples are lower than the standard values. The trace elements determination, arsenic was found to be 0 ppb. Lead and cadmium were not detected. From the examination of bacteria, sample (I) shows the presence of *Escherichia coli* (2/5) at rainy season and thus it was un-satisfactory in rainy season. In summer and winter, *Escherichia coli* was not isolated and sample (I) was used for satisfactory. *Escherichia coli* in sample (II) was found in all three seasons. Thus sample (II) may be used un-satisfactory for all seasons. In summary, sample (I) may be used for drinking and domestic uses at summer and winter. But it must be used after boiling in rainy seasons. For sample (II), it may be used for agricultural uses. It may be used for drinking after the water had been boiled and any appropriate treatment.

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