

# A SURVEY OF THE QUALITY OF GROUNDWATER DRAWN FROM BOREHOLES IN THE ASHANTI REGION OF GHANA

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# INTRODUCTION

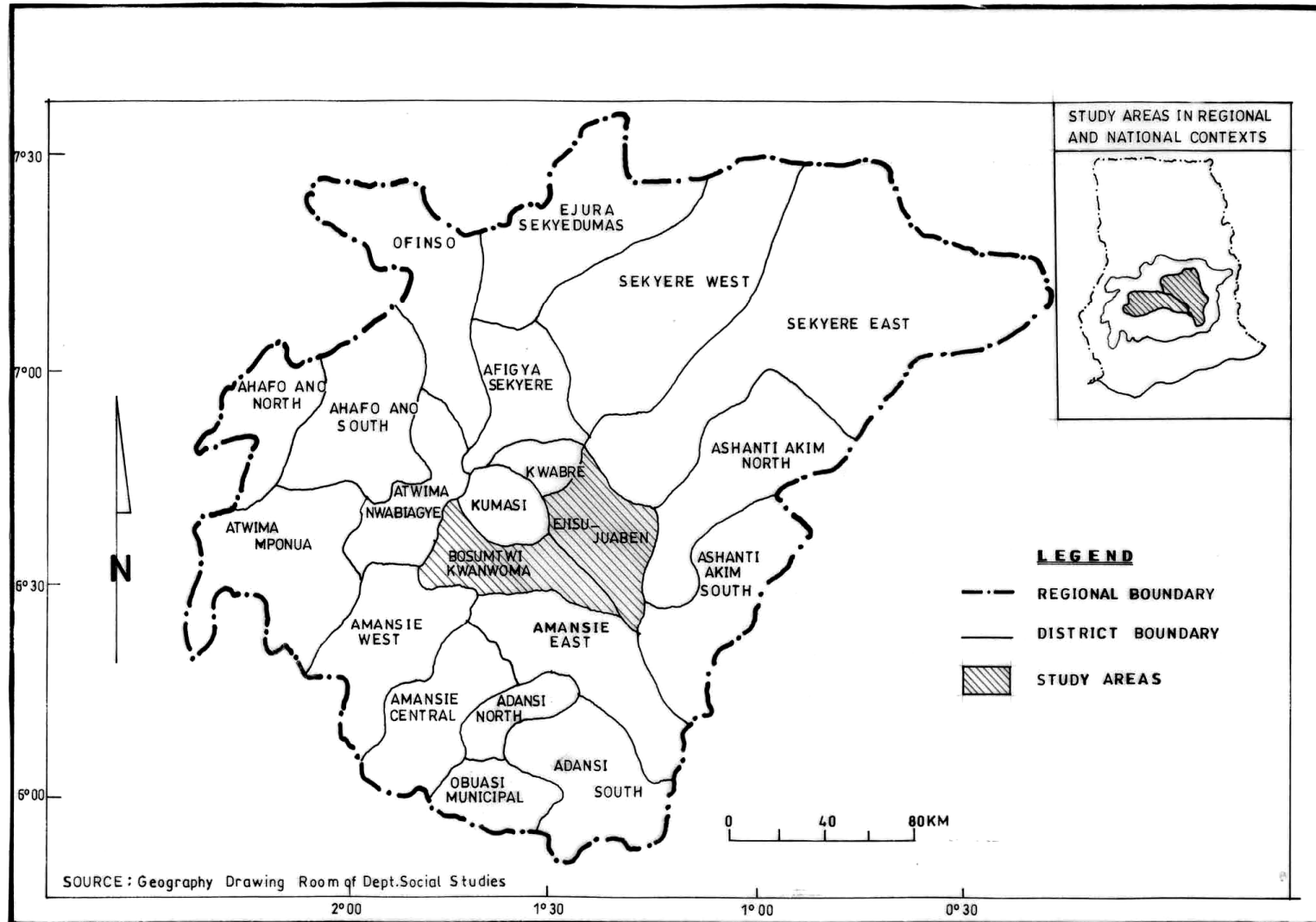
- **Water pollution arising from the presence of foreign substances (organic, inorganic, bacteriological or radiological) which tends to degrade the quality of water has become an issue of serious concern.**
- **Ejisu-Juaben (E-J) and Bosomtwi-Atwima-Kwanwoma (BAK) are among the 21 administrative districts in the Ashanti Region of Ghana [Fig.1]. The two districts are in close proximity. E-J stretches over an area of 637.2 km<sup>2</sup> while BAK has an area of 681.799 km<sup>2</sup>. E-J has a population of 124,176 and BAK has 145,524 inhabitants according to the 2000 Population and Housing Census [Osiakwan, 2002].**
- **The two districts under study are very close to Kumasi, the Capital City of the Region and are fast growing and are at the receiving end of urbanization, industrialization and its resultant climate changes in the Region.**

- Reliance of rain water is almost impossible and most surface water sources in these districts are either polluted or dried up and government and individuals have resorted to groundwater to satisfy major water needs.
- There is the general perception that water from boreholes are good for drinking and general household utilisation and the people in the study area are no exception to this assertion.
- It is therefore crucial that periodic checks are performed on groundwater to establish its security for consumption.

# OBJECTIVE

To use physicochemical indicators to determine the drinking quality of water from boreholes in the Ejisu-Juaben (EJ) and (Bosomtwi-Atwima-Kwanwoma) BAK districts.

# METHODOLOGY



**Figure 1: Ashanti Region of Ghana showing Administrative Districts**

# METHODOLOGY

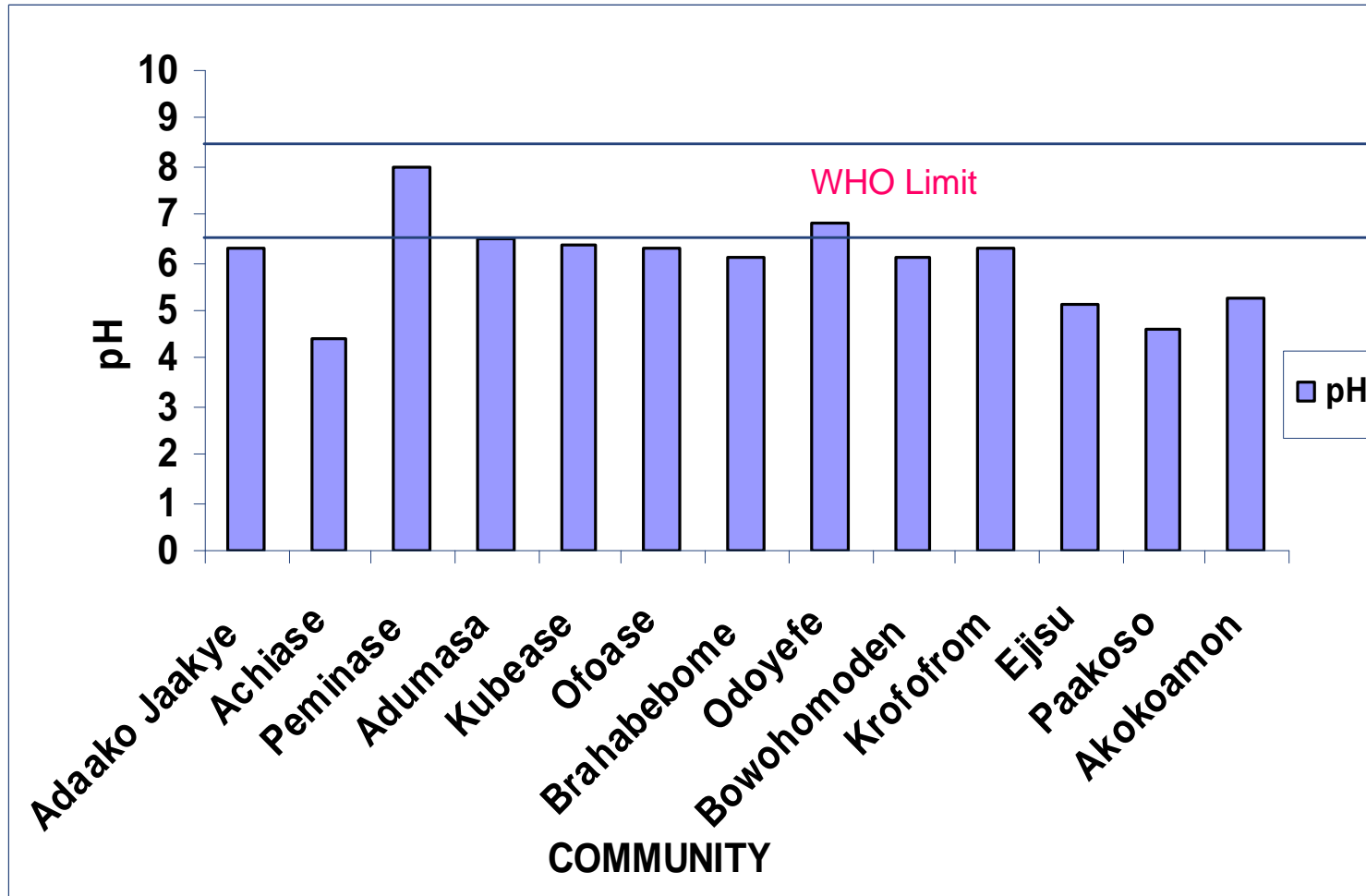
- Samples of water from 21 boreholes in 13 communities in the Ejisu-Juaben and 17 boreholes in 11 communities of the Bosomtwi-Atwima-Kwanwoma Districts of the Ashanti Region of Ghana were obtained for analysis within the period of November 2004 to June 2005.
- Titrimetry was used to determine alkalinity, hardness and Chloride content.
- Atomic Absorption Spectrophotometry was used for the determination of trace metals namely Fe, Mn, Cu, Zn, Cd, Pb, Na and K. UV-Visible Spectrophotometer was used to determine the anions ( $\text{SO}_4^{2-}$ ,  $\text{PO}_4^{3-}$  and  $\text{NO}_2^-$ ).
- Accuracy of the results was determined by recovery and sensitivity analysis.

# RESULTS

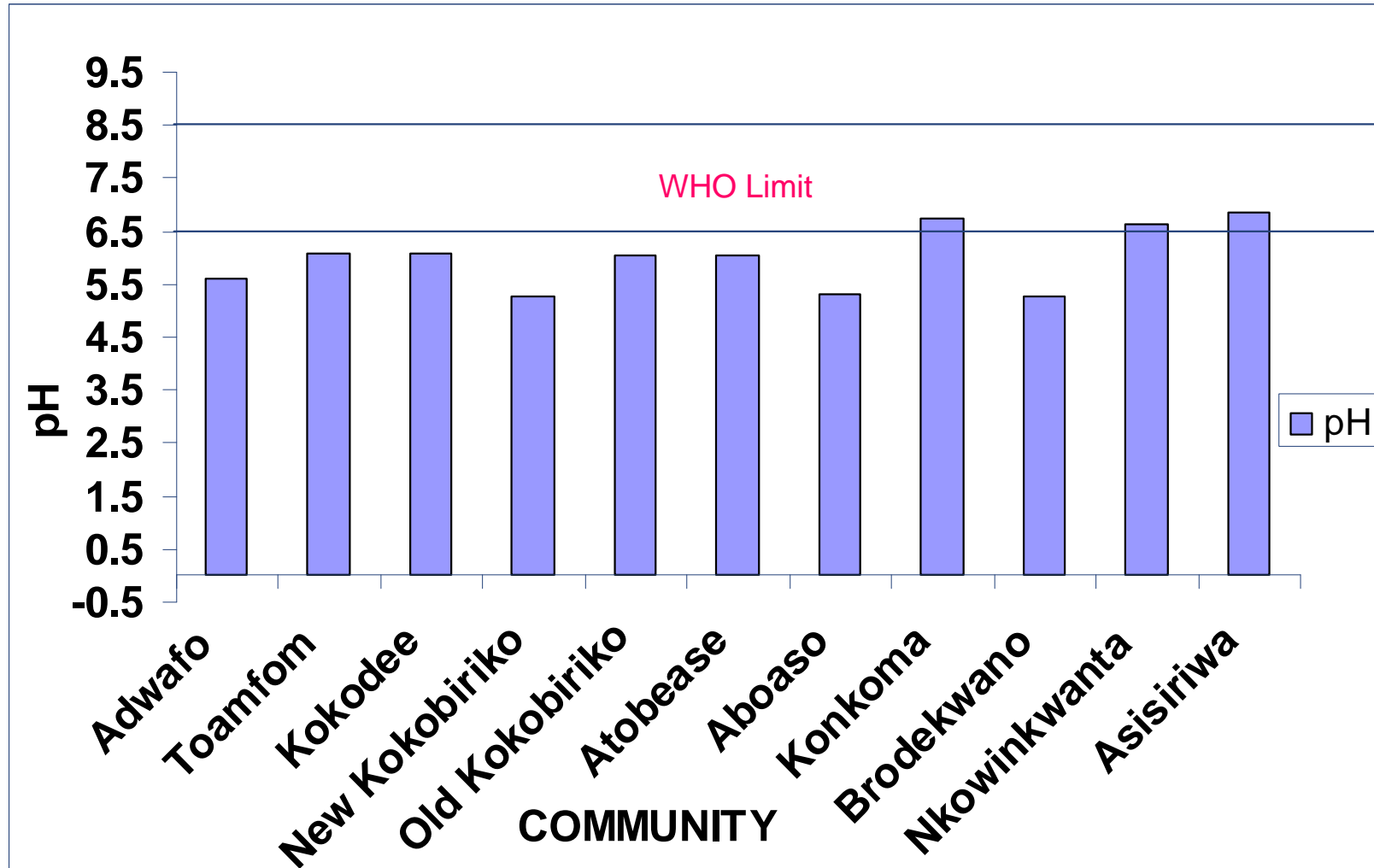
A total of 38 water samples were analysed for pH, Electrical conductivity(EC), total dissolved solids (TDS), colour, turbidity, tot. hardness, tot. alkalinity,  $\text{SO}_4^{2-}$ ,  $\text{PO}_4^{3-}$ ,  $\text{NO}_2^-$  and  $\text{Cl}^-$ , Pb, Zn, Cd, Cu, Mn, Fe, Na and K and results have been reported in Tables 1, 2 and 3 Mean recoveries and standard deviations have also been reported.

**Table 1: Range of physicochemical parameters of samples from EJ and BAK**

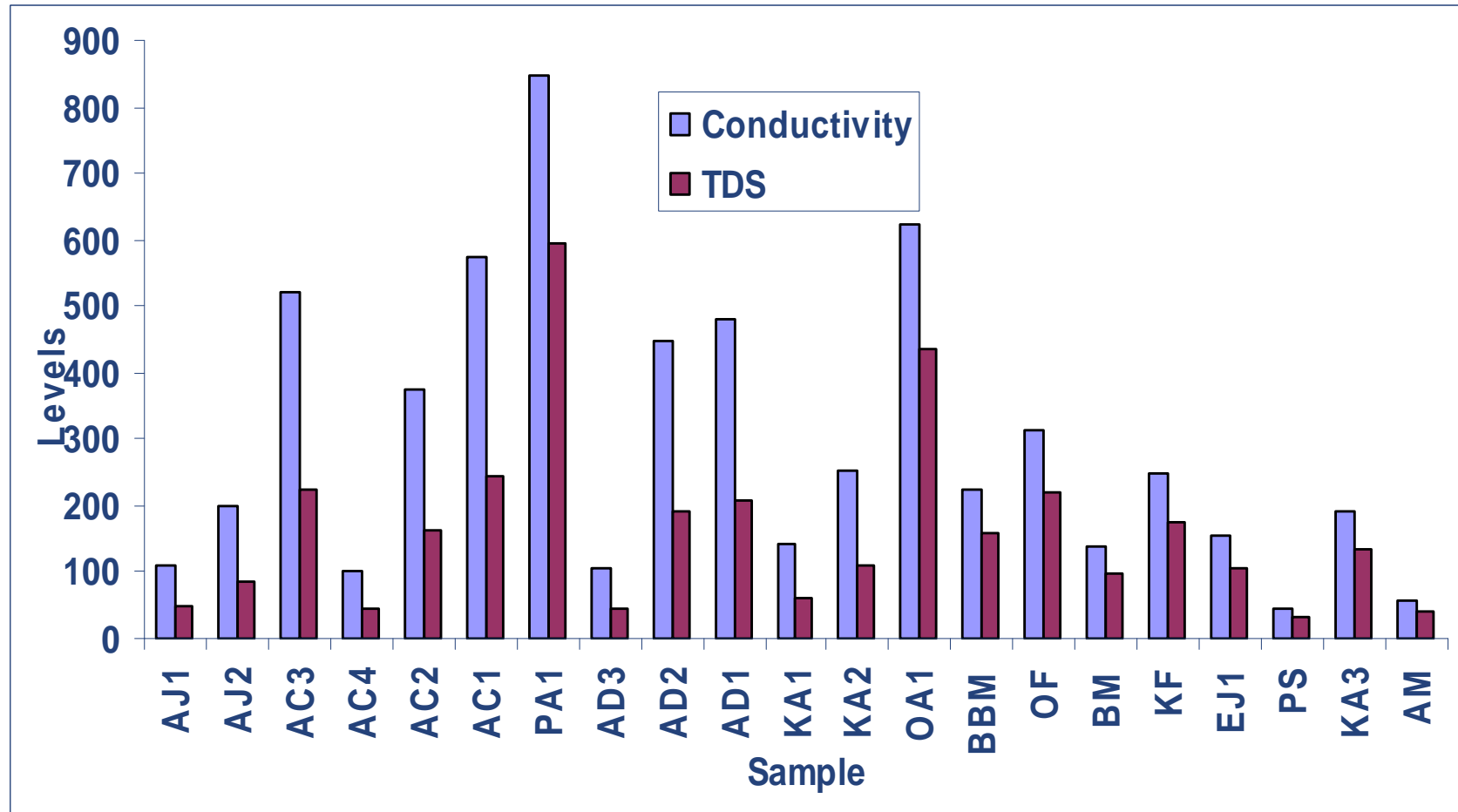
<b>PARAMETER</b>	<b>EJ DISTRICT</b>	<b>BAK DISTRICT</b>
<b>pH</b>	<b>3.95 - 7.95</b>	<b>5.1 - 6.84</b>
<b>Conductivity µmhos/cm</b>	<b>44.4 - 848</b>	<b>101 - 1114</b>
<b>TDS mg/L</b>	<b>31 - 593</b>	<b>36 - 779</b>
<b>Colour HU</b>	<b>0-5</b>	<b>&lt;5 - 60</b>
<b>Turbidity NTU</b>	<b>0.11-1.66</b>	<b>0.15 - 44.95</b>
<b>Hardness mg /L</b>	<b>13 - 231</b>	<b>3 - 402</b>
<b>Alkalinity mg / L</b>	<b>10 - 360</b>	<b>20 - 365</b>



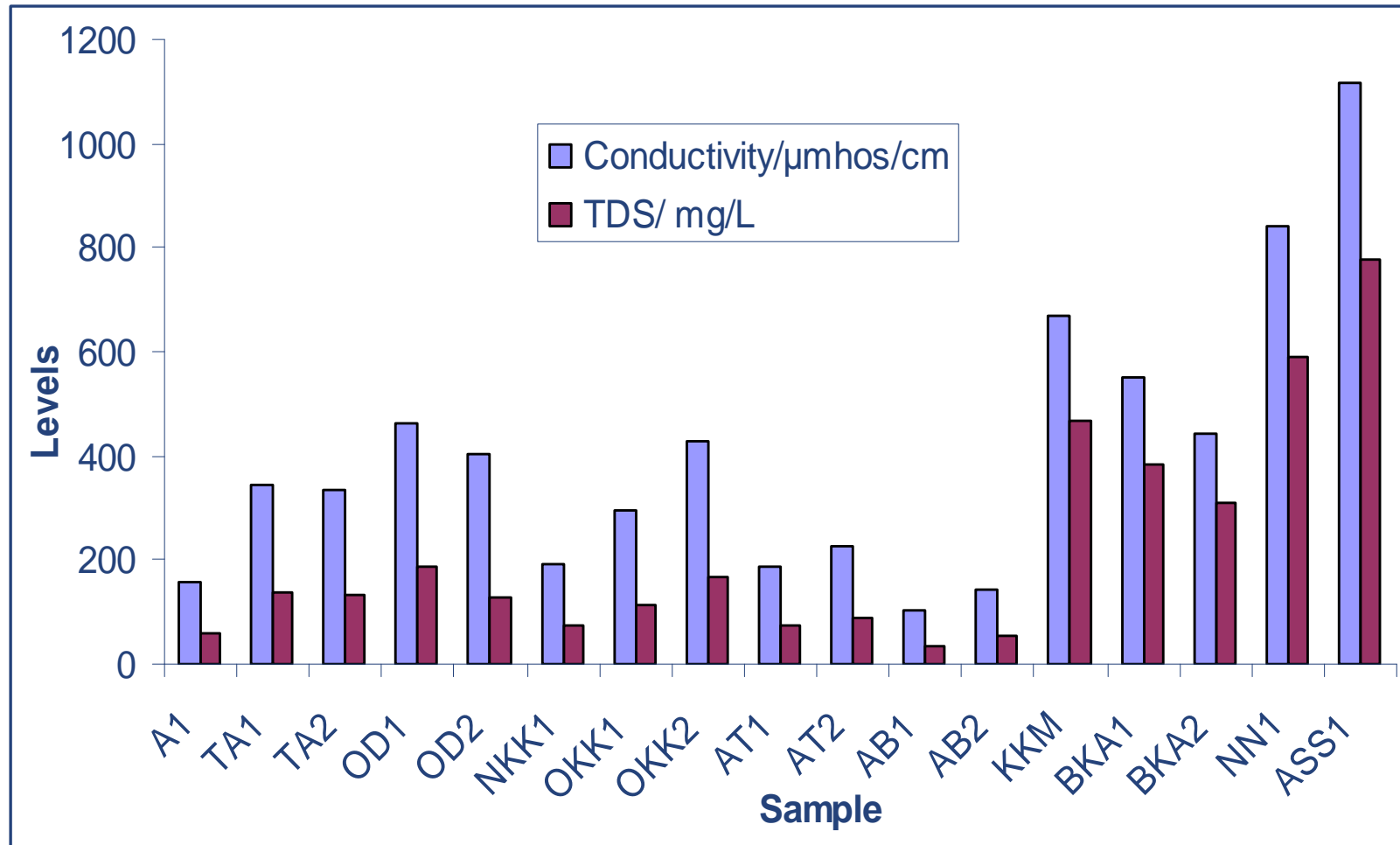
## Graph of pH versus Communities in EJ



**Graph of pH versus Communities in BAK**



**Graph of Conductivity and TDS versus Communities in EJ**



**Graph of Conductivity and TDS versus Communities in BAK**

**Table 2: Range of concentration of Anions and Cations in samples from EJ and BAK**

<b>PARAMETER mg/L</b>	<b>EJ DISTRICT</b>	<b>BAK DISTRICT</b>
<b>Cl<sup>-</sup></b>	5.0 - 91.6	8.5 - 60.1
<b>SO<sub>4</sub><sup>2-</sup></b>	0.500 - 3.700	0.5 - 16.83
<b>PO<sub>4</sub><sup>3-</sup></b>	0.002 - 1.115	0.038 -2.420
<b>NO<sub>2</sub><sup>-</sup></b>	0.001 - 0.076	b/d -0.028
<b>Fe</b>	0.080-2.063	0.055 - 3.356
<b>Mn</b>	0.001-1.646	0.001 - 0.844
<b>Cu</b>	0.013 -1.302	0.013 - 0.932
<b>Zn</b>	b/d - 0.357	b/d - 3.321
<b>Pb</b>	b/d – 0.029	b/d – 0.0378
<b>Cd</b>	b/d – 0.006	b/d -3.321
<b>Na</b>	4.0-75.7	6.0-86.7
<b>K</b>	0.5-67.5	0.2-8.0

❖ b/d: below detection

**Table 3: Mean % Recovery of Analyte and Standard Deviation**

<b>Analyte</b>	<b>Mean % Recovery</b>	<b>Standard Deviation (n = 3)</b>
<b>SO<sub>4</sub><sup>2-</sup></b>	99.7	0.66
<b>PO<sub>4</sub><sup>3-</sup></b>	99.6	0.12
<b>NO<sub>2</sub><sup>-</sup></b>	99.7	1.10
<b>Fe</b>	96.0	0.71
<b>Mn</b>	97.7	0.50
<b>Cu</b>	99.8	0.38
<b>Zn</b>	99.5	0.31
<b>Cd</b>	99.2	0.64
<b>Pb</b>	99.3	0.50
<b>Na</b>	96.3	1.10
<b>K</b>	98.8	0.31

Detection limit of the AAS: 0.93 mg/L and  
UV-Visible spectrophotometer : 0.36 mg/L

# MAJOR FINDINGS

This work has determined the quality of water from EJ and BAK districts in Ghana chemically.

- Most of the water had acceptable pH levels within the WHO limit of 6.5 - 8.5, however, few of the samples fell below this value.
- EC and TDS values recorded however were all below the WHO acceptable limits of 1500  $\mu\text{mhos/cm}$  and 1000 mg/L respectively.
- Colour and turbidity are closely related and these parameters usually have a direct correlation. The experimental results in this work did not differ in any way from this assertion.

- Samples from the EJ district all had colour content of value less than 15 HU, the acceptable limit for drinking water. It was therefore not surprising that turbidity in the same district gave a range of 0.11 - 1.66 NTU also below the limit of 5 NTU. In reference to the BAK district the general trend of colour and turbidity were acceptable with few areas of concern giving rise to a range of <5 – 60 for colour and 0.15 NTU - 44.95 NTU for turbidity.
- Total hardness and alkalinity values were all within the acceptable limits of 500 mg/L and 200 mg/L. Alkalinity levels up to 500 mg/L are permissible so values above 200 mg/L do not pose any hazard according to the USEPA.
- The water samples were rich in anions ( $\text{SO}_4^{2-}$ ,  $\text{PO}_4^{3-}$ ,  $\text{Cl}^-$  and  $\text{NO}_2^-$ ) but had concentrations below the WHO limit of 250 mg/L for sulphate, 250 mg/L for chloride and 3.0 mg/L for Nitrite. Phosphate has no set limit.

- Levels of trace metals like copper, zinc, cadmium, sodium and potassium were all of acceptable and less harmful levels in water from both districts. The upper limit of zinc for BAK was 3.321 mg/L which is above the WHO limit of 3.0 mg/L [Table 2]. It however could not pose any health risk to consumers since levels as high as 5.0 mg/L are permissible according to the USEPA guideline.
- In the case of iron and manganese levels were all permissible even though some levels were above the limits. Iron and manganese with levels up to 3.356 mg/L and 1.646 mg/L are permissible.
- Lead was present in three of the 38 samples under study and these were all above the WHO limit of 0.01 mg /L.
- Recoveries of 96.3% to 99.7 % were obtained, an indication of high accuracy of results.

## CONCLUSION

Regardless of the worry associated with a few records of low pH, high colour and isolated cases of trace metal contamination, most of the borehole water from the EJ and BAK districts of Ghana using physicochemical parameters as indicators can be said to be of acceptable quality for household utilisation.

# ACKNOWLEDGMENT

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**THANK YOU**