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Determination of Some Physicochemical Properties of Ground Water from Dalanj Area

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ABSTRACT In this study analysis was carried for fifty ground water samples collected from different sources in Dallang town and surrounding area. The aim was to evaluate the different parameters that determine drinking water quality in the area compared with WHO and S.S.M.O guide lines. The measured determined include pH values, electrical conductivity (EC), Turbidity and TDS. Spectrophotometric analysis was carried for determination of nitrate and fluoride. Chloride (Cl^-), total alkalinity and total hardness were determined titrimetrically. Atomic Absorption spectroscopy was used for determination of copper (Cu), zinc (Zn), cadmium (Cd) and lead (Pb) concentrations. The results obtained were statistically analyzed using SPSS program. The analysis shows general suitability of the studied ground water sources for drinking.
Compared to WHO and S.S.M.O standards results show, high concentrations of total dissolved solids content, carbonate, calcium, and magnesium ions. Fluoride concentrations in some sources exceeded the permissible limit.

KEYWORDS*:* Dalanj, Groundwater, Sudan, Atomic absorption, Geological background, Drinking water Quality.

I. INTRODUCTION

Ground water is a life line for many rural and agricultural regions, and their associated cultures and populations around the globe and a corner structure of global food production. Ground water constitutes nearly half the world drinking water and much of the world irrigation water supply. Population growth, over exploitation, salinization, non-points sources pollution from agricultural activities including animal farming ranching and forestry activities, impacts to surface water and ground water quality and quantity conflicts at the urban-rural interface have reach global dimensions and threaten the health and livelihood of this peanut [1].
Groundwater can be defined as the water located in the pore space of soil and rocks. Sometimes it is useful to distinct between sub-surface water, that is, closely associated with surface water and deep sub-surface water in aquifer (fossil water). Sub-surface ground water can be thought of in the same terms as sub-surface water inputs, outputs and storage [2]. Ground water resources in arid and semi arid regions with limited renewable potential have to be managed judiciously to ensure adequate supplies of dependable quantity and quality. It is a natural resource with economic, strategic and environmental value, which is under stress both due to changing climatic and anthropogenic factors. Therefore the management strategic need to be aimed at sustenance of this limited resources [3]. Toward sustainable ground water in agriculture the ground water research should brings together, leading scientist, policy analysts, policy and decision makers, and agricultural and environmental stake holder groups to define and highlight the science, challenges, and potential policy solutions in agricultural ground water resources management and ground water quality protection that will provide sustainable future at regional, national and global seals [1**].** Groundwater is the most important resource in Sudan (4). In Sudan just few kilometers from the Nile groundwater aquifers provide the only

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permanent stocks of water. These aquifers guarantee the existence of almost 75% of the population and the live stocks [5].

Study Area

The study area lies entirely north of Kadogli for about 130 kilometers. (Fig: 1). the area is located at latitudes 12°.02 north and longitude 29°.38 east and it is surrounded by the localities of Shekan at the north, Kadogli at the south, Elrahad at the east, and lagawa at the west. The area is savannah area and it is a part of the Nubian sandstone aquifer, which is, the most reliable and largest aquifer in Sudan and north east Africa. This aquifer is a potential resource of considerable importance for the country's future [5, 6].

Figure (1) Map of the study area

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The main factor that affect South Kordofan climate is the annual migration of the zone of maximum insolation and the associated intertropic convergence zone. The cold season (winter) is associated with dry north-east trades, when the zone of august insolation is in the south hemisphere. This is followed by the pre-rains hot season (summer) .The wet season (autumn) is between June and September reaching its peak in august [7]. Topographically, the area is flat with some scattered mountains. These mountains are drained by small wadis, and are crossed from the southern side by Khor Abu- Habill draining with other wadis towards Elrahad water course. The greatest fluctuation in daily temperatures occur during winter, when minimum temperatures can fall below 10^{o}C and daily maximum temperature rise above 40^{o}C daily mean temperatures is 26^{o}C. In summer daily mean temperature rise to 31^{o}C with a mean maximum around 40^{o}C and a mean minimum around 23^{o}C. Daily maximum temperature during summer often reaches 45^{o}C [7].

Geological Background

According to Izzeldeen, (2007) Dallanj location is characterized by uplifted basemen. The basement complex includes genesis, meta sediment, meta volcanic and older granite of Precambrian age. These units are metamorphosed and affected by three periods of deformation. Basement complex is over lained by superficial cover of Quaternary-Recent age, in some parts it is covered by Um-Rwaba formations (Tertiary). Generally Dallanj area consists of unconsolidated sand, clay and gravely sandstone. The superficial cover is very thin ranging from 20m to 30m, in the northern part of locality which is affected by desert creep. There are many seasonal streams (khors) running in the area, their courses are affected by the presence of outcrops. The streams run towards general slope to the north and north-east direction. Seasonal rainfall ranges from 500 to 800mm causing many runoffs. The eastern side of the locality is dominated by cotton soil, the northern side by sand and the southern part by medium to coarse sand which is the weathering products of rocks. The clay is inter-bedded with sand in many rocky areas. The sand layer is a good aquifer for accumulation of water.

Aim of the study was to evaluate ground water Quality and it is suitability for human drinking, by measuring the most essential parameters that determine drinking water quality according to world health Organization and Sudanese Standard Metrology Organization Guidlines.

II. MATERIALS AND METHODS

50 Drinking water samples were collected randomly from selected boreholes in Dallanj town and surroundings. Samples were kept in dry cleaned plastic containers and analyzed for determination of their physical and chemical properties. pH- meter, Conductivity meter, Atomic absorption, Turbidity meter and spectrophotometer were used for instrumental analysis. Titrimetric analysis was carried for determination of chloride, total hardness and total alkalinity.

III. RESULTS AND DISCUSSION

Physical properties

All samples show pH values less than (8), which is within the acceptable range (table. 1). The highest value was 7.8 in sample (No. 26), at Algoz East whereas the lowest value was (6.6) in sample No. (25). the mean value was 7.008. The standard pH value according to WHO (1983, Geneva) is ranging from (6.5 to 8.5). The highest pH values appeared in samples collected from water Yard (Donkis) and this may be due to the depth of these sources.

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Table (1): Descriptive statistic of physical properties concentration

	N	Range	Minimum	Maximum	Mean		Std.
	Statistic	Statistic	Statistic	Statistic	Statistic	Std.Error	Stastistic
Ph	50 50	1.2	6.6	7.8	7.008	0.040	0.2820
EC	50 50	3135	325	3460	1870.04	95.33	674.052
TDS	50	1522	208	1730	952.58	47.61	336.680
Turbidity NTU Valid N (listwise)	22 22	254.68	0.32	255.00	15.6932	11.8144	55.41423
Total Hardness	22	616.00	64.00	680.00	272.5455	27.3560	128.31090

The most good quality water samples were observed in samples No. 50 and 48 with TDS values 208.0 ppm , 260.0 ppm , and EC values of 325.0 µs/cm and 515 µs/cm respectively.
The mean TDS value was 952.58.0ppm and the mean EC value was 1870.04µs/cm The minimum measured EC value was 325.0µs/cm and the maximum value was 3460 µs/cm in sample No (4). The maximum measurement TDS value was 1730.0 ppm in sample No. 4 and the minimum was 208 ppm in samples No. 50.
Samples number 11, 25, 43 show high TDS and EC values which were (1520, 1650, 1600 ppm) and (3050, 3300, 3230 µs/cm) respectively. The use of such sources may be unsafe for human drinking according to WHO drinking water standards (1971, 1983, and 1999) which considered the highest TDS permissible level 500 mg/l and the maximum permissible level as 1500 mg/l and maximum EC values less than 1400 µs/cm with the exception of samples No. (4, 11, 25, 43) the analyzed drinking water samples may be classified as safe for drinking from TDS and EC values as basic drinking water quality parameters. Turbidity values in some samples were significantly high but the mean value was in the permissible level (Table. 1).Total hardness values may be considered in the suitable range.

Chemical Properties

The concentrations of the measured parameters shown in (table 2) we may say that the Total alkalinity which include: hydroxide, carbonate, and bicarbonate ions is within the permissible levels. Fluoride ions show significantly high concentrations in some samples ranging from 0.68 mg/l to 3.00 mg/l compared to the guideline range which is 0.90 to 1.70mg/l. Nitrate concentrations were below the permissible values which range from 40 to 50mg/l. Chloride ions concentration was also below the guideline value which is 250mg/l (WHO., 1971, 1983 and 1999). With respect to parameters shown by table (2) the ground water in the area can easily be described as good for human consumption.

Table (2): Descriptive statistic of Hydroxide Carbonate, bicarbonate, Fluoride, Chloride and Nitrate HCO_3^- concentration

	N	Range	Minimum	Maximum	Mean		Std.
	Statistic	Statistic	Statistic	Statistic	Statistic	Std.Error	Stastistic
OH mg/l	22	34.00	0.00	34.00	3.0909	1.8161	8.51838
CO_3mg/l	22	240.00	60.00	300	158.1818	15.5649	73.00596
HCO_3mg/l	22	305.00	0.00	305	124.7727	21.4177	100.45797
Floride mg/l	22	2.32	0.68	3.00	1.3091	0.1126	0.52834
Nitrate mg/l	22	30.20	1.80	32.00	10.3136	1.5385	7.21601
Chloride mg/l	22	47.80	7.00	54.80	20.9545	2.3363	10.95844

Calcium and magnesium concentrations in all samples were in the acceptable range. Copper and zinc concentrations were significantly low or undetected. The two elements are highly required in certain concentrations as micronutrients and they play a very important rule in the human body from bioinorganic site of view, therefore, the drinking water in the area may be considered as copper and zinc deficient.

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Table (3): Descriptive statistic of calcium and Magnesium, Copper Cu, Zinc, Cadmium, and Lead Concentrations

	N	Range	Minimum	Maximum	Mean		Std.
	Statistic	Statistic	Statistic	Statistic	Statistic	Std.Error	Stastistic
Ca mg/l	22	119.20	6.40	125.60	60.8364	6.1416	28.80685
Mg mg/l	22	584.80	17.60	602.40	209.6682	26.5694	24.62134
Valid N (listwise)	22						
Cu	15	0.000	0.000	0.000	0.00000	0.00000	0.000000
Zn	15	0.263	0.000	0.263	0.03940	0.02179	0.084378
Pb	15	0.000	0.000	0.000	0.00000	0.00000	0.000000
Cd	15	0.000	0.000	0.000	0.00000	0.00000	0.000000
Valid N (listwise)	15						

The total absence of lead and cadmium in all samples is a very good indication of the suitability of the drinking water sources in the area for human use. It is unusual to find ground water completely free of cadmium and lead which are classified within the most hazardous constituents in water and food.

IV. CONCLUSION

It may be concluded that the analyzed ground water samples of Dallanj area are generally suitable from drinking water quality site of view. High salinity was observed in some sources as TDS and EC values may need more investigation. Fluoride ions concentrations may also need further analysis to determine the suitability of some boreholes as sources of safe drinking water.

V. RECOMMONDATIONS

- The area may need further studies by analyzing more samples from different sources.
- Seasonal sampling may be required because groundwater quality may be influenced by high abstraction and the aquifers recharge.
- Other parameters, which, are essential in groundwater quality should be measured such as iodide (I^-), sulfate ($SO_4^=$), nitrite (NO_2^-), ammonia (NH_3), sodium (Na), potassium (K), iron (Fe), barium (Ba), strontium (Sr), Mercury (Hg), Arsenic (As) as well as, radio nuclides
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