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ASSESSMENT OF QUALITY OF GROUNDWATER SAMPLES FROM ABÉCHÉ CITY AND ITS SUITABILITY FOR POTABLE USE (CHAD)

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ABSTRACT

The aim of this study is assessment of quality of groundwater from abeche city and its suitability for potable use, samples were collected from five wells in two different seasons (summer and autumn), the quality of water assessed based on the physicochemical parameters (pH, TDS, EC, water hardness, Cl^-,NO_3^-, and NO_2^-) and the concentration of Ag, Al, As, B, Ba, Be, Cd, Cr, Co, Cu, Fe, Mn, Ni, Pb, Sr, Si, Sb, Mo, Ti, V, Zn , sodium, potassium, Magnesium, and calcium; the results obtained from the analysis compared with the world health organization standard for drinking water quality. The physiochemical parameters in the samples of two seasons were found less than the permissible limits of world health organization except in the sample from well no.1 in summer season showed slightly higher hardness than the WHO standard. The concentration of Lead, Cobalt and Antimony in autumn and summer season samples slightly exceed the permissible limits of World Health Organization standards for drinking water quality, so as: V, Sr, Si, Mo, Ni, Na, Mg, Fe, K and Ca in the well no. 1 in summer season also exceeded the permissible limits of World Health Organization standards for drinking water quality, while Al, As, Ag, B, Ba, Be, Cd, Cr, Cu, Mn, Ti, and Zn were less than the permissible limits.

Introduction

The ground water is defined as water that is found underground in cracks and spaces in soil, sand and rocks. This source has two distinct functions; firstly, it is a significant source of both urban and rural population's water supply and secondly it sustains many wetland ecosystems. One of the most important environmental issues today is groundwater contamination and between the wide diversity of contamination and between resources, heavy metals receive particular concern considering their strong toxicity even at low concentration. Groundwater is used for domestic, agriculture and industrial purpose in most parts of the world. The human activities like agriculture and domestic release large number of pollutants into the water bodies. The major sources of water are rainfall, surface water involving rivers, lakes and groundwater involving wells bore wells *etc*. In recent years, the growth of industry, technology, population and water use has increased the stress upon both our land and water resources. Locally, the quality of ground water has been degraded. Municipal and industrial wastes, chemical fertilizers, herbicides and pesticides have entered the soil, infiltrated some aquifers and degraded the ground-water quality [Pramod N Kamble, *et al* (2011)]. Water is a transparent fluid which forms the world's streams, lakes, oceans and rain, and is the major constituent of the fluids of living things(organisms). As a 3**,** a water molecule contains one oxygen and two hydrogen atoms that are connected by covalent bonds**.** Water is a liquid at standard ambient temperature and pressure**,** but it often co-exists on Earth with its solid state**,** ice**;** and gaseous state**,** steam **(**water vapor**).** It also exists as snow**,** fog**,** dew and cloud. Water covers 70.9% of the Earth's surface. and is vital for all known forms of life. On Earth, 96.5% of the planet's water is found mostly in oceans, 1.7% in groundwater, 1.7% in glaciers and the ice caps of Antarctica and Greenland, a small fraction in other large water bodies, and 0.001% in the air as vapor, clouds (formed of solid and liquid water particles suspended in air), and precipitation. Only 2.5% of the Earth's water is freshwater, and98.8% of that water is in ice and groundwater. Less than 0.3% of all freshwater is in rivers, lakes, and the atmosphere, and an even smaller amount of the Earth's freshwater (0.003%) is contained within biological bodies and manufactured products[Gleick, P.H *et al* (1993)].Water on Earth moves continually through the hydrological cycle of evaporation and transpiration (evapotranspiration),condensation, precipitation, and runoff, usually reaching the sea. Evaporation and transpiration contribute to the precipitation over land. Water used in the

Production of a good or service is known as virtual water. Safe drinking water is essential to humans and other life forms. Access to safe drinking water has improved over the last decades in almost every part of the world, but approximately one billion people still lack access to safe water and over 2.5 billion lack access to adequate sanitation, there is a clear correlation between access to safe water. However, some observers have estimated that by 2025 more than half of the world population will be facing water-based vulnerability. A recent report suggests that by2030, in some developing regions of the world, water demand will exceed supply by50%.Water plays an important role in the world economy, as it functions as a solvent for a wide variety of chemical substances and facilitates industrial cooling and transportation. Approximately 70% of the fresh water used by humans goes to agriculture [Baroni, L *et al*. (2007)].

Hydrology is the study of the movement, distribution, and quality of water throughout the Earth. The study of the distribution of water is hydrography.

The study of the distribution and movement of groundwater is hydrogeology, of glaciers is glaciology, of inland waters is limnology and distribution of oceans is oceanography. Ecological processes with hydrology are in focus of eco hydrology. The collective mass of water found on, under, and over the surface of a planet is called the hydrosphere. Earth's approximate water volume (the total water supply of the world) is 1,338,000,000 km3 (321,000,000 mi3). Liquid water is found in bodies of water, such as an ocean, sea, lake, river, stream, canal, pond, or puddle. The majority of water on Earth is sea water. Water is also present in the atmosphere in solid, liquid, and vapor states. It also exists as groundwater in aquifers. Water is important in many geological processes. Groundwater is present in most rocks, and the pressure of this groundwater affects patterns of faulting. Water in the mantle is responsible for the melt that produces volcanoes at subduction zones. On the surface of the Earth, water is important in both chemical and physical weathering processes. Water and, to a lesser but still significant extent, ice, are also responsible for a large amount of sediment transport that occurs on the surface of the earth. Deposition of transported sediment forms many types of sedimentary rocks, which make up the geologic record of Earth history[Gleick, P.H *et al* (1993)].The water cycle (known scientifically as the hydrologic cycle) refers to the continuous exchange of water with in the hydrosphere, between the atmosphere, soil water, surface water, groundwater, and plants. Water moves perpetually through each of these regions in the *water cycle* consisting of following transfer.

processes:

• evaporation from oceans and other water bodies into the air and transpiration from land plants and animals into air.

• precipitation, from water vapor condensing from the air and falling to earth or ocean.

• runoff from the land usually reaching the sea. Most water vapor over the oceans returns to the oceans, but winds carry water vapor over land at the same rate as runoff into the sea, about 47 Tt per year. Over land, evaporation and transpiration contribute another 72 Tt per year. Precipitation, at a rate of 119 Tt per year over land, has several forms: most commonly rain, snow, and hail, with some contribution from fog and dew [Gleick, P.H *et al* (1993)].

Condensed water in the air may also refract sunlight to produce rainbows. Water runoff often collects over watersheds flowing into rivers. A mathematical model used to simulate river or stream flow and calculate water quality parameters is hydrological transport model. Some of water is diverted to irrigation for agriculture. Rivers and seas offer opportunity for travel and commerce. Through erosion, runoff shapes the environment creating river valleys and deltas which provide rich soil and level ground for the establishment of population centers. A flood occurs when an area of land, usually low-lying, is covered with water. It is when a river overflows its banks or flood from the sea. A drought is an extended period of months or years when a region notes a deficiency in its water supply. This occurs when a region receives consistently below average precipitation.

Agriculture

The most important use of water in agriculture is for irrigation, which is a key component to produce enough food. Irrigation takes up to 90% of water withdrawn in some developing countries, and significant proportions in more economically developed countries (United States, 30% of freshwater usage is for irrigation). It takes around 3,000 litres of water, converted from liquid to vapour, to produce enough food to satisfy one person's daily dietary need. This is a considerable amount, when compared to that required for drinking, which is between two and five litres. To produce food for the 6.5 billion or so people who inhabit the planet today requires the water that would fill a canal ten metres deep, 100 metres wide and 7.1 million kilometres long – that's enough to circle the globe 180 times (WBCSD (2010).

Fifty years ago, the common perception was that water was an infinite resource. At this time, there were fewer than half the current number of people on the planet. People were not as wealthy as today, consumed fewer calories and ate less meat, so less water was needed to produce their food. They required a third of the volume of water we presently take from rivers. Today, the competition for the fixed amount of water resources is much more intense, giving rise to the concept of peak water. This is because there are now nearly seven billion people on the planet, their consumption of water-thirsty meat and vegetables is rising, and there is increasing competition for water from industry, urbanisation and biofuel crops. In future, even more water will be needed to produce food because the Earth's population is forecast to rise to 9 billion by 2050. An additional 2.5 or 3 billion people, choosing to eat fewer cereals and more meat and vegetables could add an additional five million kilo metres to the virtual canal mentioned above. An assessment of water management in agriculture was conducted in 2007 by the International Water Management Institute in Sri Lanka to see if the world had sufficient water to provide food for its growing population. It assessed the current availability of water for agriculture on a global scale and mapped out locations suffering from water scarcity. It found that a fifth of the world's people, more than 1.2 billion, live in areas of physical water scarcity, where there is not enough water to meet all demands [Molden, D (2007)]. A further 1.6 billion people live in areas experiencing economic water scarcity, where the lack of investment in water or insufficient human capacity make it impossible for authorities to satisfy the demand for water. The report found that it would be possible to produce the food required in future, but that continuation of today's food production and environmental trends would lead to crises in many parts of the world. To avoid a global water crisis, farmers will have to strive to increase productivity to meet growing demands for food, while industry and cities find ways to use water more efficiently [Chartres, C. *et al*.(2010)].

ISSN 2229-5518

Heat exchange

Water and steam are used as heat transfer fluids in diverse heat exchange systems, due to its availability and high heat capacity, both as a coolant and for heating. Cool water may even be naturally available from a lake or the sea. Condensing steam is a particularly efficient heating fluid because of the large heat of vaporization. A disadvantage is that water and steam are somewhat corrosive. In almost all electric power stations, water is the coolant, which vaporizes and drives steam turbines to drive generators. In the U.S., cooling power plants is the largest use of water (http:/nationalatlas. gov/ articles/ water/ a_wateruse. html).

In the nuclear power industry, water can also be used as a neutron moderator. In most nuclear reactors, water is both a coolant and a moderator. This provides something of a passive safety measure, as removing the water from the reactor also slows the nuclear reaction down however other methods are favored for stopping a reaction and it is preferred to keep the nuclear core covered with water so as to ensure adequate cooling. [Berry D (2012)].

Objective

The objective of this research is the assessment of quality of groundwater of the water samples from Abeche city and its suitability for potable use. the quality of ground water assessed based on the physicochemical parameters (pH, TDS, EC, water hardness, Cl^-,NO_3^-, and NO_2^-) and the concentration of Ag, Al, As, B, Ba, Be, Cd, Cr, Co, Cu, Fe, Mn, Ni, Pb, Sr, Si, Sb, Mo, Ti, V, Zn , Na , K, Ca and Mg, the results obtained from the analysis compared with the world health organization standard for drinking water quality.

ISSN 2229-5518

MATERIAL AND METHODS

Water samples

Ground water samples used in this research were collected from different five wells in Abeche city(Chad) during summer and autumn season 2015 -2016. samples were collected in 1.5 liter plastic bottles, which were previously thoroughly washed with tap water and rinsed with distilled water. These were immediately acidified to pH 2 with HNO_3 in order to keep metals in solution and prevent them from adhering to the walls of the bottles.

Methods

Total Hardness determination

Method: the determination of the total hardness of water is based on a complex metric titration of calcium and magnesium with a solution of EDTA at a PH of 10. At the end point of the titration the sample turns from red to blue color in the presence of Eriochrome Black T(EBT) indicator. procedure **:** 50 ml of each ground water samples were pipetted into a clean conical flask, 1 ml of buffer solution (pH 10) were added, 2-3 drop of EBT indictor has been added, then the mixture were titrated against EDTA solution from burette until the end point, result has been recorded and calculation has been done.

EC determination

An electrical conductivity meter (EC meter) measures the electrical conductivity in a solution. It is commonly used in hydroponics, aquaculture and freshwater systems to monitor the amount of nutrients, salts or impurities in the water.

procedure**:** Take the water sample in clean beaker (100ml), rinse the conductivity cell with distilled water and then with the sample .Temperature and cell constant corrections are adjusted on the conductivity meter if provided. Connect conductivity cell to meter and dip in the sample. Pass the current and adjust the current by rotating the dial in such a way that the width of shadow in cathode ray (magic eye) is maximum. Then read the conductivity value in dSm^{-1} . Direct readings may be obtained in digital type of meters .Observed value of EC are multiplied by the cell constant (usually given on conductivity cell) and a temperature factor to express results at 25c . Values of conductivity usually vary by 2% per degree increase or decrease in temperature. Conductivity increases with in increase in temperature compensation is to introduce a resistance element into the bridge circuit that may change with temperature at the same rate as the solution under test. Cell constant of conductivity cell may also be determined by observing the specific conductance of standard 0.10N potassium chloride (dissolving o.7456 gm kcl per litre). Specific conductivity of kcl solution is 1.4118 dSm^{-1} at 25c. The cell constant may be calculated as follows.

Cell constant = 1.4118 ⁄ observed conductivity of kcl solution.

ISSN 2229-5518

TDS determination

procedure**:**

1- Direct reading by using conductivity(TDS)meter and results reported in mg/l. 2- There is a relationship between TDS and EC. Generally speaking the TDS in mg/l is about 2/3-3/4 of the EC measured in uS/cm. So, now you have a way of calculating TDS if you know the EC; TDS ~ 0.7 EC. TDS = 0.7EC

pH determination

A pH Meter is a scientific instrument that measures the hydrogen-ion concentration (or pH) in a solution, indicating its acidity or alkalinity. The pH meter measures the difference in electrical potential between a pH electrode and a reference electrode

procedure: The pH is determined by taking about 50 ml water sample in a 100ml clean beaker and immersing the glass and calomel electrodes or combined electrode of the pH meter in it. The pH is indicated on the dial. P^H meter is first adjusted to the known pH of buffer solutions having pH of 4and 9.2. Practical Suggestions:

1- allow the pH meter to warm for 10 minutes before recording the pH.
2- Adjust pH meter on two Ph values(4 and 9.2) of known buffer solutions.
3- Never allow the lower portion of glass electrode to touch bottom of the beaker.
4- Always put the switch to neutral , zero or release Ph button whenever solution is changed.
5- Ensure that the calomel electrode is clean and filled with saturated kcl solution.

RESULTS AND DISCUSSION

Results of the samples

Table (4.1): Physiochemical parameters of groundwater samples in summer season:

Sample NO.	pH	Temp(ºC)	EC(µS/cm)	TDS(ppm)	NO_3(ppm)	NO_2^-(ppm)	CL(ppm)	Total Hardness
1	6.93	25	0.912	583.68	38.64	0.051	177.5	510.27
2	7.040	25	0.950	608.00	32.48	0.101	170.4	482.31
3	6.640	25	0.827	529.28	26.88	0.122	113.6	356.4
4	6.714	25	0.597	382.08	14.56	0.226	106.5	251.64
5	7.165	25	0.580	371.20	14.56	0.226	99.4	272.61

Table(4.2):Physiochemical parameters of groundwater samples in autumn season:

Sample N^O.	pH	Temp(ºC)	EC(µS/cm)	TDS(ppm)	NO_3^- (ppm)	NO_2^- (ppm)	CL(ppm)	Total Hardness
1	6.750	25	0.872	558.08	24.64	0.134	170.4	461.34
2	6.74	25	1.031	659.84	33.60	0.098	184.6	440.4
3	6.825	25	0.607	388.48	17.36	0.189	99.4	272.61
4	7.045	25	0.685	438.40	19.60	0.168	113.6	370.4
5	7.191	25	0.664	424.96	30.24	0.109	113.6	244.65

Table(4.3): Element content in groundwater samples in summer season

Elements	Unit	Summer 1	Summer 2	Summer 3	Summer 4	Summer 5
Ag		<0.0035	<0.0035	<0.0035	0.0099	0.0068

ISSN 2229-5518

Al		<0.0055	<0.0055	<0.0055	0.0181	<0.0055
As		<0.0281	<0.0281	<0.0281	<0.0281	<0.0281
B		0.4063	<0.0024	<0.0024	<0.0024	<0.0024
Ba		0.5178	0.0322	0.0194	0.015	<0.0005
Be		<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Ca		11066	109.3	96.88	64.78	54.84
Cd		<0.0009	<0.0009	<0.0009	<0.0009	<0.0009
Co		<0.0018	<0.0018	<0.0018	<0.0018	<0.0018
Cr	ppm	<0.0013	<0.0013	<0.0013	<0.0013	<0.0013
Cu		<0.0013	<0.0013	<0.0013	<0.0013	0.0044
Fe		1.865	<0.0062	<0.0062	<0.0062	<0.0062
K		444.2	3.611	3.004	2.999	2.006
Mg		2724	23.18	14.05	12.43	11.44
Mn		0.1580	<0.0034	<0.0034	<0.0034	<0.0034
Mo		4,887	<0.0051	<0.0051	<0.0051	<0.0051
Na		350.6	4.345	4.967	3.901	3.821
Ni		1.149	<0.0053	<0.0053	<0.0053	<0.0053
Pb		<0.0150	<0.0150	<0.0150	<0.0150	<0.0150
Sb		<0.0149	<0.0149	<0.0149	<0.0149	<0.0149
Si		1296	13.93	13.18	13.17	11.55
Sr		96.20	1.344	1.234	0.9612	0.6512

Ti		<0.0006	<0.0006	<0.0006	<0.0006	<0.0006
V		0.6018	0.0037	0.0076	0.0035	<0.0016
Zn		2.837	<0.0022	<0.0022	<0.0022	<0.0022

Table(4.4): Element content in groundwater samples in autumn season

Elements	**Unit**	**Autumn 1**	**Autumn 2**	**Autumn 3**	**Autumn 4**	**Autumn 5**
Ag		<0.0035	<0.0035	<0.0035	<0.0035	<0.0035
Al		<0.0055	<0.0055	<0.0055	<0.0055	<0.0055
As		<0.0281	<0.0281	<0.0281	<0.0281	<0.0281
B		<0.0024	<0.0024	<0.0024	<0.0024	<0.0024
Ba		<0.0005	0.0308	0.0146	<0.0005	0.0197
Be		<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Ca		126.6	128.7	68.73	58.41	104.6
Cd		<0.0009	<0.0009	<0.0009	<0.0009	<0.0009
Co		<0.0018	<0.0018	<0.0018	<0.0018	<0.0018
Cr		<0.0013	<0.0013	<0.0013	<0.0013	<0.0013
Cu	ppm	<0.0013	<0.0013	<0.0013	<0.0013	<0.0013
Fe		<0.0062	<0.0062	<0.0062	<0.0062	<0.0062
K		4.646	4.233	3.254	2.050	5.041
Mg		23.98	23.82	11.75	10.91	13.98
Mn		<0.0034	<0.0034	<0.0034	<0.0034	<0.0034

Mo		<0.0051	<0.0051	<0.0051	<0.0051	<0.0051
Na		2.821	4.594	3.661	3.828	4.889
Ni		<0.0053	<0.0053	<0.0053	<0.0053	<0.0053
Pb		<0.0150	<0.0150	<0.0150	<0.0150	<0.0150
Sb		<0.0149	<0.0149	<0.0149	<0.0149	<0.0149
Si		12.77	13.71	12,81	11.52	12.64
Sr		0.8487	1.370	0.8777	0.6517	1.183
Ti		<0.0006	<0.0006	<0.0006	<0.0006	<0.0006
V		0.0044	0.0055	0.0046	0.0014	0.0079
Zn		<0.0022	<0.0022	<0.0022	<0.0022	0.266

Discussion of the results

The tables shown in the result above represent the concentrations of different parameters in the groundwater samples collected from Abeche city during two seasons summer and autumn.

Chloride (Cl): the concentration of chloride in all samples in the two different seasons, were found177.5, 170.4, 113.6,106,5 and 99.4ppm respectively in summer season in well 1,2,3,4 and 5 compared to the concentration in autumn season which is 170.4, 184.6,99.4, 113.6and 113.6 ppm respectively. However the concentrations in well(2)in summer, well (1) in autumn equal(170.4ppm) and well(5) in summer ,well(3) in autumn equal(99.4ppm) and well(3) in summer and well(4),(5)in autumn respectively equal (113.6ppm).all samples were less than permissible limits of World Health Organization for drinking water quality as shown in appendix (D) below.

Nitrate(NO_2^-): the concentration of nitrite in summer season samples were found 0.051, 0.101, 0.122, 0.226 and 0.226 ppm respectively in well 1,2,3,4 and 5, compared to the concentration in autumn season which is 0.134, 0.098,0.189, 0.168 and 0.109 ppm respectively in well 1,2,3,4 and 5, except well no.(4),(5) which found equal (0.226ppm) in summer season. However the both concentrations were less than the permissible limits of World Health Organization for drinking water quality as shown in appendix (D) below.

Nitrate(NO_3^-): the concentration of nitrate in summer season samples were found 38.64, 32.48, 26.88, 14.56 and 14.56 ppm respectively in well 1,2,3,4 and 5, compared to the concentration in autumn season which is 24.64, 33.60,17.36, 19.60 and 30.24 ppm respectively in well 1,2,3,4 and 5, All concentration mention above were less than the permissible limits of World Health Organization for drinking water quality as shown in appendix (D) below.

Total Hardness : the concentration of total hardness in all samples in the two different seasons, were found 510.27, 482.31, 356.4,251.64 and 272.61ppm respectively in summer season in well 1,2,3,4 and 5 compared to the concentration in autumn season which is 461.4, 440.4, 272.61, 370.4and 244.65 ppm respectively. However the concentrations in well(5)in summer, well (3) in autumn equal(272.61ppm), all samples results were less than the permissible limits of World Health Organization for drinking water except well no. 1 in summer samples exceeded the permissible limits of WHO as shown in appendix (D) below.

Total Dissolved Solids (TDS): the TDS of all samples in the tow different season were found less than the permissible limits of World Health Organization for drinking water quality as shown in appendix (D) below.

Electrical Conductivity (EC): The EC of the samples in two different seasons, as shown in the result tables above, the maximum is (0.950µS/cm) and the minimum is (0.580µS/cm) , where were less than the permissible limits of World Health Organization for drinking water as shown in appendix (D) below.

Aluminum(Al): the concentration of aluminum in all samples in the two different seasons , were found equal (0.0055 ppm) in summer and autumn, except well no.(4) which found equal (0.01805 ppm) in summer season. However the both concentrations were less than the permissible limits of World Health Organization for drinking water quality as shown in appendix (D) below.

Arsenic (As): In the two different seasons, the concentrations of As in all samples were found less than (0.0281ppm) , where this concentration is less than the permissible limits of World Health Organization for drinking water quality as shown in appendix (D) below.

Silver(Ag): The concentration of silver is found less than (0.0035ppm) in all wells in autumn samples and wells no. 1,2 and 3 in summer season. respectively, in two different seasons. However the concentrations in well 4 and well 5 in summer season were found (0.00995ppm) and (0.00682ppm) respectively, the concentration of silver in all samples were less than permissible limits of World Health Organization for drinking water quality as shown in appendix (D) below.

Antimony(Sb): In the two different seasons, the concentration of antimony in all samples were less than (0.0149ppm), where this concentration is exceeded the permissible limits of World Health Organization for drinking water as shown in appendix (D) below.

Boron(B): In Summer and autumn seasons, The concentrations of boron in all samples is less than (0.0024 ppm), except in sample no.1 in summer season where is (0.4063ppm). however the concentration of boron in all samples were less than the permissible limits of World Health Organization for drinking water quality in appendix (D) below.

Barium (Ba): all well water samples showed variation in the concentration of barium. well (5) in summer and well (1) and well (4) in autumn were found (0.0005 ppm), while well (1) in summer shoed high concentration of barium (0.51782 ppm), the rest of wells showed small concentration of barium,(0.003222 ppm), (0.01942 ppm) and (0.015 ppm) in summer season for well (2), (3) and (4) respectively, for autumn season (0.03083 ppm), (0.0146 ppm) and (0.01969 ppm) respectively for well (2), (3) and (5).

Beryllium (Be): in two different seasons, The concentrations of Beryllium in all samples is less than (0.0002 ppm), where this concentrations is less than the permissible limits of World Health Organization for drinking water quality is in appendix (D) below.

Calcium(Ca): the concentration of calcium in summer season samples were found 11066, 109.3, 96.88, 64.78 and 54.84 ppm respectively in well 1,2,3,4 and 5, compared to the concentration in autumn season which is 126.6, 128.7,68.73, 58.41 and 104.6 ppm respectively in well 1,2,3,4 and 5, the concentration of calcium in autumn samples slightly higher than summer this due to the storm runoff water . all samples results were less the permissible limits of World Health Organization for drinking water except well no. 1 in summer samples exceeded the permissible limits of WHO as shown in appendix (D) below.

Cadmium(Cd): In the two different seasons, the concentrations of cadmium in all samples were found less than (0.0009ppm) , where this concentration is less than the permissible limits of World Health Organization for drinking water quality, as shown in appendix (D) below.

Chromium (Cr): In the two different seasons, the concentrations of chromium in all samples were found less than (0.0013ppm) , where this concentration is less than the permissible limits of World Health Organization for drinking water quality, as shown in appendix (D) below.

Cobalt(Co): In the two different seasons, the concentration of cobalt in all samples were less than (0.0018ppm), where this concentration is exceeded the permissible limits of World Health Organization for drinking water as shown in appendix (D) below.

Copper (Cu): the concentration of copper in all samples in the two different seasons , were found equal (0.0013ppm) in summer and autumn, except well no.(5) which found equal (0.00435 ppm) in summer season. However the both concentrations were less than the permissible limits of World Health Organization for drinking water quality, as shown in appendix (D) below.

Potassium(k): the concentration of potassium in summer season samples were found 444.2, 3.611, 3.004, 2.999 and 2.006 ppm respectively in well 1,2,3,4 and 5, compared to the concentration in autumn season which is 4.646, 4.223,3.254, 2.050 and 5.041 ppm respectively in well 1,2,3,4 and 5, the concentration of potassium in autumn samples slightly higher than summer this due to the storm runoff water . all samples results were less the permissible limits of World Health Organization for drinking water except well no. 1 in summer samples exceeded the permissible limits of WHO as shown in appendix (D) below.

Iron (Fe): the concentration of iron in all samples in the two different seasons , were found equal (0.0062ppm) in summer and autumn, all samples results were less the permissible limits of World Health Organization for drinking water except well no.(1) which found equal (1.865 ppm) in summer season samples is exceeded the permissible limits of World Health Organization for drinking water quality, as shown in appendix (D) below.

Magnesium(Mg): the concentration of magnesium in summer season samples were found 2724, 23.18, 14.05, 12.23 and 11.44 ppm respectively in well 1,2,3,4 and 5, compared to the concentration in autumn season which is 23.98, 23.82,11.75, 10.91 and 13.98 ppm respectively in well 1,2,3,4 and 5, the concentration of magnesium in summer samples slightly higher than autumn. all samples results were less than the permissible limits of World Health Organization for drinking water except well no. 1 in summer samples exceeded the permissible limits of WHO as shown in appendix (D) below.

Manganese (Mn): the concentration of manganese in all samples in the two different seasons , were found equal (0.0034ppm) in summer and autumn, except well no.(1) which found equal (0.1580 ppm) in summer season. However the both concentrations were less than the permissible limits of World Health Organization for drinking water quality, as shown in appendix (D) below.

Sodium(Na): the concentration of sodium in summer season samples were found 350.6, 4.345, 4.967, 3.901 and 3.821 ppm respectively in well 1,2,3,4 and 5, compared to the concentration in autumn season which is 2.821, 4.594,3.661, 3.828 and 4.889 ppm respectively in well 1,2,3,4 and 5, the concentration of sodium in summer samples slightly higher than autumn. all samples results were less than the permissible limits of World Health Organization for drinking water except well no. 1 in summer samples exceeded the permissible limits of WHO as shown in appendix (D) below.

Nickel (Ni): the concentration of nickel in all samples in the two different seasons , were found equal (0.0053ppm) in summer and autumn, well no.(1) which found equal (1.149 ppm) in summer season samples. where this concentration is exceeded the permissible limits of World Health Organization for drinking water quality as shown in appendix (D) below.

Lead (Pb): In the two different seasons, the concentration of lead in all samples were less than (0.0150ppm), where this concentration is exceeded the permissible limits of World Health Organization for drinking water quality as shown in appendix (D) below.

Molybdenum (Mo): the concentration of molybdenum in all samples in the two different seasons , were found equal (0.0051ppm) in summer and autumn, all samples results were less the permissible limits of World Health Organization for drinking water except well no.(1) which found equal (4.887 ppm) in summer season samples is exceeded the permissible limits of World Health Organization for drinking water quality, as shown in appendix (D) below.

Silicon(Si): the concentration of silicon in summer season samples were found 1296, 13.93, 13.18, 13.17 and 11.55 ppm respectively in well 1,2,3,4 and 5, compared to the concentration in autumn season which is 12.77, 13.71,12.81, 11. 52 and 12.64 ppm respectively in well 1,2,3,4 and 5, the concentration of silicon in summer samples slightly higher than autumn. all samples results were less than the permissible limits of Indian Standard Institution(ISI) is(150ppm) for drinking water quality except well no. 1 in summer samples exceeded in the range permissible limit of(ISI) as shown in appendix (D) below.

Strontium (Sr): the concentration of strontium in summer season samples were found 96.20, 1.344, 1.234, 0.9612 and 0.6512 ppm respectively in well 1,2,3,4 and 5, compared to the concentration in autumn season which is 0.8487, 1.370, 0.8777, 0.6517 and 1.183ppm respectively in well 1,2,3,4 and 5, the concentration of strontium in summer samples slightly higher than autumn. all samples results were less than the permissible limits of World Health Organization for drinking water except well no. 1 in summer samples exceeded the permissible limits of WHO as shown in appendix (D) below.

Titanium(Ti): In the two different seasons, the concentrations of titanium in all samples were found less than (0.0006ppm) , where this concentration is less than the permissible limits of World Health Organization for drinking water quality, as shown in appendix (D) below.

Vanadium (V): the concentration of vanadium in summer season samples were found 0.6018, 0.0037, 0.0076, 0.0035 and 0.0016 ppm respectively in well 1,2,3,4 and 5, compared to the concentration in autumn season which is 0.00442, 0.00548, 0.00457, 0.00139 and 0.00788ppm respectively in well 1,2,3,4 and 5, the concentration of vanadium in autumn samples slightly higher than summer season . all samples results were less than the permissible limits of World Health Organization for drinking water except well no. 1 in summer samples exceeded the permissible limits of WHO as shown in appendix (D) below.

Zinc (Zn): The concentration of zinc is found less than (0.0022ppm) in all wellsno.1,2,3 and 4 in autumn samples and wells no. 2,3,4 and 5 in summer season. respectively, in two different seasons.

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However the concentrations in well 5 in autumn and well 1 in summer season were found (0.26604ppm) and (2.837ppm) respectively, the concentration of zincr in all samples were less than permissible limits of World Health Organization for drinking water quality as shown in appendix (D) below.

CONCLUSION AND RECOMMENDATION

Water is one of the very precious substances on the earth, it is very essential for the existence and survival of the life. The aim of this study is to assessment of quality of groundwater samples from Abéché city and its suitability for potable use, the result obtained from the study compared to each other the two season autumn and summer and compared to the world health organization standard for drinking water quality. The assessment of water quality based on the concentration of different heavy metals and physicochemical parameters(pH, TDS, EC, water hardness, Cl^-,NO_3^- ,and NO_2^-)in the groundwater samples. The physiochemical parameters in the samples of two season were found in the permissible limits of world health organization except in the sample from well no.1 in summer season showed slightly higher hardness than the WHO standard. The concentration of Lead, Cobalt and Antimony in autumn and summer season samples were slightly exceed the permissible limits of World Health Organization standards for drinking water quality, so as: V, Sr, Si, Mo, Ni, Na, Mg, Fe, K and Ca in the well no. 1 in summer season were also is exceeded the permissible limits of World Health Organization standards for drinking water quality, while the rest of metals such as: Al, As, Ag, B, Ba, Be, Cd, Cr, Cu, Mn, Ti, and Zn were less than the permissible limits of World Health Organization standards for drinking water quality. Based on this study we recommend that the well no. 1 is not suitable for human use and must be closed, and the water from the other wells must be subjected to treatment before human use to avoid the health impact.

REFERENCES

1- Pramod N Kamble1, Viswas B Gaikwad(2011) , Shashikant R Kuchekarl, Der Chemica Sinica, 2 (4):229-234.

2-Gleick, P.H., ed (1993). "Water in Crisis: A Guide to the World's Freshwater Resources". Oxford University Press. p. 13, Table 2.1.

3-Baroni, L.; Cenci, L.; Tettamanti, M.; Berati, M. (2007). "Evaluating the environmental impact of various dietary patterns combined withdifferent food production systems". European Journal of Clinical Nutrition 61 (2): 279–286. doi:10.1038/sj.ejcn.1602522. PMID 17035955..

4-Gleick, P.H., ed (1993). "Water in Crisis: A Guide to the World's Freshwater Resources". Oxford University Press. p. 13.

5-Gleick, P.H., ed (1993). "Water in Crisis: A Guide to the World's Freshwater Resources". Oxford University Press. p. 13.

6- "WBCSD (2010) . Water Facts & Trends"(http://www.wbcsd.org/includes/ getTarget.. Retrieved 25- July -2010.

7- Molden, D. (Ed) (2007). Water for food, Water for life: A Comprehensive Assessment of Water Management in Agriculture. Earthscan/IWMI, 2007.

8- Chartres, C. and Varma,(2010) . Water from Abundance to Scarcity and How to Solve the World's Water Problems FT Press (USA), 2010.

9-Water Use in the United States (http:/nationalatlas. gov/ articles/ water/ a_wateruse. html), National Atlas.gov

10 - Berry D (2012) Managing moisture. Food Prod Des June:34–42