Assessment of Groundwater Pollution in Different Locations of Al-khums City, Libya

Dr. Fathi K. Elyaagubi[1],Dr.Salem M.ELNakeib[2], Dr.Mohamed A.Alrabib[3]&Eng. AfafAbouzed[4]

1 Dept. of Geological Engineering, Faculty of Engineering, University of Tripoli.

2 Dept. of Chemistry, Faculty of Science, University of Al Asmaryia Islamic.

3 Dept. of Geology, Faculty of Science, University of Zawia.

4 Advanced laboratory for chemical analysis-Tripoli.

Abstract:

A study was carried out in different areas of Al-Khums City (KH) as Celine (CN), Al- Mergub (MG), and Suk-Al-Khamis (Sk). Four samples were collected from eight wells sites 0.5 to 9km away from Mediterranean Sea coast in summer season, The samples were analyzed for their pH, electrical conductivity (EC), total dissolved solids (TDS), Alkalinity (TA), Total hardness (TH), Na^+,K^+,Mg^{+2},Ca^{+2}, Cl^-,SO_4^{-2}, HCO_3^-, as well as the evaluation of the degree of heavy metal contamination such as (iron , zinc, and cadmium) present in the samples.

Results showed that the water quality status was found to vary place to place. The results were analyzed and compared with water quality guidelines (WHO). The results detected that the ground water was not proper for drinking as well as domestic purposes due to significant variation of most of the results from the standard permissible limit which was high in water samples collected from nearby coastal areas such as Suk-Al-Khuamis (Sk) and Al-Khums (KH. Results of this study suggest that the ground water of the area needs a substantial degree of purification treatment before using for drinking and domestic purposes.

Key words*:Physico-chemical composition, Heavy metals, Groundwater, Al-Khums City, Libya.*

Introduction.

Groundwater is an important water resource in both the urban and rural areas of Libya.   Most of the people using groundwater for various purposes such as agriculture, industrial, household and environmental activities. Water represents about 70% of the total body weight [1]. Groundwater plays a vital role in the development of arid and semi-arid zones [2]. Protection of groundwater is a major environmental matter for the sake of maintaining the human health. Worldwide, groundwater resources are experiencing an increasing threat of pollution from industrial development, agricultural and mining activities. Groundwater resources are suffering an increasing threat of pollution from urbanization, industrial development, agricultural and mining activities. Thus requiring extensive study of the quality of ground water leading to proactive expedite and practical actions to protect the natural quality of groundwater. In Libya a large part of drinking water supply is by groundwater . Ground water is source of drinking water, thus a large population to risk of consuming contaminated water. While some of these elements are fundamental for humans, at high levels they can also mean a toxicological risk [3]. Regular observation of the quality of ground water should be undertaken, temporarily and spatially to identify the sources of toxic contaminants and other inhibitory compounds that affect the quality of water [4]. Heavy metals in groundwater are toxic even at low concentrations [5]. Human activities have increased the concentrations of heavy metals in the environment, for example, industry, agriculture, and solid waste disposal increase the contents of heavy metals in water, soil, etc. [6]. Environmental health involves all the factors, circumstances and conditions in the environment or surroundings of humans that can influence health and well being. The quality of water influences the health status. Thus, analysis of water for physical, biological and chemical properties including trace element contents are very important for public health studies. Human activities can change the natural composition of ground water through the disposal of chemicals and mining activities, at the land surface and into soils, or through injection of wastes directly into ground water.

However, in this study these wells are the main source of drinking water and other activities. The physicochemical properties as well as heavy metals on the groundwater in the Al Khums area was studied. The aim of this study to determine the extent of ground water pollution and seawater intrusion around Al-khums coastal area.Physico-chemical analysis and the heavy metals were done with the ground water samples collected from four different sites 0.5km to 9km away from the seashore around Al-Khums City coastal area.

Materials and Methods:

Study area:

Areas nearby Al-khums city situated on the Mediterranean coast , see Table1.

Table1: Showing sample collection areas.

Name of site	Distance from sea coast
Celine (CN)	9 km
Al- mergub (MG)	9km
Al-Khums (KH)	0.5 km
Suk-al-khamis (Sk)	0.5 km

Sampling

This study involved four samples obtained from eight wells, , it is located about 9km away from Mediterranean Sea coast, that samples were collected in summer season, 2017. The groundwater samples were collected in pre-cleaned polyethylene bottles and prior to collection, the samples bottles were rinsed thoroughly with the sample water. The water samples were taken through pumping so the sample will be a well representative and in order to avoid any contamination from the surface.

Sample analysis

The following physico-chemical parameters were determined by analytical methods, the pH were measured using pH-meter type HANNA model HI8014, and electric conductivity (E C) values were measured using E C meter model 4520, total dissolved solids (TDS) using gravimetry method, alkalinity (TA) was determined by titrimetrically, Total hardness (TH) was determined by complexomertry, sulphates (SO_4^{2-}), sodium (Na^+) and potassium (K^+) are determined by exciting atoms by flame photometer. Total Hardness, chloride(Cl^-), carbonate ($C0_3^{-2}$), bicarbonate (HCO_3^-), calcium (Ca^{+2}) and magnesium (Mg^{+2}) were determined according to [7]. Also heavy metals such as Iron (Fe), zinc (Zn) and cadmium (Cd) were determined using atomic absorption spectrometry. The electrical conductivity (EC) and pH of the groundwater samples were determined in-situ. All the studies were carried out in Advanced laboratory for chemical analysis. Analysis of variance (ANOVA) and Pearson correlation were performed on the data using SPSS (10.0) for Windows for significant variations and inter-element relationships. Results were presented as the mean ± standard error.

Results and discussion

pH provides an important piece of information in many type of geochemical equilibrium and is considered as an important ecological factor [8]. The pH was recorded high as 7.28 at sampling (KH) site, while it recorded low as 6.92 at sampling (SK) site (Figure 1).This may be attributed to different types of buffers normally present in the groundwater [9]. The variations in pH are relatively small. However, The mild alkalinity indicates the presence of weak basic salts in the soil [10], [11]. The mild alkaline nature suggests that approximately 95% of CO_2 in water is present as bicarbonate [12].

However, found to be in the permissible limit as prescribed under standard values of WHO [13]. Electrical conductivity (EC) is a useful to evaluate the pureness of water [14]. Electrical conductivity values were in the range of 1800 µs/cm (CN) to 4465 µs/cm (KH) see Figure 2. EC values for all the inspected samples were found to be greater than the limit prescribed by WHO and Libyan standard which indicate the presence of high amount of dissolved inorganic substances in ionized form. Views high values of EC may be due to the high concentration of ionic constituents present in sea water intrusion. The germination of almost all the crops would be affected and it may result in much reduced yield and these water samples cannot be used for drinking purposes. The total dissolved solids (TDS) values of sampling area are more of the permissible limits of WHO, except ground water wells which faraway from sea are very high concentration. The high TDS value may also be due to sea water intrusion. The results of continuous pumping of groundwater wells. High levels of TDS may aesthetically be unsatisfactory for more activities. Figure 3 shows that in the (KH) site, TDS values are 3155 mg/l where as in the area of (CN) was low about 1201mg/l.

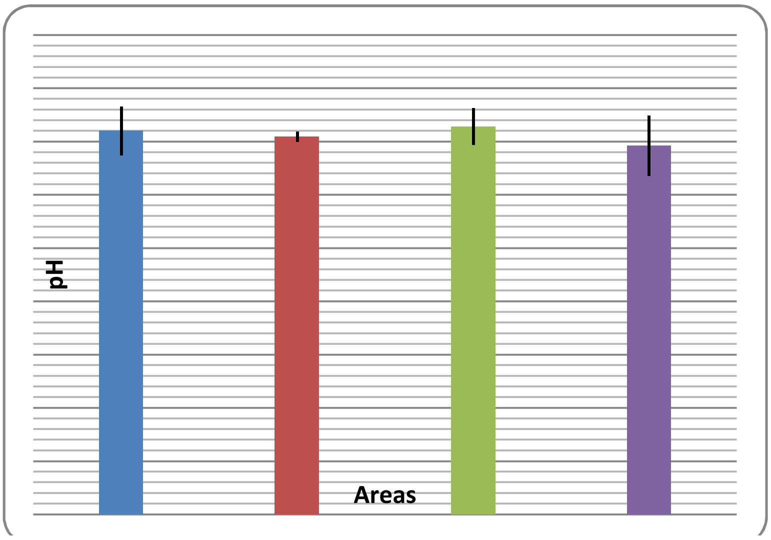
Alkalinity (TA) value in water provides a valuable idea of natural salts present in water. The reason of alkalinity is the presence of minerals which dissolve in water from soil. The different ions that contribute to alkalinity include bicarbonate, phosphate and organic compounds. These factors are characteristics of the source of water and natural changes occur at any given time [15]. The high value of alkalinity was found as 750 mg/l at sampling location KH and minimum 600 mg/l at CN (Figure 4) and KH found major than the limit prescribed by WHO and Libyan standard. Neutral salts of calcium or magnesium such as sulphates and chlorides may be present because of the sea water intrusion [15]. Total Hardness in the sample water was ranges from 545 mg/l (CN) to 3050 mg/l (KH) see Figure (5), which shows the values higher than the permissible limit prescribed by WHO and Libyan standards .It indicates very high values of hardness of water at all sampling locations according to the prescribed classification of water on the basis of hardness [16]. Sodium (Na^+) concentration was high at sample location SK 300 mg/l and low concentration was 130 mg/ml at sample location CN Figure (6). All the samples were found to have sodium ion concentration under permissible limit of WHO, except sample location KH, which showed slightly higher concentration than permissible limit.

The main quantity of potassium (K^+)in ground water enters with weathering of rocks but the quantities increase in water due to disposal of waste water [17]. Higher concentration of potassium was 22.9 mg/l at sample location KH and lower concentration was 9.54 mg/ml at sample location CN see Figure (7). All the samples were lower concentration of K^+ than the permissible limit of WHO. Magnesium (Mg^{+2})is supposed to be non toxic at the concentration generally met in natural water. The ranges of magnesium hardness have been found at 50.7 mg/l in CN area to 148.7 mg/l in KH area (Figure 8). Calcium (Ca^{+2}) varies between 73.9 and 209 mg/l in CN and KH , respectively. the high values of Ca^{+2} may be related to the lithology of water-bearing sediments and surface calcareous materials [18] (Figure 9). Chloride (Cl^-) in ground water source is usually found as NaCl, $CaCl_2$ in mostly varying concentrations The variation of concentration of chloride is mainly depend on the salts present in the soil and sewage and industrial wastes. Figure 10 shows the maximum value of chloride was as 1204 mg/l at sampling location KH and minimum was 389 mg/l (CN) and greater than the WHO. Sulphate (SO_4^{-2}) varies in content between 785mg/l near the Mediterranean Sea in KH and 155 mg/l far the Mediterranean Sea in CN area (Figure 11).

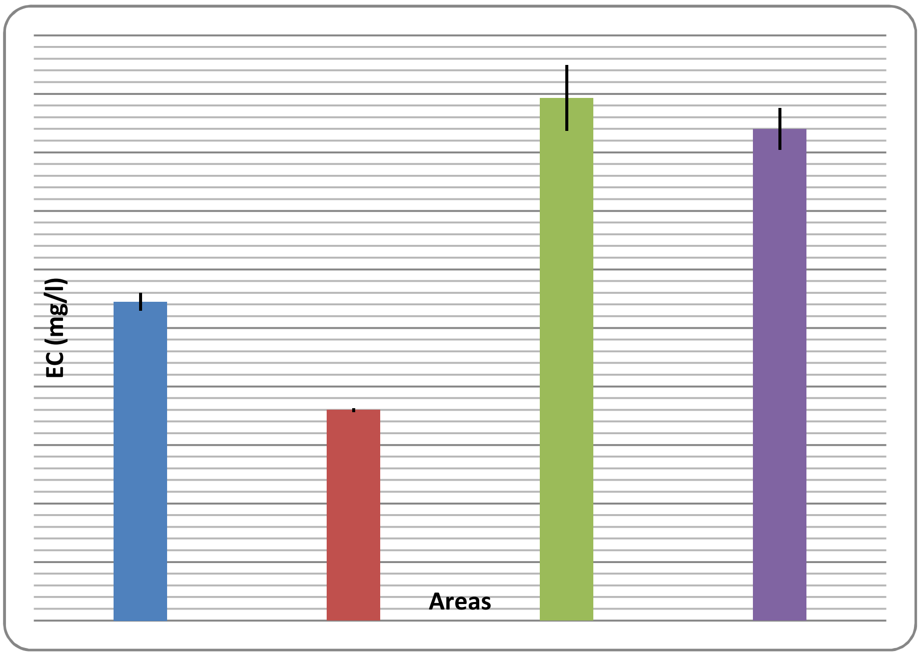
The studied water wells samples show high contents of bicarbonate (HCO_3^-). Bicarbonate concentration ranges between 261 to 360 mg/l see Figure (12). High Bicarbonate concentration may be attributed to local calcareous water bearing sediments. Results showed that three heavy metals (Fe, Zn and Cd) in Figure 13, 14, and 15, respectively, Fe concentrations is usually found in drinking water in the range of 0.0044 – 0.0047 mg/l. Our results showed that all samples are within WHO limit. While Zn in water samples were varying concentrations from 0.032 in CN site to 1.603 mg/l in SK site, all samples are within WHO limit,except only one sample location near the sea, which showed slightly higher (5.20 mg/l) concentration than permissible WHO limit. The increasing the element Cd concentrations in 15% of water samples than permissible WHO limit, thus, the heavy metals discharged by industries, traffic, municipal wastes, hazardous waste sites as well as from fertilizers for agricultural purposes and accidental oil spillages from tankers can result in a steady rise in contamination of ground water [19].

Conclusions:

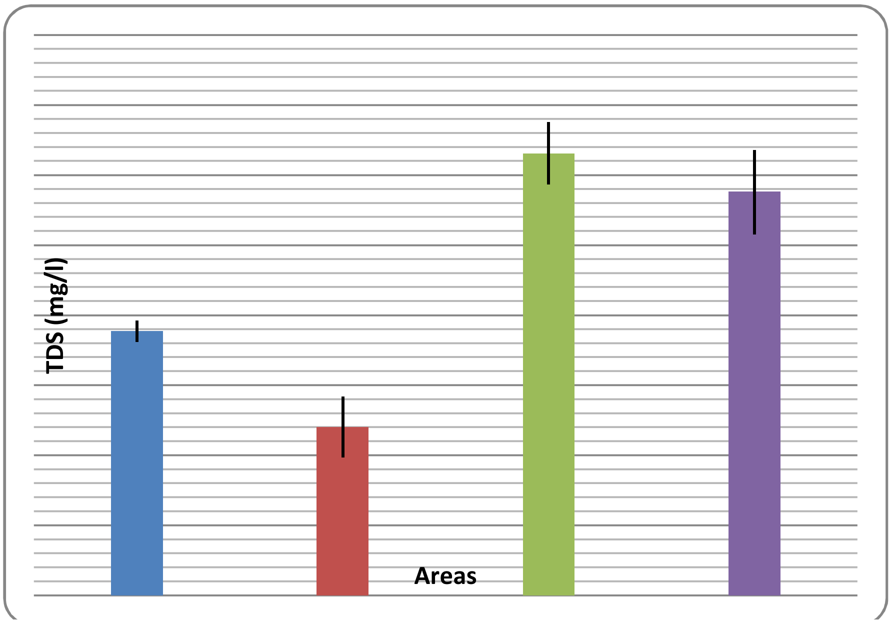
Analysis of ground water samples collected from different locations of Al-khums City revealed that all water samples do not comply with WHO standards. The water samples that are collected 0.5 km away from the sea water are gradually more contaminated near sea coast than those are collected 9 km away from the sea shore. The non portability of the ground water may be due to high values of TDS and Total Hardness. Because the ground water was contaminated more by the sea water intrusion and salts present in higher concentration in soil and rocks or due to other contaminations [20]. Ground water samples that are collected near the coastal area cannot be used not even for domestic purposes and requires a substantial degree of purification treatment before use for drinking and domestic purposes. Samples analyzed from ground water wells, with trace metals (Fe, Zn, and Cd) is within the allowed WHO limits in drinking water. Except only two samples location near the sea, which showed slightly higher concentration than permissible WHO limit.



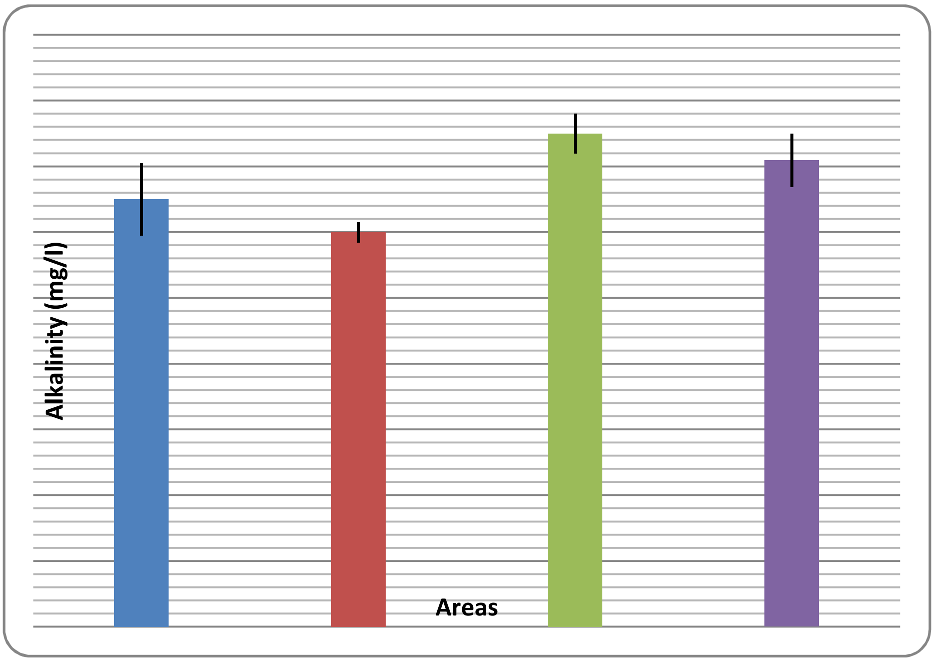
Figure(1): Mean pH values of water samples from the four sites.



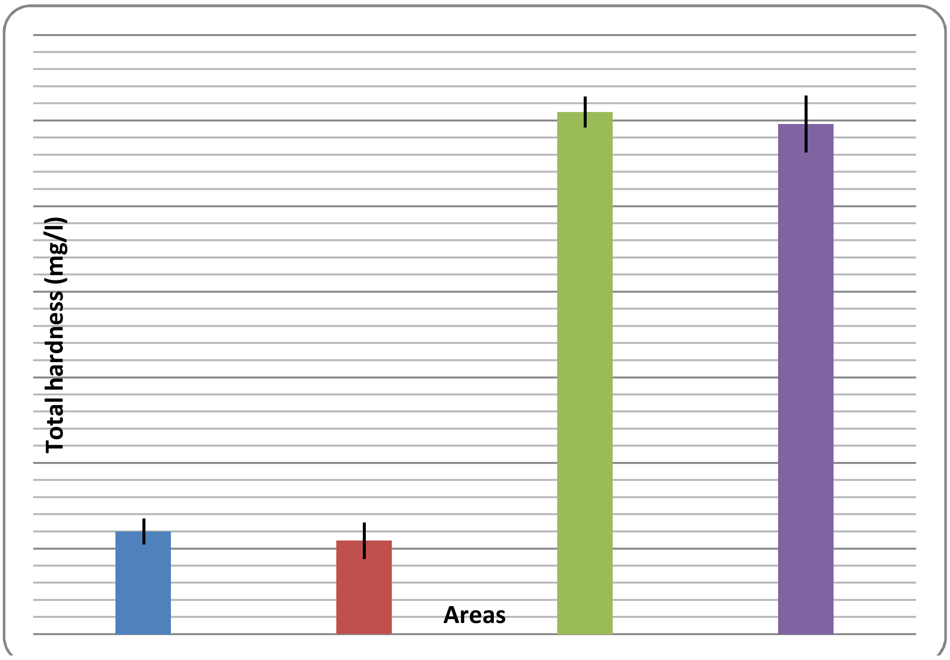
Figure(2): Mean EC values of water samples from the four sites.



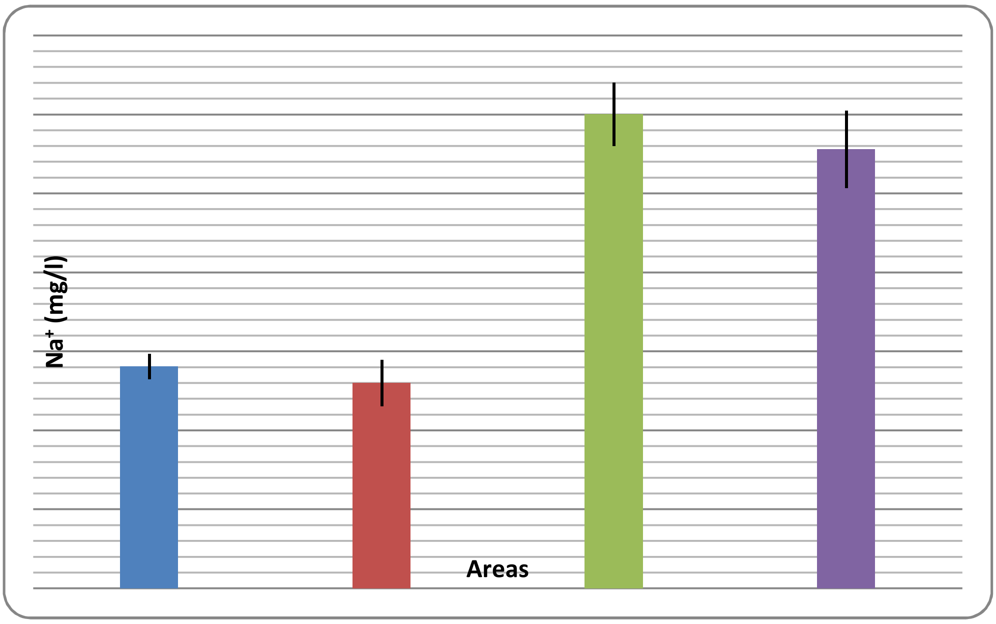
Figure(3): Mean TDS values of water samples from the four sites.



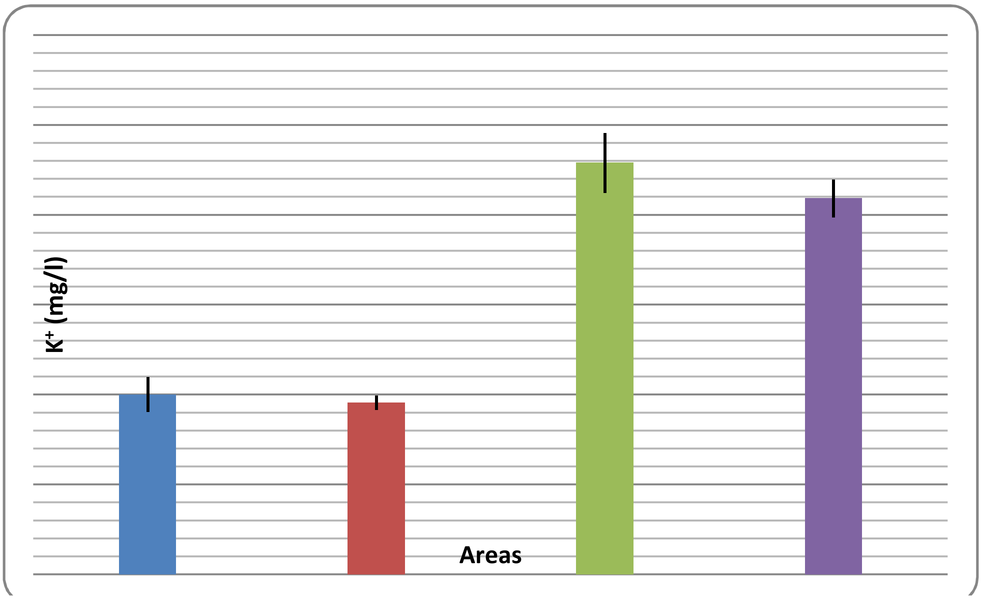
Figure(4): Mean Alkalinity values of water samples from the four sites.



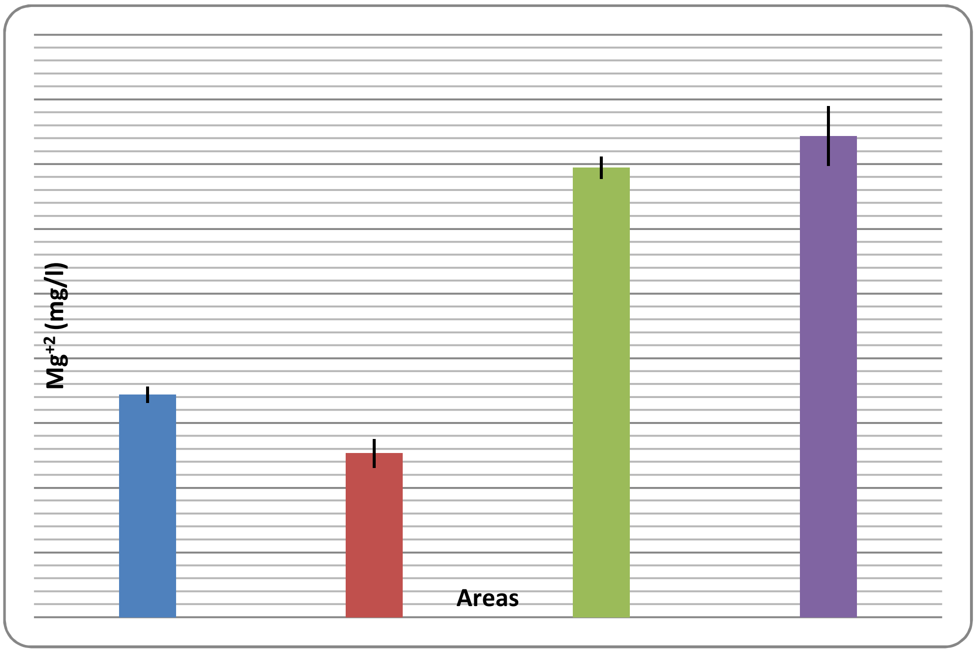
Figure(5): Mean total hardness values of water samples from the four sites.



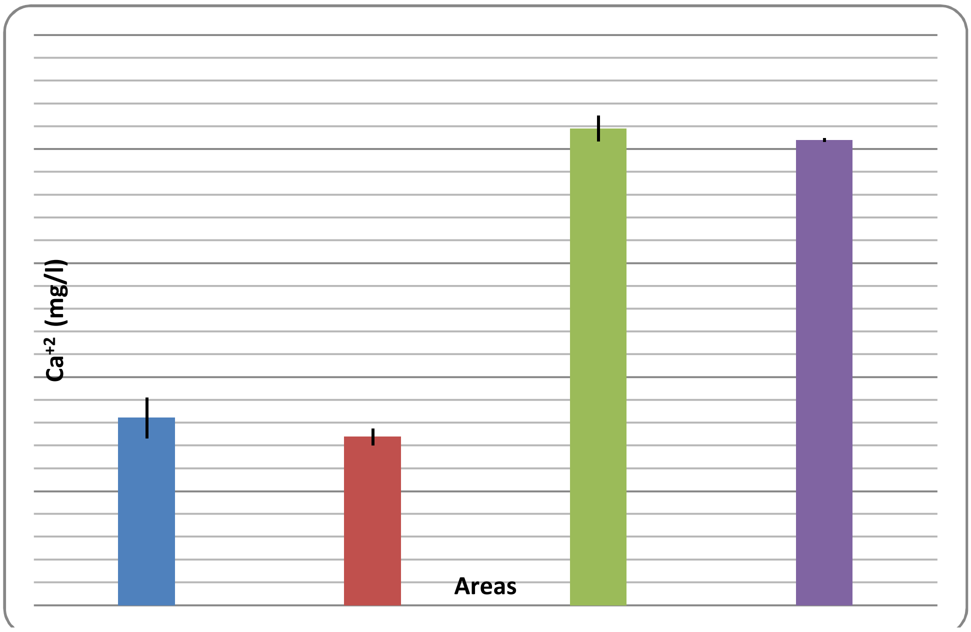
Figure(6): Mean Na^+ values of water samples from the four sites.



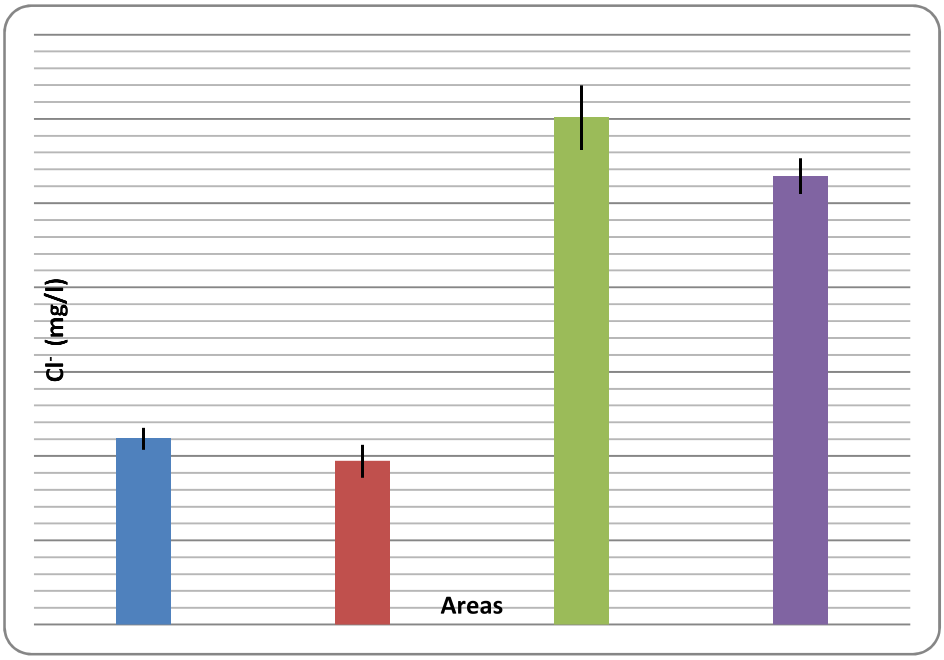
Figure(7): Mean K^{+} values of water samples from the four sites.



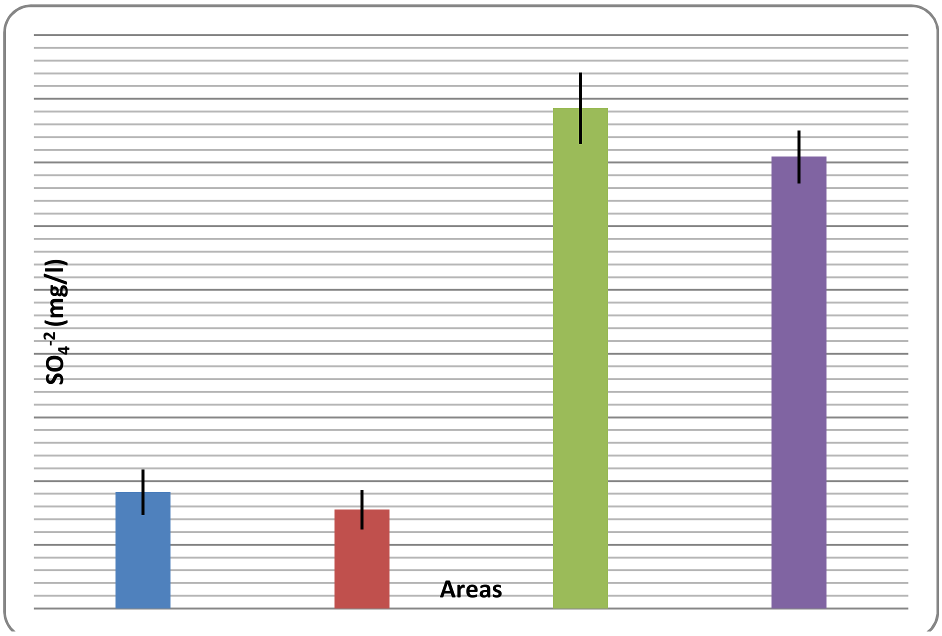
Figure(8): Mean Mg^{+2} values of water samples from the four sites.



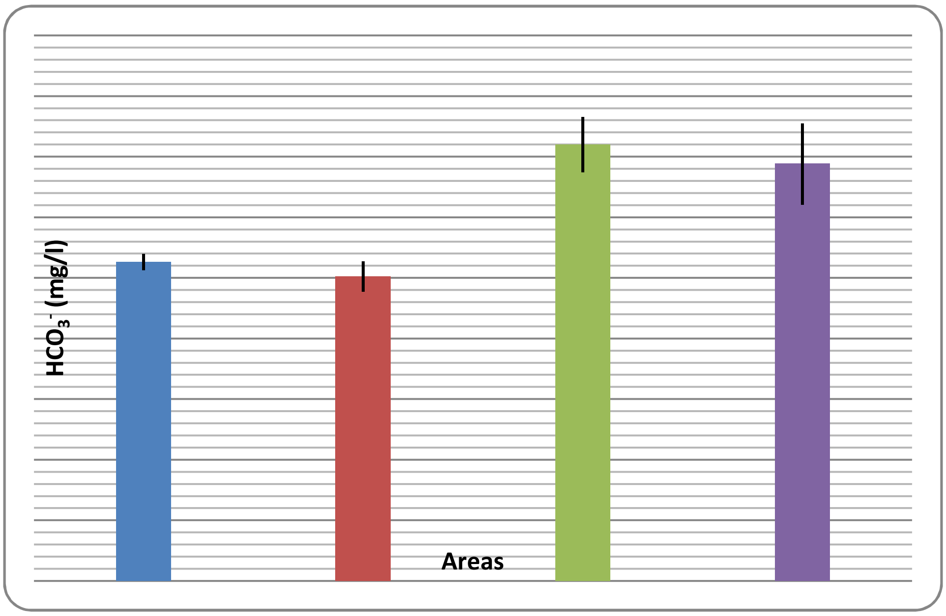
Figure(9): Mean Ca^{+2} values of water samples from the four sites.



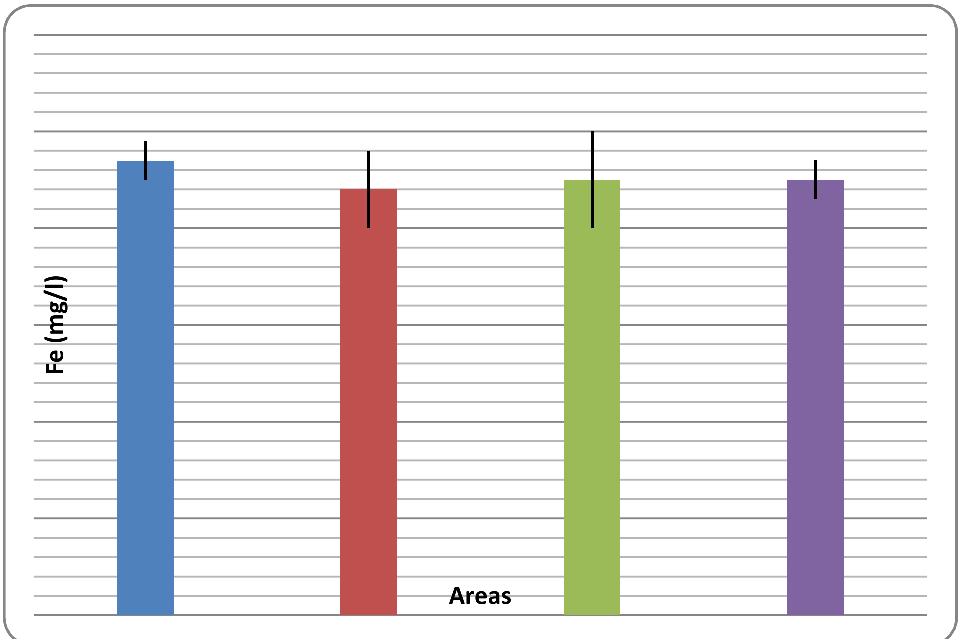
Figure(10): Mean Cl^{-} values of water samples from the four sites.



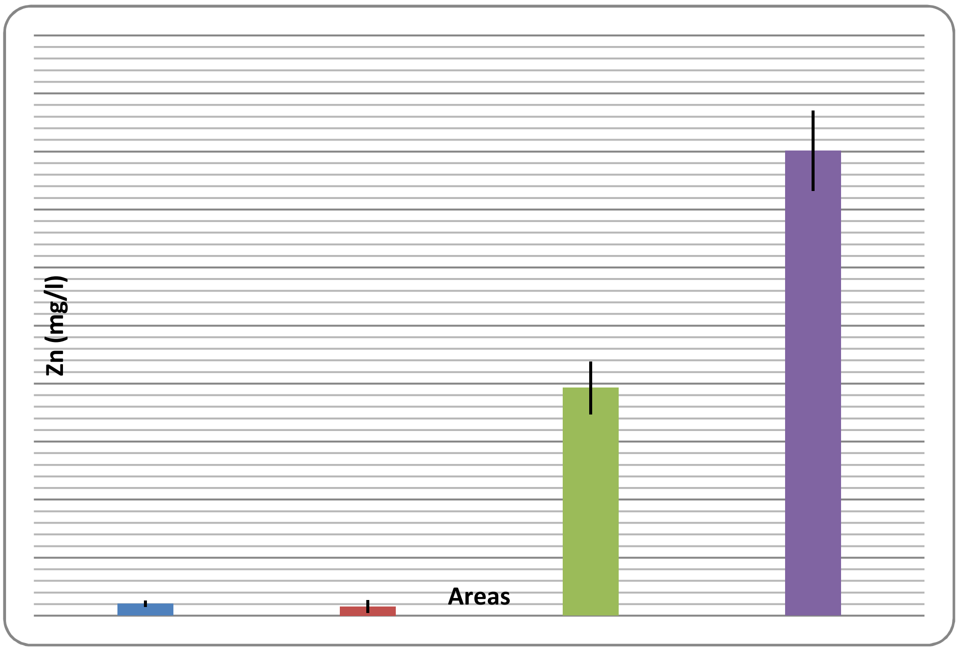
Figure(11): Mean So_4^{-2} values of water samples from the four sites.



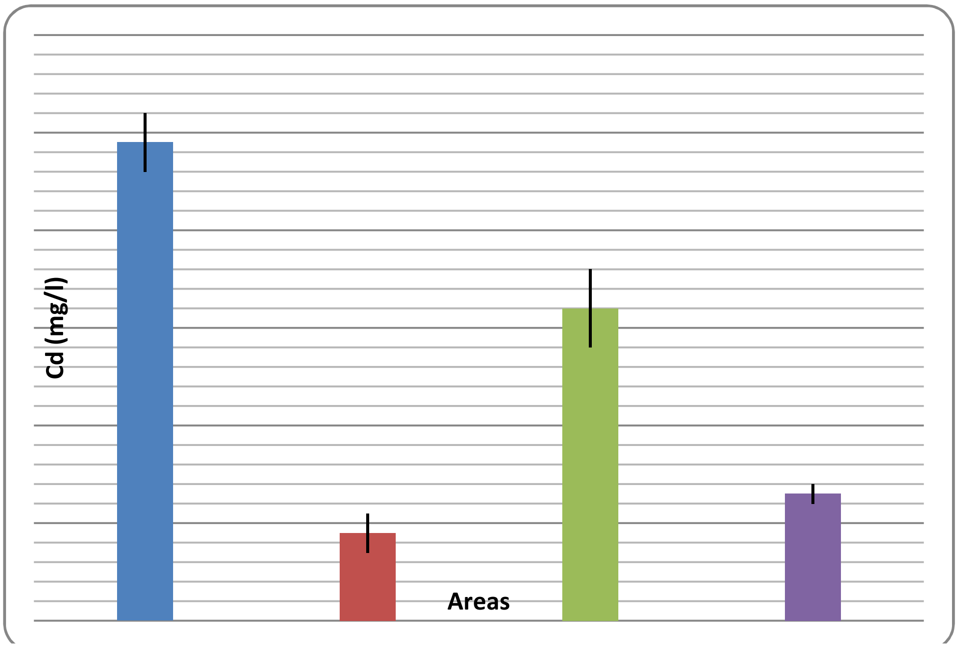
Figure(12): Mean HCO_3^- values of water samples from the four sites.



Figure(13): Mean Fe values of water samples from the four sites.



Figure(14): Mean Zn values of water samples from the four sites.



Figure(15): Mean Cd values of water samples from the four sites.

References:

[1] CBD (2010). The Convention on Biological Diversity, A good practice guide drinking water, Biodiversity and Development.

[2] Saleem, Q. and Algamal Y. (2016).Assessment of Physico-chemical and Biological Properties of Ground Water of Khulais, Province, Kingdom of Saudi Arabia.Ijsrm. Human, Vol.: 5, Issue:1, 505-521.

[3] Chang, L. W. (1996). Toxicology of metals.CRC Lewis Publishers, Boca Raton, FL, USA.

[4] Srinivas C. H., Ravi Shankar Piska, Venkatesan C., Sathya Narayan Rao M. S. and Ravinder Reddy R. (2000). Studies on ground water quality of Hyderabad, Poll. Res., 19(2), 285–289.

[5] Marcovecchio J. E., Botte S. E. and .Freije R. H. (2007). Heavy Metals, Major Metals, Trace Elements. In: L. M. Nollet, Ed.,

Handbook of Water Analysis, 2nd Edition, CRC Press, London. 275-311.

[6] Adekunle I., Adetunji M., Gbadebo A., and Banjoko O. (2007).Assessment of Groundwater Quality in a Typical Rural Settlement in Southwest Nigeria. International Journal of Environmental Research and Public Health, Vol. 4, No. 4, 307-318.

[7] APHA / AWWA / WPCF. (1998). Standard Methods .for the Examination of Water and Wastewater. 20th. ed., Washington, APHA / AWWA / WPCF.

[8] Shyamala, R., Shanthi, M., Lalitha, P. (2008). Physicochemical analysis of borewell water samples of Telungupalayam area in Coimbatore District,.Tamilnadu, India., E-Journal of chemistry, 5(4), 924-929.

[9] Weber, W. J. Jr., and Stun, W. (1963). Mechanism of hydrogen ion buffering in natural waters, J. American Water Works Association, 55, 1553–1555.

[10] Saha T. K., and Bose S. K. (1987). Observations on diurnal variations in Hydrobiological factors at Hazharibag h lake, Bihar, in: Proceedings of 74th Indian Science Congress, Part – III, Abstract, paper,39.

[11] Abdul Jameel A. (2002). Evaluation of drinking water quality in Tiruchirappalli, Tamil Nadu, Indian J. Env.Hlth., 44(2), 108–112.

[12] Azeez P. A., Nadarajan N. R., and Mittal D. D. (2000). The impact of monsoonal wetland on ground water chemistry, Poll. Res., 19 (2), 249–255.

[13] World Health Organization. (2004). Guidelines for Drinking-water Quality; Volume 1.Recommendations, Third ed., World Health Organization, Geneva, Switzerland.

[14] Pradeep Jain K. (1998). Hydrogeology and quality of ground water around Hirapur, District Sagar (M.P.), Poll. Res., 17(1), 91–94.

[15] Sharma, M.R. , J. (2004). Pollut Res, 23(1), 131- 134.

[16] Saravanakumar, K., Kumar, R. R. (2011). Analysis of water quality parameters of groundwater near Ambattur .Industrial Area, Tamil Nadu, India. Indian Journal of Science and Technology, 4(5), 560-562.

[17] Trivedy, R. K., Goel, P. K. (1984). Chemical and Biological Methods for Water Pollution Studies.Environmental Publication, Karad (India).

[18] Okashaaly. (2011). Sea water intrusion along the coastal area between wadi - kaam, northwest Libya.Journal of Environmental, Agricultural and Food chemistry, 10(7). 2426-2438.

[19] Igwilo I. O., Afonne O. J., Maduabuchi U. J. and Orisakwe O. E. (2006). Toxicological Study of the Anam River in Otuocha, Anambra State, Nigeria.Archives of Environ- mental & Occupational Health, Vol. 61, No. 5, 205-208.

[20] Kumar A., Zaiad G. Awheda I., and Fartas F. (2012). Physico-chemical analysis of ground water in different sites of alkhums city.IJSR, 2(7), 2395-2397.