EVALUATION OF THE GROUND WATER QUALITY IN EASTERN CHAD OF ABECHE CITY, (ACASE STUDY)

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Abstract

This study was carried out to assess the quality of ground water of the unevaluated and most consumption open wells water supplies in eastern **CHAD) .** For this purpose Samples of ground water were collected from 4 different Wells inside of the residential Areas in ABECHE city. Two sets of samples were measured , one at dry season and other at wet season , the physicochemical parameters of the analysis were includes (Temperature, pH, Conductivity, Turbidity, Total dissolved solids, and concentrations of ions of (Ca^+ , Mg , Mn^{+2} , SO_4^{-2}, CN^- ,NO_3^-, NO_2^- , NH_4^+ , CL^-, Fe , Br_2) for each season, samples were measured for each sample and the values were comparing with the World Health Organization (WHO)standards guidelines for drinking water. The study was demonstrated some parameters were unacceptable and unsafe which give higher values comparing with the WHO standards, those are ((conductivity and TDS in Digueri Well , Turbidity in Djinene Fock at wet season , Ca^+ in Digueri Well and Benjedid , Mn^{+2} in all wells, Br_2 in all wells with simple exceeded in some wells)), and some parameters were below than limits as (Fe, CL^-, NO_3^-). An others parameters such as (Odor, color, taste, temperature, pH, CN^-, Mg , SO_4^{-2} , NO_2^- , NH_4^+) were found to be within the permissible limits of WHO standards for drinking water and show excellent properties .

Key Words: **Water Quality ,WHO standards, Abeche, groundwater and physicochemical**.

1. INTRODUCTION

First and for most, the prosperity of nation depends on exploitation of natural resources, water is considered as one of that natural resources and it is necessary to life needs, as the population of the world grow, the demand for freshwater will continue to increase[1]. Water is a molecule made up of two hydrogen atoms and one oxygen atom. It has the formula H_2O. It contains strong polar covalent bonds that hold the two hydrogen atoms and one oxygen atom together. Water covers about 70% of Earth's surface. Pure water is colorless, odorless, and tasteless, even though it contributes no calories to the diet. Water also greatly affects the texture of foods, It gives crisp texture or turgor to fruits and vegetables, and it also affects perception of the tenderness of meat and so common that you probably never think about how unique it is and how essential to life [2]. The population in developing countries have health problems associated with either lack of drinking water or due to the presence of microbiological contamination in water [3]. Absence of water that has good quality is the reason of death

of an estimated of 5 million children in the developing countries[4]. An estimated of about 75% of the Earth's surface is covered by water, about 97% of this water is saline and not drinkable and 2% is found as solids in the format of glaciers and icecaps. The residual of this amount, that is, 1%, is fresh water and available to humanity uses. This small amount can be found in the format of surface water and groundwater[1]. Groundwater is main source of water in most of study area (Abeche city) , as it main source in all of country expect some regions in South and West southern of Chad they are depends to surface water from Rivers (Logon, Chari, …) and Lake Chad . Groundwater is only source of drinking water in Area of study, it is using in all need's (drinking, irrigation, lives stoke watering and others). Abeche city with declining drinking water resources has an acute shortage of water, and suffers increase of salt in some wells. Abeche is depends on water from wells spreader around of city and Network by water pipeline from Bouteha valley about 37 Km away from Abeche but this Network is not covered all city and amount of it is go down in March to May at this period major people they use this wells loudly, and at other time it use lowly. The main objective of this research of work is to indicate the quality of ground water for the more consumption selected 4 Wells at sides from (North, East, South ,West) Areas of Abeche City.

2. MATERIALS AND METHODS:

2.1 Description of Sampling Area:

Samples of ground water were taken from wells directly from the wells in the Residential Areas Dabanair Area located in North , Benjadid Sud in East ,Djinene Fock in South , Digure in West side.
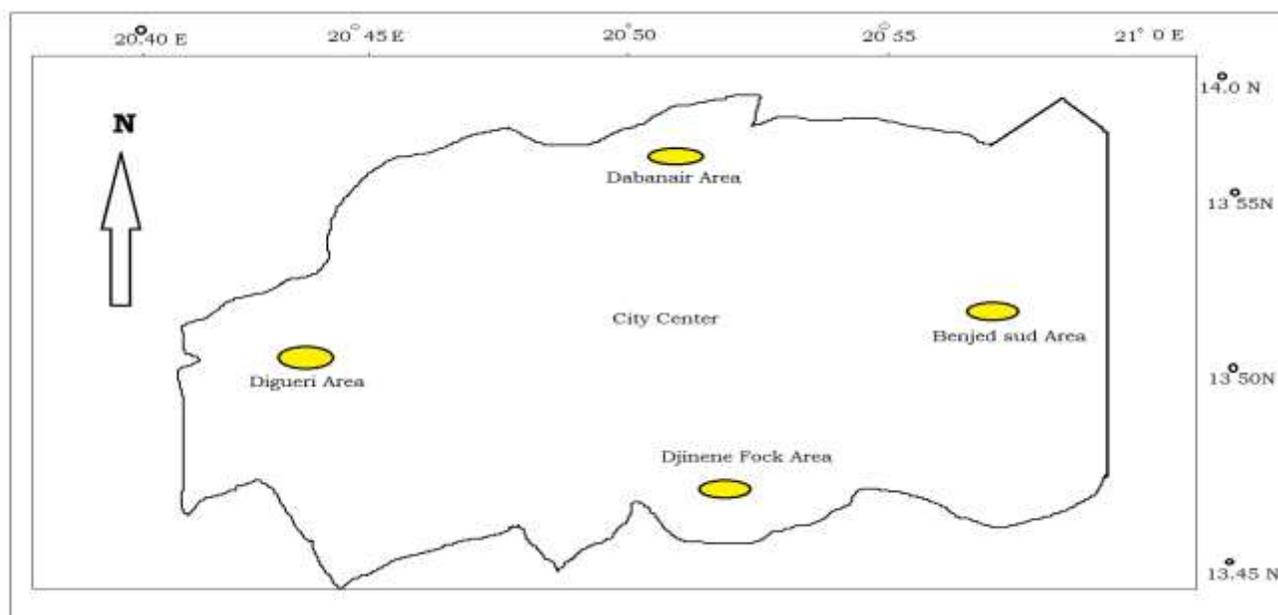

fig1:Location of Sampling from Wells inside of Areas

Table 1 below include the Information of wells in the residential Areas:

Areas Information	Dabanair	Benjedid Sud	Djinene Fock	Digueri
Location	North of city	East of city	South of city	West of city
Depth	24 m	59 m	30 m	60 m
Daily Consumptions	120 -180 Barrel/day	360 - 420 Barrel/day	80 - 100 Barrel/day	200 - 250 Barrel/day
Uses	Drinking and house uses	Drinking and house uses	Drinking and irrigation Gardens	Drinking and Irrigation trees

2.2 Methods of *physic-chemical analysis*
2.2.1 *physical testing:*

Several water quality parameters ; 14 physical at wet season June 2015 and dry season February 2016 , 11 chemical for once were tested for the samples collected, the Physical testes were include: (Temperature, pH ,Turbidity ,Conductivity , Concentration of Total dissolved solids

(TDS) , Odor , Color ,Taste) . Samples were collected in plastic container poly ethylene (1.5 L), the physical taste were tasted directly and stored transported in cool box[6] kept below in temperature of (4-8 $^\circ$C) and were carried to the laboratory in N'Djamena capital where Stay away of about 900 km from the studies Areas .

2.2.2 Chemical testing:

11 chemical parameters Were testing included the ions of (Ca^+ , Mg , Mn^{+2} , SO_4^{-2} , NO_3^-, NO_2^- , NH_4^+ , CL^- , CN^- and Fe , Br_2), the chemical variable were analyzed by spectrometer method using (HACH) portable all in format about analysis methods in procedure manual and the HACH Master Catalog of DR 2800 instrument[7]. Samples were measured in standard laboratory of Chadien Water Company in N'Djamena City.

Table 2 : Analytical method for different of both physical and chemical parameters

Parameter	Abbreviation	Units	Instrument/Technique used
pH	pH	--	pH enomenal-model (Co 3000L)
Temperature	Temp	$^\circ$C	Digital thermometer and-Hg thermometer
Turbidity	TBR	NTU	TURBIQUANT- model(1500 IR)
Electric Cond.	EC	µS/cm	Digital Conductivity meter-model(Co 3000L)
Total dissolved solids	TDS	mg/l	Digital Conductivity meter-model(Co 3000L)
Chemical parameters		mg/l	DR 2800 instrument(HACH)

3.Results and Discussions:

Table 3.1: Summary of the physical Parameters Results for Wells samples with WHO limits(at dry Season):

No	Parameters	WHO	Dabanaier	Benjadid Sud	Djinene Fock	Degueri
1	Temperature ($^\circ$C)	<35	36.1	35.6	36.7	37
2	pH	6.5-8.5	7.22	7.38	7.7	7.06
3	Turbidity(FAU)	5(NTY)	0.46	0.23	333	0.34
4	Conductivity µS/cm	1400	616	818	359	1268
5	TDS (mg\L)	1000	362	481	180	745.88
6	Odor /Taste	None	-	-	-	-
7	Colour	None	-	-	-	-

Table(3.2): Summary of the Physical Parameters Results for Wells samples with WHO limits(at Wet Season):

No	Parameters	WHO	Dabanaier	Benjadid Sud	Djinene Fock	Degueri
1	Temperature ($^\circ$C)	<35	34.9	35.5	34.3	34.4
2	pH	6.5-8.5	6.7	7.7	7.0	6.5
3	Turbidity(FAU)	5(NTY)	0.2	0.1	0.0	0.0
4	Conductivity µS/cm	1400	565	788	338	1225
5	TDS (mg\L)	1000	301	419	180	653
6	Odor /Taste	None	-	-	-	-
7	Colour	None	-	-	-	-

Table (3.3): Summary of the Chemical   ions Concentrations Parameters Results for Wells samples with WHO limits

No	Parameters	WHO	Dabanaier	Benjadid Sud	Djinene Fock	Degueri
1	CL	250	5.6	1.4	14	240
2	Ca	200	153	399	118	540
3	Mg	150	24	72	12	78
4	CN	0.07	0	0	0	0
5	NO_3	45	6.5	3.5	2.2	18
6	NO_2	0-0.1	0.01	0.01	0.01	0.01
7	SO_4	250	41	51	11	110
8	Br_2	0.025	0.03	0.035	0.03	0.03
9	NH_4^+	<0.2	0.077	0.141	0.103	0.16
10	Fe	0.3	0.07	0.09	0.15	0.08
11	Mn	0.05	0.9	0.6	0.7	0.8

Conductivity :

The conductivity values were ranged between 338 – 1225 at µS/cm which has higher conductivity , the maximum values were found to be in Digueri residential Area 1225 µS/cm and the minimum values were found to be in Djinene Fock residential Area , this variation due to basement aquifer for wells[8] . Increase in ions concentration enhances the electrical conductivity of water, Generally the amount of dissolved solids in water determines the electrical conductivity[9].

Turbidity:

The measured values of Turbidity were found to be within the WHO range in all wells, except in Djinene Fock at wet season , which were found to be 333 NTU is unacceptable, due to entering rain water through manhole of walls, and cracks at sides of wells .

TDS :

The concentration of TDS in wells samples were ranged between (180 - 653) mg/l and (211.2 – 745.88) at dry season and wet season respectively. The maximum values were reported in Digueri well. Its within the fair range, the minimum values 180 and 211.2 in Djinene Fock well are within the permissible limits of WHO range for drinking and it was considered as   excellent results.

Manganese :

The Concentrations of Manganese ions in the studies samples of water were found to within the range of (0.6 - 0.9) mg/l , which have a big exceeding, when the Manganese levels exceeding 0.1 mg/L it supplies causes an undesirable taste in beverages stains sanitary were and laundry [10]. Concentrations below 0.1 mg/L are usually acceptable to consumers, even at 0.9 mg/L manganese will often from a coating on pipes [11]

Calcium :

Calcium is a dietary mineral that is present in the human body in amounts of about 1.2 kg, no other element in abundant in body[12] . Calcium concentrations in the wells samples were ranged between (118 - 450) mg/k, the maximum values of Ca concentrations were found to be in the Digueri well, which has exceeding from level in Digueri Well and Benjedid Sud Well, this may be due to dissolvability of calcareous rocks in water, which was considered as the main source of calcium, Calcium is the principal parameter in hardness of water .

Bromide :

The permissible limits of (WHO) for the Bromine concentration in water is 25 µg/L , the concentrations of Bromine in the samples of water , were found to be within the range of (0.03 - 0.035) in wells , samples within this ranges of Bromine concentrations were acceptable with the limits of (WHO) **.** Br_2 may reacts with Oxigane , when bromide ions [Br–] present in water are oxidised by ozone and some other oxidising agents (including, it is believed, chlorine) Occurs BrO_3^- has sanitary significance Both carcinogenic and mutagenic [13]

Chloride :

Chloride exists in all natural water . Surface water bodies often have low concentration of chlorides as compare to ground water [9] . Chloride concentrations in the samples of water were ranged between (1.4 - 240) mg/l , the maximum values were i2510450_570578_379_384   pn Digueri well (240 mg/l), which is   within acceptable limits of (WHO) 250 mg/l . The minimum value were 1.4 mg/l in Benjadid well - which is much below for drinking water standards.

Photos: Typical sources analyzed in the area study
(A) Open well without pump work by the traditional pull;   (B) Well with a foot pump.

Conclusion:

In conclusion, based on the above results, the physical and Chemical analysis of the ground water of the traditional open wells in Abeche city, it has been found that the water of some of those wells was not safe and because they polluted with some Chemical Pollutants and not matched with the World Health Organization standards. there for these sources of waters may be dangerous for human being use but it can be used for other purposes such as irrigation of lands.

Acknowledgment

References :

[1] Julian Atmadja, Amrrossions C.Bagatzoglou , State of the Art Report on Mathentatical Methods for Groundwater Pollution Source Identification ,Journal of Environmental Forensics, No 2-214doi: 10. 1006/enfo.2001.0055, available online at http://www.idealibrary.com. (accessed in June. 2016).

[2] Osman et al, 2018, Evaluating of the Drinking Water Quality in Kassala-City, Sudan Saudi Journal of Biomedical Research (SJBR) ISSN 2518-3214 (Print) Scholars Middle East Publishers ISSN 2518-3222 (Online).

[3] F. X. R Van Leeuwen, Food and Chemical Toxicology, 38 pp 51-58, 2000.

[4] G. Holgate, Environmental and Waste Management, 3 pp 105-112, 2000 .

[5] Development Plan of Communal Abeche Report , Government Diagnostic Report, Abeche, Chad, pp 3-25, December 2015.

[6] Duane H. Schuettpelz, fecal and total coliform tests in water quality evaluation , research report, department of Natural Resources, Madison, Wis, 1969.

[7] Master Catalog DR 2800™ PORTABLE-SPECTROPHOTOMETER,©Hach Company , USA,2012. < http // int@hach.com

[8]Ahmed Alssarwy, Physical and Chemical Treatment for waste water,darallaamiya , Cairo , Egypt ,pp.460, 2008

[9] Muhammad Mohsin ,Samira Safdar ,Faryal Asghar., Farrukh Jamal, Assessment of Drinking Water Quality and its Impact on Residents Health in Bahawalpur City, International Journal of Humanities and Social Science Vol. 3 No. 15, 2013.

[10] Guidelines for drinking-water quality, 2004, 3rd edition, volume 1. World Health Organization (WHO), Geneva,.

[11] Jamie Bartram and Richard Balance ,Water Quality Monitoring – Apractical Guide to the Design and Implementation of Freshwater Quality Studies and Monitoring Programmes,Chapter7-Physical And Chemical Analyses, United Nations Environment Programme and the World Health Organization,1996.

[12] James Fred Kushe , 2009, Assessment of the chemical quality of groundwater for drinking in Dedza District , M Sc theses , Malawi,.

[13] Environmental Protection Agency , Parameters of water quality Interpretation and Standards , Ireland,2001. www.epa.ie..